Repatriation Medical Authority

Proceedings of the RMA Consensus Conference on

Stress and Challenge — Health and Disease

BRISBANE
February 9–11, 1998

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Foreword

The Repatriation Medical Authority (RMA) hosted this conference in February 1998 as part of its investigation into the possible causative role of:

- psychosocial stress (particularly) war or service related stressors in the development of ischaemic heart disease (including coronary atherosclerosis), hypertension, cerebrovascular accident and psoriasis.
- post traumatic stress disorder and hypertension, and
- post traumatic stress disorder and ischaemic heart disease.

The RMA conducts its investigations in accordance with the requirements of the Veterans' Entitlements Act (1986) and is mandated by this legislation to determine the presence or absence of casual relations between service related factors and disease, injury or death.

In its role the RMA recognised that the literature examining the effects of psychosocial stressors and the perception of stress needed review in a broad contextual process and therefore, in response to this challenge, the conference was held to examine the effects of stress on psychiatric illness and cardiovascular disease.

The conference brought together eminent Australian and overseas scholars and researchers acknowledged for their expertise in examining associations between stress and psychiatric illness and cardiovascular disease. The RMA acknowledges and thanks them for their very valuable contribution in presenting and considering the information current at the time of the conference.

Conference Delegates:

Dr Trevor Anderson
Dr Alex Bordujenko
Professor Don Byrne
Dr Gerard Byrne
Professor Ken Donald
Professor John Duggan
Professor Terry Dwyer
Professor Murray Esler
Dr Warren Harrex
Professor Richard Heller
Professor Scott Henderson
Dr Kym Hickey
Professor Alan J Husband
Professor John Kaldor
Professor Terence Keane
Professor John Kearsley
Professor Alexander McFarlane
Professor Philip Morris
Professor Jake Najman
Professor Beverley Raphael
Dr Mekala Srirajalingam
Professor Christopher Tennant
Professor George Vaillant
Professor Lars Weisæth
Professor Malcolm West

Executive Summary and Conference Overview

Professor Beverley Raphael
Professor Philip Morris
and Dr Alex Bordujenko

EXECUTIVE SUMMARY

A consensus conference entitled Stress and Challenge, Health and Disease was convened in February 1998 by the RMA as part of the investigation into the possible causative role of psychosocial stress (particularly war or service related stressors) in the development of ischaemic heart disease (including coronary atherosclerosis), hypertension, cerebrovascular accident and psoriasis (gazetted 22/1/1997) and in respect of post traumatic stress disorder and hypertension and post traumatic stress disorder and ischaemic heart disease (gazetted 23/4/1997).

The RMA was established in 1994 under the provisions of the Veterans' Entitlements Act 1986 (the Act). Its primary function is the determination of Statements of Principles (SOPs) under section 196B of the Act. These SOPs apply to a particular kind of injury, disease or death and list the factors which must be related to war or defence service. The RMA is mandated by Australian law to determine the presence or absence of causal relations between service related factors and disease, injury or death. In this case the factors of interest are psychosocial stress (particularly war or service related stressors) and post traumatic stress disorder. The RMA is required to use the applicable criteria for assessing causation currently applied in the field of epidemiology.

The RMA recognized that the literature examining the effects of psychosocial stressors and the perception of stress needed review in a broad contextual process. This is particularly in respect to the sound medical-scientific evidence concerning both the positive and negative effects of stress on the human organism.

To respond to this challenge the conference was held to examine the effects of stress on psychiatric illness and cardiovascular disease. It brought together eminent Australian and overseas scholars and researchers acknowledged for their expertise in examining associations between stress and psychiatric illness and cardiovascular disease. The conference was opened by the Minister for Veterans' Affairs, Bruce Scott and co-chaired by Professors Beverley Raphael and Philip Morris. The veteran community was represented at the conference by observers from various ex-service organisations.

The three main questions addressed by the conference were:

> How can we establish causes, measure and set doses that explain the association between exposure to stressors, psychiatric illness and cardiovascular disease?
>
> Is there an association between exposure to stressors, psychiatric illness and cardiovascular disease?
>
> What are the potential mechanisms for the association between stressors and disease, with special emphasis on psychiatric illness and cardiovascular disease?

The formal conference program combined reviews of the published literature with presentations of new data sets from Dr Terry Keane, Professors George Vaillant, Jake Najman and Gerard Byrne. Dr Trevor Anderson provided a personal and evocative presentation of the human perspective of positive and negative responses to stressor challenge and Professor Lars Weisæth outlined the Norwegian system of military compensation and the United Nations perspective in the recognition, management and prevention of abnormal stressor responses in military and peace keeping personnel. The counterpoint of individual and population based data focused the conference participants in their tasks. The structure of the conference demanded considerable syndicate group consideration of the central issues, one of the key underlying issues being the definitions of stressors and stress which would have utility for the RMA.

The utility and role of modern epidemiological methods in the assessment of causal relationships between psychosocial stressors and psychiatric illness and cardiovascular disease were canvassed. A consensus was reached that use of the science of epidemiology was appropriate and necessary in the process of examining potential causal associations between stressors, stress and disease.

The process of causal inference was recognised as complex and subject to interindividual variation. It was considered that the use of causal criteria such as those attributed to Sir Austin Bradford Hill assisted in clarifying observed associations from causal associations. The Bradford Hill criteria are:

- Strength of association
- Consistency of association
- Specificity of association
- Temporality of association
- Gradient of effect (dose)
- Biological plausibility/coherence
- Experimental evidence
- Analogy

It was recognised that in assessing causal associations between stressor experiences and many of the psychiatric and cardiovascular disorders a number of the criteria would not be met fully or at all. However, it was felt that in the consideration of the body of evidence, the Bradford Hill or similar criteria should be used as an important part of evaluating causality between stressor experiences and disease.

It was considered that once causality had been inferred, a dose, based on the available sound medical scientific evidence, could be determined. In some situations the dose would take the form of a threshold effect in that only after a certain exposure would a negative health consequence emerge.

Outline of Broad Issues and the Consensus Findings

How can we establish causes, measure and set doses that explain any association between exposure to stressors, psychiatric illness and cardiovascular disease?

A number of differing models and definitions of stress were considered. Stress may be referred to as a cause or as an effect and the term "stressor" is gaining greater acceptance as a representation of the cause. Stress then refers to the psychological and physiological responses which result from experiencing a stressor. For the purposes of considering potential causal associations the term stress was considered ambiguous and difficult to quantify and the term "experiencing a stressor" was preferred by the conference participants. The conference canvassed a number of opinions about the nature of stressors and the essential elements of stressors that lead to adverse outcomes in terms of psychiatric illness or cardiovascular disease.

The ex-service representatives provided the stimulus for the development of a definition of military stressor. This definition was formed on the DSM-IV definition of the stressor criteria required for the diagnosis of post traumatic stress disorder, the advice of the expert participants, (including that arising from systematic studies and data analyses, in particular Dr Terry Keane), and input from the ex-service representative observers at the conference. A stressor relevant to military service was defined by the conference participants as:

> The person experienced, witnessed or was confronted with an event or events that involved actual or threat of death or serious injury, or a threat to the person's or other people's physical integrity that might evoke intense fear, helplessness or horror.
>
> In the setting of service in the Defence Forces, or other service where the Veterans' Entitlements Act 1986 applies, situations that qualify as stressors include:
>
> (i) Engagement with the enemy; or
> (ii) Witnessing casualties or participation in or observation of casualty clearance, atrocities or abusive violence; or
> (iii) Acute or chronic threat of serious injury or death; or
> (iv) Prolonged experience of malevolent environments.

It was recognised that this definition of stressor was at the more severe end of the spectrum of psychosocial stressors that individuals can be faced with either in military service or in civilian life.

The participants recognised that less obviously severe stressors might contribute to morbidity but chose not to deal with data concerning such effects because of lack of consistent systematic definitions for such stressors in the scientific literature and the very diverse methodologies and outcome measures which allowed little opportunity for pooling of data or comparison.

Is there an association between exposure to stressors, psychiatric illness and cardiovascular disease?

The formal presentations, which included detailed literature reviews by Professors Tennant, Don Byrne, Esler and West as well as results of primary research findings, syndicate and group discussions demonstrated a range of opinion and highlighted the need to consider the potential for

bias and particularly confounding, in the available data sets. Professor Vaillant's 50 year prospective data sets demonstrated that much retrospectively collected material may support mere association and not causation, and demonstrated the importance of known confounding variables such as alcohol and cigarette consumption when considering cardiovascular disease outcomes.

Consensus was reached on a number of psychiatric illnesses and cardiovascular diseases where associations between exposure to specified stressors and the illness was agreed to be causally related.

Psychiatric illnesses that may be associated with exposure to stressors are: post traumatic stress disorder, acute stress disorder, panic disorder, major depressive disorder, dysthymic disorder and alcohol dependence.

Cardiovascular diseases that may be associated with acute exposure to stressors are: sudden cardiac death and cardiac arrhythmias. The body of evidence regarding the association between hypertension and exposure to stressors was not considered indicative of a causal association.

Panic disorder was considered as potentially associated with certain ischaemic heart disease end points, most particularly sudden cardiac death.

A number of other associations were considered. However, high levels of co-morbidity and the potential for confounding weakened the case for causality and necessitated further detailed and critical analysis. Post traumatic stress disorder was considered of particular interest by the participants. However, the limited published data available, and the frequent co-morbidity with substance use and other disorders, precluded the attribution of any specific causal associations between PTSD and cardiovascular outcomes.

What are the potential mechanisms for the association between stressors and disease, with special emphasis on psychiatric illness and cardiovascular disease?

Conference participants discussed potential mechanisms explaining associations between stressors and psychiatric illness and cardiovascular disease.

In addition to the general propositions that stressors involving threat may lead to anxiety spectrum conditions and stressors involving losses may produce depressive spectrum conditions, the range of theoretical constructs underlying associations were considered and potential psychoneuro-endocrine and psychoneuro-immune pathways were acknowledged particularly in the contributions from Professors Allan Husband and Alexander McFarlane.

Professor Scott Henderson provided a thought provoking contribution on the role of genetics in both the likelihood of stressor exposure and potential disease outcome. Genetic and other vulnerability and the immediate biological response to stressor exposure may explain associations between stressors and certain psychiatric illnesses. Professor Najman's research highlighted aspects of social adversity, lifestyle risk factors and stressor experiences. Dr Terry Keane's re-evaluation of the US National Vietnam Veteran Readjustment Study data set provided support to the view that war zone stressors are associated with a range of psychiatric disease end points and that gender contributes to a differential pattern of disease outcomes.

The potential mechanisms invoked to explain associations between stressors and acute cardiovascular end points were discussed. Acute stressors may be linked to certain cardiovascular disease end points directly, or indirectly through certain forms of psychiatric illness. An example of a direct link is the onset of serious cardiac arrhythmias closely following the experience of a severe life stressor. Experimental stress models demonstrate high secretion of noradrenaline and increased sympathetic stimulation of the heart under conditions of mental stress. Noradrenergic and sympathetic stimulation of this sort can trigger arrhythmias in subjects who have pre-existing cardiac disease. An example of an indirect pathway is where an individual exposed to a stressor develops panic disorder and a panic attack can then lead to a serious arrhythmia or sudden death. The proposed mechanism here is that the panic attack causes excessive sympathetic stimulation of the heart which then leads to the arrhythmic event. Consensus was reached that a number of direct and indirect pathways may link acute stressors with certain psychiatric and cardiovascular outcomes. Overall, however, it was clear that the psychoneuro-endocrine responses associated

with stressors are complex and are subject to considerable intra and inter-individual variability and are not fully elucidated at this time.

Conclusion

The RMA Consensus Conference, Stress and Challenge, Health and Disease provided a valuable opportunity for an informed debate about the relationship between the stressor experience, stress and psychiatric illness and cardiovascular disease.

Consensus was reached about a number of general proposals. It was agreed that modern epidemiological methods and the Bradford Hill criteria are appropriate to assess associations between certain stressor exposure and these disorders. A list of psychiatric and cardiovascular conditions were identified that could be causally associated with stressor exposure. A number of other psychiatric illnesses and specific cardiovascular end points were nominated for the RMA to investigate further.

CONFERENCE OVERVIEW

Introduction

In this overview we place the consensus conference in context and outline the issues that were discussed in the meeting. The RMA had received many requests regarding the possible relationship between stressors and psychiatric conditions, as well as the possible relationship between stressors and cardiovascular disease, in particular ischaemic heart disease and hypertension. The consensus conference was held as part of the larger RMA Formal Investigation held under section 196(G) of the Act, in respect of the possible causative role of psychological stress (particularly war or service related stressors) in the development of ischaemic heart disease (including coronary atherosclerosis), hypertension, cerebrovascular accident and psoriasis."

In order to address these issues the RMA convened a consensus conference entitled "Stress and Challenge, Health and Disease". The conference was held in February, 1998 and brought together eminent Australian and overseas scholars and researchers acknowledged for their expertise in examining associations between stressor exposure and psychiatric illness or cardiovascular disease. The conference was opened by the Hon Mr Bruce Scott, Minister for Veterans' Affairs. In addition to the invited participants, the conference was attended by members of the RMA. The veteran community was represented by observers from ex-service organisations.

These proceedings were prepared to capture the issues raised during the consensus conference and to make the background for the consensus statements available to a wide readership. Several of the underlying issues are highlighted in detail in the overview however most of this paper relates to the data available to the participants at the time of the conference. It is appreciated that the field of stressor research is expanding and that with this the knowledge base for assessment of putative associations changes. These proceedings reflect the material considered by the consensus conference in February 1998.

Conference Questions

In preparing for this consensus conference, the RMA identified three broad themes that the conference should address. These themes were represented more specifically as three conference questions.

Question 1

How can we establish causes, measure and set doses that explain the association between exposure to stressors and psychiatric illness on the one hand and cardiovascular disease on the other?

Question 2

Is there an association between exposure to stressors, psychiatric illness and cardiovascular disease?

Question 3

What are the potential mechanisms for the association between stressors and disease, with special emphasis on psychiatric illness and cardiovascular disease?

The consensus conference ran over three days and had the following structure. During the first two days the invited participants presented their papers addressing the conference questions. The formal conference program combined reviews of the published literature provided by a number of the participants with presentations of new data

sets from Dr Terry Keane, Professors George Vaillant, Jake Najman and Gerard Byrne. Dr Trevor Anderson provided a personal and inspiring presentation of the human perspective of the positive and negative responses to stressor challenge, based on his own experiences during the Vietnam War. Professor Lars Weisæth outlined the Norwegian system of military compensation and the United Nations perspective in the recognition, management and prevention of abnormal stressor responses in military and peace keeping personnel.

The counterpoint of individual and population based data acted to focus the conference participants. Key underlying issues for the conference were the definitions of stressors and stress which would have utility for the RMA and the role of epidemiology and tools such as the Bradford Hill criteria in the context of stressor research.

In the afternoon of each of the first two days, syndicate groups met to discuss the conference questions in more detail and to develop recommendations. On the final day these recommendations were presented and discussed by all participants and RMA members. On this day the discussion focussed on answering the conference questions and consensus positions were developed and agreed upon where possible. The model used for this conference had been used previously by the RMA for a consensus conference on smoking and prostate cancer. This conference model has also been used by the US National Institutes of Health for developing consensus positions on the aetiology and treatment of a number of medical and psychiatric conditions.

Background to the Repatriation Medical Authority

The Repatriation Medical Authority (RMA) is established under the provisions of the Veterans' Entitlement Act 1986 (the Act). Its primary function is the determination of Statements of Principles (SoPs) under section 196B of the Act which apply to a particular kind of injury, disease or death and list the factors which must be related to war or defence service.

The RMA operates within a legislative framework and before considering concepts of stress and stressors it may be useful to outline certain of these legislative parameters:

> **"sound medical-scientific evidence"**, in relation to a particular kind of injury, disease or death, has the meaning given by section 5AB(2) of the Veterans' Entitlement Act (the Act).
>
> 5AB(2) *Information about a particular kind of injury, disease or death is taken to be sound medical-scientific evidence if:*
>
> *(a) the information:*
>
> *(i) is consistent with material relating to medical science that has been published in a medical or scientific publication and has been, in the opinion of the Repatriation Medical Authority, subjected to a peer review process; or*
>
> *(ii) in accordance with generally accepted medical practice, would serve as the basis for the diagnosis and management of a medical condition; and*
>
> *(b) in the case of information about how that kind of injury, disease or death may be caused — meets the applicable criteria for assessing causation currently applied in the field of epidemiology.*

Epidemiology is the study of variations in disease frequency among population groups, and the factors that influence these variations. The principle objective of epidemiology has been to determine factors which may cause or contribute to disease processes.

It is obvious that the definition for sound medical-scientific evidence about how a kind of injury, disease or death may be caused requires more than a mere statistical association. It implies the application of causal criteria (such as the Bradford Hill criteria) to the body of available information which has satisfactory internal and external validity.

How is this sound medical-scientific evidence utilised? The following are the relevant sections of the Act (sections 196B(2) and 196B(3))

Determination of Statement of Principles

> 196B(2) *If the Authority is of the view that there is sound medical-scientific evidence that indicates that a particular kind of injury, disease or death can be related to:*

(a) operational service rendered by veterans; or
(b) peacekeeping service rendered by members of Peacekeeping Forces; or
(c) hazardous service rendered by members of the Forces;

the Authority must determine a Statement of Principles in respect of that kind of injury, disease or death setting out:

(d) the factors that must as a minimum exist; and
(e) which of those factors must be related to service rendered by a person;

before it can be said that a reasonable hypothesis has been raised connecting an injury, disease or death of that kind with the circumstances of that service.

196B(3) *If the Authority is of the view that on the sound medical-scientific evidence available it is more probable than not that a particular kind of injury, disease or death can be related to:*
(a) eligible war service (other than operational service) rendered by veterans; or
(b) defence service (other than hazardous service) rendered by members of the Forces;

the Authority must determine a Statement of Principles in respect of that kind of injury, disease or death setting out:

(c) the factors that must exist; and
(d) which of those factors must be related to service rendered by a person; before it can be said that, on the balance of probabilities, an injury, disease or death of that kind is connected with the circumstances of that service.

This legislation requires that for each factor included in a Statement the information meets the applicable criteria for assessing causation currently applied in the field of epidemiology. Additionally, there is a necessity to describe or quantify the factor so that it may be operationalised.

The RMA had previously conducted a number of investigations concerning the associations between stressors and both physical and psychiatric disorders which were the subject of SoPs. The RMA currently recognises the role of stressors and/or psychiatric illness in the genesis or aggravation of a number of physical disorders. These conditions include asthma, cerebrovascular disease, impotence, irritable bowel syndrome, ischaemic heart disease, subarachnoid haemorrhage and sudden unexplained death. The RMA also recognise the role of stressors in the genesis or aggravation of a number of psychiatric disorders, including:

Acute stress disorder
Adjustment disorder
Alcohol dependence and abuse
Bipolar disorder
Depressive disorder
Drug dependence and abuse
Generalised anxiety disorder
Personality disorder
Post traumatic stress disorder
Schizophrenia
Suicide or attempted suicide

Issues Relating to the Measurement of Stress and Stressors

On Day One there was discussion relating to exposures of interest and their measurement, particularly relating to the meaning and use of the terms stress and stressors. There are a number of differing models and definitions of stress. Stress may be referred to as a cause or as an effect and the term "stressor" is again[1] gaining greater acceptance as a representation of the cause. Stress then refers to the psychological and physiological responses (including the fight/flight response) which result from experiencing a stressor.

Models of stress and coping examine the mental and physical processing of life stress experience. These include the stimulus and response oriented theories, as well as interactional theories. Life change or stressful events rarely occur in isolation. Individuals will have past and current experience of such events ranging from minor and moderate to major. Some researchers have catego-

1 Selye (1976) called the external initiators of a stress reaction "stressors", however stress has often been a term used more generally to describe either a negative state or its precipitant.

rised stressors into four categories which may have differing effects upon an individual:

- acute time limited stressors
- single stressor sequences
- chronic intermittent stressors
- chronic stressors

This concept of stress and stressors may well exclude issues of personality and /or personality traits such as seen in the literature relating to "type A personality", hostility, cynicism, and the so called "hot reactors".

Other authors have attempted to consider positive and negative events, or controlled and uncontrolled events, or desirable compared to undesirable events. Some suggest it is the disturbance of an individual's psychosocial balance that is essential rather than the direction of the disturbance. Life change events have been categorized by authors on numerical rating scales (Holmes and Rahe, 1967; Holmes and Rahe, 1978; and Miller and Rahe, 1994). These events are perceived by an individual and this perception is effected by past experience (for example the quality of early life experiences), social supports, and genetic and acquired factors inherent to the individual such as age, education, income and gender. Another aspect of life event stress is that of the perceived-threat. The degree of perceived threat imposed by recent life events determines the individual's emotional and psychophysiological reactions to events and subsequent methods of coping.

The stress and coping model includes psychological defenses such as denial, displacement, repression, reaction formation and isolation. Psychophysiological responsivity to acute life stress experience has been a major area of stress research for more than three decades. Normal stress responses to stressors have been identified and include both hormonal and autonomic nervous system components (Musselman, 1998).

An individual's inherent and learned coping techniques can modulate certain of these psychological and psychophysiological responses. These coping (response reduction) techniques include:

- health sustaining habits: diet, muscle relaxation, physical exercise and short term prescribed medications,
- social supports: social support structure (networks) as well as function (readily available, accessible support),
- responses to stress: measures described by Folkman and Lazarus (1984) on positive coping styles (problem solving, utilizing social support, looking for a silver lining) and negative coping styles (avoidance, self-blame and wishful thinking),
- life satisfactions: optimism, work, family, nature, arts, humor, spirituality (Rahe, 1995).

The stress and coping model would suggest that when an individual is unable to cope with life stress they may experience ongoing psychophysiological activation and sustained symptoms which may then lead to organ dysfunction and eventual disease. Is this model accurate in relation to chronic physical disease?

A number of differing theoretical models and definitions of stress exist. A functional definition was developed by the Australian National Heart Foundation Stress Working Party (Stress Working Party NHF, 1988) whose concept of stress contains three linked components:

1. external stressors
2. the way that they are interpreted by the individual
3. the individual's response

In the context of the RMA and military compensation the external stressors described (such as those in most life event models) need to adequately cover the military perspective. Here combat, combat training, peace keeping, and even the experience of serving within the defence force, convey differing demands on the individual.

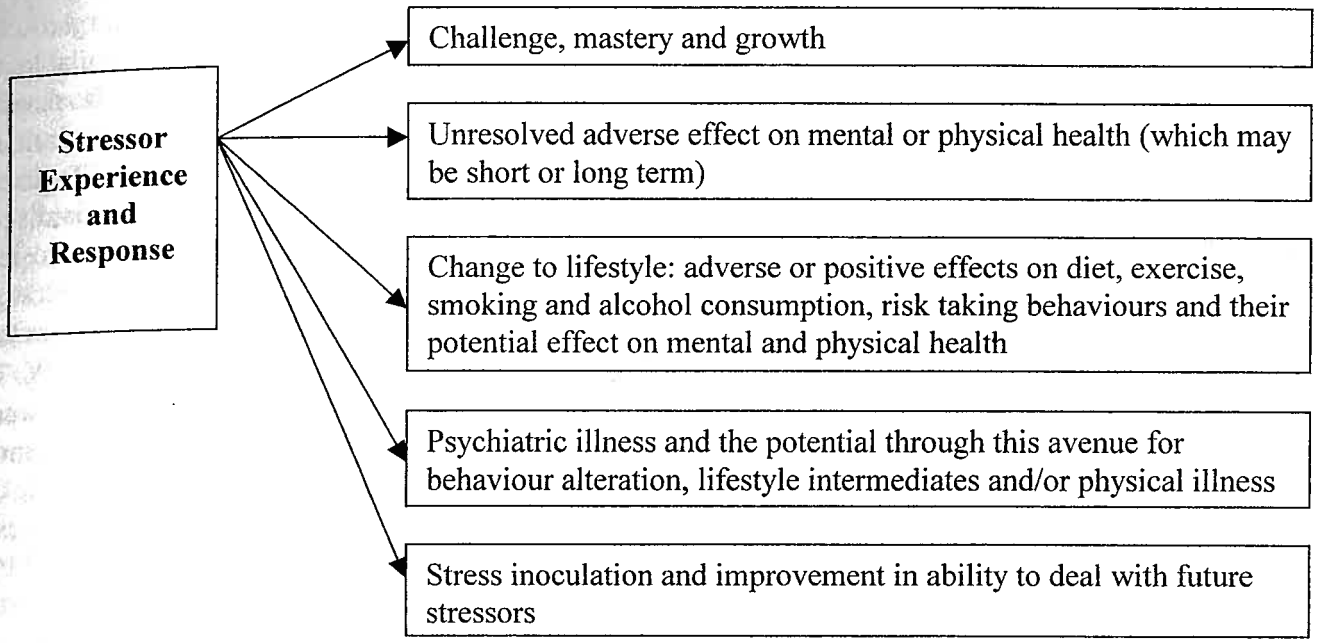
Such stressors may be divided into two broad groups:

- acute stressors: discrete and specific experiences or events which may be isolated, concurrent or recurrent and which include combat, loss, accident, and
- long term stressors akin to job strain, issues of control, occupational requirements, environmental impacts, family separation etc,

These stressors are not mutually exclusive and impact on the individual's inherent makeup and psychological/psychiatric state.

An example of the theoretical process may include the following options:

Hypothesised outcomes following exposure to a significant stressor include:



While exposures and immediate outcomes may be considered most simply, a number of difficulties arise in the examination of the literature on stress and chronic physical disease, particularly when it is separated in time from the stressor exposure, these include:

- The wide range of stressor definitions encountered in the literature;
- Differences in the methodology used in the assessment of stress/stressor, which raises questions about the comparability of data.
- Study design

  Measurement of stress is in most instances retrospective and subject to recall bias.
  Stress is usually measured at one point in time (eg. the preceding 6 months) and taken to be indicative of the subject's usual stress levels.
  Variable and often limited assessment of potential confounders.

Currently the most consistently presented and accepted definition of stress involves the concept of a threatening or distressing experience, "the stressor", producing in the individual a "stress response" that disturbs physiological homeostasis. Normal stress responses to stressors have been identified however, psychiatric conditions that are frequently associated with traumatic or distressing stressors, such as post traumatic stress disorder (PTSD), have underlying pathophysiological manifestations that do not appear to represent the normal stress response seen immediately after stressful events. While these psychiatric conditions may be a consequence of a significant stressor, they are not thought to represent a normal stress response or even the persistence of a normal stress response (Yehuda et al, 1996).

Military Stressors

Several conference participants provided contributions to the consideration of military stressors, particularly those related to war time, combat and peace keeping experiences.

Traumatic stress exposure in military service may be representative of the broad class of serious stressor experience that can be seen in civilian life, but is also unique in that war produces a range of traumatic exposures that may not be seen in other circumstances. Weisæth (1998) describes a time-phase model of stressful war experiences; threat, attack, invasion, occupation, liberation, post-war legal action against collaborators and war criminals, and finally peace, with the re-establishment of national institutions. Each of these phases brings accompanying characteristic stressors. He also describes a classification of severe war stressors that affect military personnel. They are (i) shock traumas of relatively brief duration, (ii) repetitive or serial trauma, and (iii) prolonged exposures to danger characterised by low predicability and low control. He proposes that these

different forms of exposure create risks of developing different types of post traumatic illness. For example, shock traumas may produce PTSD, particularly if the shock is severe and inescapable. If the individual has no previous trauma history and no other psychiatric illnesses, the outcome of such exposure is likely to be a relatively uncomplicated form of PTSD. However, series of traumatic events during military service may produce cases of PTSD with high co-morbidity for other psychiatric conditions. Combinations of extended duration extreme stress, constant uncertainty and little possibility of control may produce delayed PTSD or enduring personality changes with a broad spectrum of other psychiatric problems (Eitinger, 1973).

The effect of military service in war is not uniformly negative for mental health. The prevalence of certain types of psychiatric problems may fall, and strong leadership and motivation are potential mediating factors that improve coping during such stressful times (Weisæth, 1998).

War service can expose the individual to both toxic and protective factors. Weisæth (1991, 1994) suggests that the five most important dimensions of war which are likely to predict an acute or long term psychiatric disorder are (i) physical injury, (ii) threat to life, (iii) loss of loved ones, (iv) an attack on one's physical integrity or honour, and (v) denial of identity. Other authors have suggested that in addition further negative factors include (i) stress that is prolonged, repeated and of high intensity, (ii) is deliberately and not accidentally destructive, (iii) or is man made and hence should not occur.

Protective features identified by Weisæth include control of the situation, being a member of a strong cohesive group, having strong trust in the leaders, having a strong commitment, high quality personal training and good emergency services.

This understanding of what may be toxic exposures and protective factors in war service has led to the construction of a number of methods of assessing stressors in the military setting. Combat exposure and danger scales (for example Janes et al, 1991) have been developed and are valid and reliable measures of this aspect of stressor experience. The question arises as to whether these measures, which have been developed for American military personnel, are applicable or valid in the Australian setting. Although this represents a limitation in the study of war stressors for Australian veterans, it is the only approach available at the moment until better measures can be developed for Australian populations. Some Australian diagnostic tools have been developed. O'Toole et al (1996a) used the AUSCID-V, a standardised psychiatric diagnostic interview for Vietnam related PTSD in Australian Vietnam Veterans, which included the establishment of the "A" criteria and the symptom inventory of SCID-NP-V.

Further refinement of the broad group of war-zone stressor events captured in combat exposure scales has been undertaken (King, 1995). Keane et al (1998) describes a group of four war-zone stressors that have been derived from data collected by the National Vietnam Veterans Readjustment Study (NVVRS) interview protocol. From this retrospective analysis of American Vietnam veterans, the four war stressor factors are:

- exposure to traditional combat (observable, stereotypical, warfare experiences such as receiving enemy fire, seeing injured or dead colleagues, going on special missions and firing weapons),
- exposure to atrocities or episodes of extraordinarily abusive violence (observable events that might be considered extremely deviant or beyond normal war experiences, including terrorising, or wounding or killing of non-combatants or mutilation of bodies),
- subjective or perceived threat (individual appraisals as to whether war-zone events or circumstances were frightening, perilous, or potentially harmful to personal safety, including judgements based on the experience of fear and the degree of danger), and
- the general milieu of a harsh or malevolent environment (the extent to which the veterans rated daily war-zone living conditions as bothersome, annoying or uncomfortable, including lack of privacy, inadequate food, bad climate, insect infestation, disease and filth).

The first three of these factors have been recognised consistently as important elements of war-zone stressors. The fourth factor, that of malevolent environment, is new and has not been examined in other studies of Vietnam veterans in the United States or Australia. Keane and colleagues (Keane et al, 1998) claim that this factor is a predictor of post traumatic illness as it is associated independently with the presence of

subsequent psychiatric disorder even after controlling for the effect of the other three war-zone factors, however the retrospective nature of the data collection and the evidence that this is highly correlated with the other factors necessitates validation of this last stressor.

Another aspect of war is the possibility of being captured and being taken as a Prisoner of War (POW). Being a POW is generally accepted as a severe war stressor. While accepting that being a POW is a uniformly traumatic experience for most individuals, it is possible that POW experiences do vary, both from camp to camp, and at different times in the same camp. However, no study has attempted to describe the nature of POW stressors that would allow operationalised definitions and the construction of a measurement tool for these exposures. There is evidence to suggest that POW's do manifest higher rates of certain diseases, particularly those related to chronic infections and malnutrition, and also suffer from high rates of anxiety and depressive disorders compared to relevant control groups (Venn and Guest, 1991).

Each war of the 20th century has had common elements however other features exist which contribute to profound differences in the style of warfare and to stressor experience. Trench warfare characterised the major war-zone stressors of The Great War (Regnell, 1919), whereas in the Pacific Theatre in World War II jungle warfare and the primary role of individual combat were dominant features of stressor experience (Sinclair 1943; Sinclair, 1994; Grinker and Spiegel, 1943; Sinclair et al, 1946). In subsequent wars (Korea and Vietnam) manpower management changed and 12-month troop rotations to the theatre were introduced. This had implications for the extent and duration of exposure of soldiers to war-zone stressors. In the Vietnam War guerilla warfare created unique stressor exposures. The lack of a front and the possibility that Vietnamese civilians within controlled areas could be the most dangerous adversaries were on a scale which created a level of sub-acute persistent threat that may be unique to that war.

Peacekeeping operations offer a new and different set of challenges. The United Nations has deployed numerous peacekeeping units often made up of multi-national collaborative military missions. These missions attempt to create peace or maintain fragile peace in areas of unrest (Weisæth, 1998). Peacekeepers face problems that are different from the combat faced by other soldiers. Inability to retaliate to aggression, endurance of taunts and humiliation by locals, witnessing of abusive violence with the frequent inability to protect the victims, ambivalence towards the role of peacekeeper, and lack of extensive training required for that role are all potentially stressful situations. Furthermore, it has been common for peacekeepers to be drawn from separate units to make up a peacekeeping force. This may reduce the cohesion, the sense of commitment to the group and morale that could be protective in coping with these difficult circumstances. An understanding of the different nature of stressors experienced by peacekeepers in comparison to war service, and the effect of these stressors on subsequent psychiatric morbidity has only been possible recently as systematic studies of PTSD in peacekeepers have emerged. Studies that are available suggest that peacekeepers run a considerable risk of developing chronic post-traumatic stress reactions. The predictors of these conditions include stressors experienced during the deployment, the quality of leadership of the unit, perceived lack of meaningfulness of the mission, and the level of alcohol consumption due to sleeplessness (Weisæth, 1998).

Issues Relating to the Assessment of the Effects of Stressor Exposure

The science of epidemiology is used to identify and describe associations and to clarify potential causal relationships. The underlying principles and methodology are as relevant to assessment of risk for measures of stressor exposure as they are to the quantitative assessments of cigarette consumption in cancer epidemiology. Considerable discussion by conference participants focussed on the use of epidemiological methods in assessing the literature concerning the potential effects of stressor exposure. The RMA is required by legislation to consider and apply epidemiological principles in the development of the Statements of Principles.

Models for the assessment of causation are well accepted for the identification of biological

agents which may cause disease, especially where the factor can be measured objectively. More than 30 sets of inductive criteria have been developed to guide the assessment of causal relationships (Holman, 1997). The process of causal inference was recognised as complex and subject to a degree of interindividual variation. The fundamental issue of the utility and role of modern epidemiological methods in the assessment of causal relationships between psychosocial stressors and psychiatric illness and cardiovascular disease was canvassed by the conference participants. In attempting to deal with this issue a number of concerns needed to be addressed by conference participants.

First, is the concept of "stress" too vague and difficult to be used in epidemiological causal modeling? This may be the case if stress is allowed to refer to too many things (eg. stressor, stress response, psychological distress). However, as detailed, the notion of a stressor leading to a stress response (a perturbation of homeostasis) which may then lead to a disease or disorder makes it possible to identify the "stressor" as a putative aetiological agent. This model of stress opens the way for evaluation of causation by epidemiological criteria since the stressor becomes the primary aetiological agent (factor).

Second, can stress be measured? In order to determine any strength of association between stress and disease, to determine a dose-response relationship or biological gradient, then some measure of stress must be available. Measures of stress can be applied at a number of points in the stress cascade model. At the level of stressor, there are few general measures of traumatic or psychosocial stressors available or which have been found to be valid or reliable. The one major exception is in the field of military studies where combat exposure scales and other forms of warzone stressor scales have been developed and used reliably (Keane et al, 1998). At the next cascade point, the level of the stress response, measures of changes in physiological homeostatic balance are possible. Candidate variables include cortisol levels, noradrenaline secretion, CRF release, and sympathetic nervous system activity, among others. Finally, changes in psychological status or presence of symptoms of psychological distress can be quantified. A plethora of symptom measures are available to measure this aspect of stress. In summary, stressors are potentially measurable but the difficulty of this task must not be understated.

Third, does the individual's perception of the stressor matter? This is a vital question because it may go some way to explaining why individuals respond to the same stressful event in very different ways. For one person the stressor may be seen as a challenge, or opportunity to master the event, with the consequence of enhanced self esteem and better health. For another person the experience may be catastrophic and devastating, leading to fear, failure, humiliation, and psychiatric disorder. We know that outcomes do vary, as even after an exposure to a severe stressor like combat the majority of soldiers do not develop psychiatric sequelae although a minority do develop chronic psychiatric illness.

The individual's perception of a traumatic event may be predetermined. An argument can be mounted that genetic make-up or previous experience (of other traumas, for example) determine one's perception of an event and therefore sets the parameters for a successful or blighted outcome (Henderson, 1998). Alternatively, the perception of an event may be primarily a function of the severity of the stressor and its effect on arousal and the level of dissociation in the observer. Assessing variability in perception of a stressor is difficult. Ideally measures of perception should be done at the time the stressor is being experienced, or soon after. Measures taken later are open to bias. In symptomatic individuals the search for explanations for their suffering, or "meaning" to the events, may distort recollections of perceptions at the time of the event. A further problem is not having a current useful model or understanding of perception in this setting, with the attendant difficulties of a lack of operational definitions and measurement instruments.

Fourth, there are both unique difficulties and benefits in applying causal criteria to "post stressor" psychiatric disorders. Delayed onset PTSD may have its onset months or years after the traumatic stressor. This may mask any temporal association with the exposure. Additional evidence supporting an association may be provided in post stressor illnesses, such as where regular symptom

exacerbations occur on the anniversary of the stressor experience or where the psychopathological content of the illness is related directly to the nature of the stressor. This feature is most obvious in PTSD where intrusive memories are often of the actual stressor experience. It can also be found in the obsessions and rituals of obsessive compulsive disorder (OCD), the type of phobias in phobic disorders and the ruminations and preoccupations in depressive disorder, when these conditions are caused by a traumatic or psychosocial stressor exposure (O'Brien, 1998).

Experiencing a Stressor

At the consensus conference it was considered that, for the purposes of assessing potential causal associations the term stress was ambiguous and difficult to quantify. The conference participants preferred the term "experiencing a stressor". The conference canvassed a number of opinions about the nature of stressors and the essential elements of stressors that lead to adverse outcomes in terms of psychiatric illness or cardiovascular disease.

An obvious problem concerning the relation between stressor exposure and subsequent illness is determining what type of stressor exposure is most salient and what level of severity of stressor exposure leads to negative health outcomes. This issue is by no means resolved in the psychiatric literature even with regard to the most specific of the post stressor illnesses, post traumatic stress disorder (PTSD).

The ex-Service representatives provided the stimulus for the development of a definition of military stressor. This definition was formed using the DSM-IV definition of the stressor criteria required for the diagnosis of PTSD, the advice of the expert participants, (including that arising from systematic studies and data analyses, in particular Dr Terry Keane), and input from the ex-Service representative observers at the conference. A stressor relevant to military service was then defined by the conference participants as:

> "The person experienced, witnessed or was confronted with an event or events that involved actual or threat of death or serious injury, or a threat to the person's or other people's physical integrity that might evoke intense fear, helplessness or horror.
>
> In the setting of service in the Defence Forces, or other service where the Veterans' Entitlements Act 1986 applies, situations that qualify as stressors include:
>
> (i) Engagement with the enemy; or
> (ii) Witnessing casualties or participation in or observation of casualty clearance, atrocities or abusive violence; or
> (iii) Acute or chronic threat of serious injury or death; or
> (iv) Prolonged experience of malevolent environments."

It should be noted that this definition is different in some respects from the DSM-IV stressor definition (Criterion A) for PTSD. In that definition the stressor must evoke intense fear, helplessness or horror. In the definition accepted by the consensus conference it was recognised that some individuals might not experience intense fear, helplessness or horror because of severe dissociation or other manifestations of anxiety that prevent these emotions being expressed. Examples of situations likely to occur in war that qualify as stressors were taken from findings of the Centre for Disease Control Vietnam Experience Study (CDC VES) (CDC, 1989), the National Vietnam Veterans' Readjustment Study (NVVRS)(Kulka, 1988) and the Australian Vietnam Veterans Health Study (AVVHS)(O'Toole et al, 1996a,b,c). The inclusion of prolonged experience of malevolent environments as a qualifying stressor was considered provisionally considered because evidence that this is associated with subsequent psychiatric morbidity is only available from one data set (NVVRS) and awaits further validation.

The military stressor described is conceptually consistent (with the exception of malevolent environment discussed later) with validated research relevant to the causation of post traumatic psychiatric disorders such as PTSD and acute stress disorder. Other less severe stressors of a psychosocial nature (bereavement, loss of employment, separation etc.) are recognised as occurring as part of war service but a definition of these stressors was not attempted by the consensus conference.

The participants recognised that the definition of a stressor relevant to military service was at the more severe end of the spectrum of psychosocial stressors that individuals can be faced with either

in military service or in civilian life and that less obviously severe stressors might contribute to psychiatric morbidity. Exposure to stressors of less intensity than those described as qualifying for a diagnosis of PTSD have been clearly established as precipitants or causal factors in the onset or exacerbation of psychiatric disorders, including major depression and adjustment disorder. There is a large body of work examining negative life events which establishes a link between psychosocial stressors that are not outside the range of normal experience (eg. protracted conflict at work, bereavement, interpersonal relationship problems and physical illness) and such psychiatric disorders.

The debate about the nature and severity of stressors that are necessary for the development of subsequent psychiatric disorder is ongoing and associations require further elucidation. However, despite this uncertainty the broadly accepted psychiatric classification systems such as DSM-IV (APA, 1994) and ICD-10 (WHO, 1992) continue to interpret the stressors required for post traumatic psychiatric illness as being at the severe end of the spectrum of exposure.

It was considered that because of the lack of consistent systematic definitions for the less severe stressors in the scientific literature and the very diverse methodologies and outcome measures used by researchers, which allowed little opportunity for pooling of data or comparison, these would not be considered within the consensus conference framework.

As can be seen from the preceding discussion, there is controversy over the nature and severity of stressors required to produce psychiatric illness. In the civilian field, established and reliable measures of stressors have been hard to find, although recently measures of acute stressor experience have been developed. Within the field of military studies, however, the stressor criterion has been operationalised and associations between the presence and severity of military stressors have been determined for PTSD and a range of other psychiatric disorders.

Consensus was also reached that use of the science of epidemiology was appropriate and necessary in the process of examining potential causal associations between stressors, stress and disease. It was considered that the use of causal criteria such as those attributed to Sir Austin Bradford Hill assisted in clarifying causal associations from observed associations. The Bradford Hill criteria are:

- Strength of association
- Consistency of association
- Specificity of association
- Temporality of association
- Gradient of effect (dose)
- Biological plausibility/coherence
- Experimental evidence
- Analogy

It was agreed that in judging causal associations between stressors and the development of psychiatric disorders or cardiovascular disease, a number of the Hill criteria may not be fully met. However, considered appraisals of the available evidence for causal links between stressors and disease could be undertaken. As Bradford Hill (1965) indicated: "All scientific work is incomplete — whether it be observational or experimental. All scientific work is liable to be upset or modified by advancing knowledge. That does not confer upon us a freedom to ignore the knowledge we already have, or to postpone the action that it appears to demand at a given time".

It was considered that once causality had been inferred, a dose, based on the available sound medical scientific evidence, could be determined. In some situations the dose would take the form of a threshold effect in that only after a certain level or degree of exposure would a negative health consequence emerge.

Exposure to Stressors and Psychiatric Disorders

Post Traumatic Stress Disorder

Clearly the most well researched of the post traumatic psychiatric disorders is PTSD. There is general agreement that exposure to traumatic stressors is a necessary but not sufficient cause of PTSD. The aetiological role of traumatic stress as the primary cause of PTSD has been acknowledged in DSM-IV with the need for stressor experience to be present before PTSD can be diagnosed (APA, 1994). While traumatic stressor exposure is necessary, it is not sufficient. This is because the majority of individuals exposed to

traumatic stressors do not develop PTSD or other post traumatic illnesses. This may be explained in part by the fact that not all traumatic stressors are the same and there is substantial variability in the severity of stress from one form of traumatic experience to another. There is also some evidence that there is a threshold of severity of traumatic stress that has to be exceeded before PTSD develops.

In studies of US Vietnam veterans, those who saw high levels of combat were more likely to develop PTSD than those who experienced moderate or low levels of combat. Goldberg (1990) using the Vietnam veteran twin registry and Jordan et al (1991) who examined the NVVRS data found that high levels of exposure to war-zone stressors showed the strongest associations with PTSD and other psychiatric disorders. This finding has been confirmed in a recent study by Keane et al (1998).

Another explanation for the observation that not all individuals exposed to traumatic stressors develop PTSD is that some may be more vulnerable to this condition than others. A range of vulnerability factors have been proposed including personality make up, pre-existing psychiatric illness, genetic predisposition, exposure to previous traumatic stressors, and the life experiences of the individual immediately following the traumatic exposure. Investigators have examined many of these vulnerability factors and there is now evidence supporting associations between an anxious personality make up (neuroticism), previous traumatic stress exposure, presence of existing or past psychiatric illness or drug an alcohol problems, and poor social support immediately after the trauma and the development of PTSD.

Recently, there have been reports that pre-existing alterations in certain aspects of the central nervous system function (such as the hypothalamic-pituitary-adrenal (HPA) axis) may predispose an individual to develop PTSD (Yehuda 1998; McFarlane 1998). One view that takes into account the importance of vulnerability proposes that, following traumatic stressor exposure, if an individual develops a post traumatic illness, then the disorder developed will be one for which the individual has most genetic or constitutional loading. Currently, a consensus is emerging that both the salience of the traumatic exposure and the presence of vulnerability factors need to be considered in the aetiology of PTSD.

Other Post Traumatic Psychiatric Disorders

Although PTSD is the disorder most clearly associated with traumatic stress exposure, there is general acceptance that a number of other psychiatric illnesses are also more common after trauma. But unlike PTSD where intrusive symptoms of the trauma are a hallmark of the condition, other post traumatic disorders do not require the trauma to be represented in symptomatology. The presence of non-PTSD post traumatic illness can occur in two situations. First, it may arise independent of PTSD as a post traumatic illness in its own right. Second, it may be found comorbid with PTSD.

There is clear evidence that a diagnosis of PTSD is associated with an increased risk of other psychiatric diagnoses (Helzer et al, 1987; Davidson, 1991; O'Toole et al, 1996a,b,c; O'Toole et al 1998). The type of comorbid condition varies across studies and may reflect social influences. For example, studies of veterans with PTSD show high rates of comorbid alcohol and substance abuse whereas survivors of the holocaust suffering from PTSD have very low rates of these drug related conditions. Hence social and religious constructs may make fundamental contributions in the development and modulation of comorbid psychiatric conditions.

The onset of comorbid post traumatic disorders in veterans usually begins at varying times after the onset of PTSD (O'Toole et al, 1998). The course of comorbid conditions interacts over time with PTSD such that exacerbations of PTSD are often precipitated by exacerbations of the comorbid condition (eg. repeated episodes of depression or substance abuse exacerbate PTSD) and vice versa.

Large US population based epidemiological studies such as the Epidemiological Catchment Area Study (ECA) (Helzer et al, 1987) and the National Comorbidity Study (NCS) (Kessler et al, 1994, 1995) have confirmed that for a wide range of psychiatric disorders there is an increased risk of the lifetime prevalence of some other or co-existing psychiatric disorder. The ECA study found that people with PTSD were twice as likely

to have some other psychiatric diagnosis as people without PTSD.

A recent detailed analysis of the Australian Vietnam Veteran's Health Study (O'Toole et al, 1998) indicates that the disorders which may be consequent on PTSD include panic and generalised anxiety disorder, and somatoform pain disorder. Alcohol and drug use disorders and social phobia may have mixed aetiology while gambling disorder may be unrelated. The authors suggested that depression and dysthymia seem to represent aspects of vulnerability in that they may be risk factors for the development for PTSD after the experience of combat exposure. In this study depression was not found to be related to combat exposure, and dysthymia was unrelated to this exposure after controlling for PTSD.

Evidence also points to an independent association between traumatic stressor exposure and the onset of a number of non-PTSD psychiatric disorders. The most recent disorder to be classified in this category is acute stress disorder. Acute stress disorder has a stressor criteria that is identical to that for PTSD. This immediate, distressing but usually brief reaction to trauma has a strong dissociative component (APA, 1994). Individuals whose acute stress disorder symptoms persist beyond a month have a higher chance of progressing to PTSD than those without such symptoms. PTSD and acute stress disorder are the only two psychiatric disorders described in DSM-IV where the association with traumatic stressors is made explicit.

This is not completely mirrored in another internationally recognised classification system, ICD-10. ICD-10 includes a grouping (F43) of conditions known as "reaction to severe stress, and adjustment disorders". ICD-10 indicates that this group of disorders differs from others in that they are identifiable "not only on grounds of symptomatology and course", but because their relation to either "exceptionally stressful life events" or "significant life change". In all the disorders listed in this grouping the life event or life change is seen as being a primary overriding causal factor. The conditions listed in this group include (i) acute stress reaction, (ii) PTSD, (iii) adjustment disorders, (iv) brief depressive reaction, (v) prolonged depressive reaction, (vi) mixed and anxiety and depressive reaction, (vii) other reactions to severe stress, and (viii) reaction to severe stress unspecified. Clearly, ICD-10 has broadened the net and includes many more specific trauma related conditions than DSM-IV. An additional diagnosis in ICD-10 that does not appear in DSM IV is that of enduring personality change after catastrophic experience (F62.0). The traumatic exposure necessary for this diagnosis is a catastrophic stressor such as prolonged captivity in a hostage situation or concentration camp, or experiencing torture. The condition is characterised by a hostile or mistrustful attitude towards the world, social withdrawal, feelings of emptiness or hopelessness, a chronic feeling of being on edge or threatened, and estrangement from others. Many of these symptoms overlap with PTSD and enduring personality change shares much with the concept of the Disorder of Extreme Stress Not Otherwise Specified (DESNOS) that was proposed for inclusion in DSM-IV but was not included.

Beyond PTSD and the ICD-10 group F43 of traumatic stress related conditions, a number of other psychiatric disorders have been considered to be related independently to traumatic stressors. They include, (i) alcohol and drug abuse/dependence, (ii) mood disorders (particularly depressive episodes), (iii) other anxiety disorders (generalised anxiety disorder, specific phobias, obsessive compulsive disorder, panic disorder and social phobia), (iv) somatoform disorders, and (v) dissociative disorders (O'Brien, 1998). Schizophrenia and other psychotic disorders have not demonstrated the same form of association with traumatic stressors or as comorbid conditions with PTSD (O'Brien, 1998; Marchevsy and Baram, 1992; Eberly and Engdahl, 1991; Hryvniak and Rosse, 1989).

Both in Australian and US Vietnam veterans, high rates of alcohol abuse/dependence have been reported as comorbid with PTSD (Kulka et al, 1990; O'Toole et al, 1996). The interaction between substance use disorder and PTSD is complex. Substance use disorders are frequently seen as comorbid with PTSD but also can appear in isolation following trauma. Substance use disorders may suppress, exacerbate or perpetuate PTSD (Jelinek and Williams, 1984). It is possible that alcohol and other drugs are used by sufferers of PTSD to self-medicate their distressing symp-

toms. Among Vietnam veterans the onset of drug or alcohol dependence or abuse may occur at about the same time as the onset of PTSD. This is usually not the case for other psychiatric disorders which may occur some time after the traumatic stressor exposure and the onset of PTSD.

Depressive episodes can be provoked by stressful life events, however the stressor experience required appears to differ from that outlined in the A criteria required for PTSD. Depression appears related to a broad range of psychosocial stressors encompassing loss (bereavement, divorce, job loss). Where the life event has been of a traumatic nature and bereavement has been experienced, then the onset of depression is well recognised. A recent study of men experiencing conjugal bereavement (death of a spouse) examined the effects of this common but significant adverse life event on the incidence of psychiatric disorder in older males (over 65 years) living in Brisbane (Byrne, 1998). Soon after bereavement significantly more widowed men suffered from major depressive disorder than a comparison group of older married males. This observation reflected similar findings of increased prevalence of depressive illness among younger people who were friends of adolescent suicide victims (Brent, 1993 and 1995; and Brent et al, 1994).

Among anxiety disorders other than PTSD, there is good evidence that traumatic events are associated with an increased prevalence of generalised anxiety disorder. Studies of Ash Wednesday fire fighters (Spurrell and McFarlane, 1993), people exposed to the Exon Valdes oil spill (Palinkas et al, 1993), the Mount St Helens eruption victims (Shore et al, 1989) and Sri Lankan civil war victims (O'Brien, 1998), all show high rates of generalised anxiety disorder. A dose-response relation between severity of stressor and prevalence of generalised anxiety disorder has been identified. After exposure to a severe traumatic stressor the onset of obsessive compulsive disorder, social phobia and panic disorder has been noted in a number of studies. Among studies of veterans, obsessive compulsive disorder, social phobia and panic disorder are observed to occur more frequently than expected (Davidson et al, 1991; Green et al, 1990; Orsillo et al, 1996). Reports of battered women and the adult survivors of child rape note a high prevalence of obsessive compulsive disorder, social phobia and agoraphobia (Gleason, 1993).

Somatoform disorders as described in DSM-IV are characterised by somatic physical symptom presentations that are not fully explained by any general medical condition and are not intentional or consciously produced. The experience of traumatic stressors has been associated historically with somatic presentations, somatisation symptoms or frank conversion hysteria. For example, the term "traumatic hysteria" was coined following World War I to describe hysterical blindness, mutism and paralyses in soldiers returning from the trenches. Despite this long acceptance of a link between trauma and somatoform disorders, the small number of studies that have reported on this issue have produced contradictory results. A study of Vietnam veterans with PTSD did not show an excess of somatisation whereas another study of veterans found somatisation associated with chronic rather than acute PTSD (Orsillo et al, 1996; Davidson et al, 1991). The Australian Vietnam Veteran's Health Study reported a significant association (adjusted OR=3.15, 95%CI=2.07-4.78) between presence of PTSD and somatoform pain disorder. An association also was described between this condition and reported combat exposure however the association diminished with control for the presence of PTSD (O'Toole et al, 1998).

Stressor Specificity

In the preceding section it has been suggested that the experience of stressors, particularly the more severe or traumatic ones, can cause a range of psychiatric disorders. PTSD is the most obvious condition but other psychiatric disorders have also been associated with stressor experience. An important question that arises is whether different types of stressors produce different psychiatric disorders. A clear answer to this question is not available at this time. There is limited evidence suggestive that stressors involving threat may lead to anxiety spectrum conditions while stressors involving loss may produce depressive spectrum conditions.

Traumatic experiences that involve bereavement through unexpected loss of loved ones have been associated with the onset of depressive ill-

ness. Byrne's (1998) study of elderly men (noted previously) who had suffered a significant loss (the death of their spouse) illustrates this association clearly. In comparison to a matched group of men who were not bereaved, the bereaved men had much higher rates of major depressive disorder at six weeks post-bereavement. The traumatic stressors delineated in the A criteria for diagnosis of PTSD are those that are characterised by high levels of threat such as combat, rape, severe motor vehicle accidents and natural disasters. These events may also be associated with severe injury and loss of life and the traumatised individual thus has both threat and loss to contend with. A complex stressor thus may have components to precipitate both PTSD and depressive disorder.

From the military perspective it is important to determine what aspects of war-zone stressors are associated with different post traumatic illnesses in this setting. Keane and associates (1998) have examined these issues in detail for both male and female Vietnam veterans using data from the NVVRS. Keane noted that war stress is a recognised cause of PTSD among veterans but the relation of war-zone stress to other psychiatric conditions has been less well-examined. One important exception to this situation is the report by Jordan et al (1991) looking at the NVVRS data. These authors found that high combat exposure, in comparison to moderate or low exposure, was associated in male veterans with elevated rates of PTSD, depression, dysthymic disorder, obsessive compulsive disorder, generalised anxiety disorder, alcohol abuse and anti-social personality disorder. Drug abuse (other than alcohol) and mania was not elevated among men with high combat exposure. Among women veterans, high exposure to combat was associated with depression, dysthymic disorder and panic disorder.

Keane and colleagues examined the NVVRS data more closely to examine relationships between the four war-zone stressors (traditional combat, atrocities and abusive violence, perceived life threat, and malevolent environment) and presence or history of psychiatric disorder. The data set included 1,200 male and 432 female Vietnam veterans from the NVVRS dataset. The results showed that war-zone stressor variables consistently predicted many of the psychiatric conditions measured. In general, the more an individual was exposed to the four dimensions of war-zone stress, the more likely he or she would be to develop PTSD and a range of other psychiatric conditions. Higher levels of all four war-zone stressors predict the development of psychiatric disorders and elevations in each of the four dimensions is also associated with psychiatric disorder. Major depression and panic disorder were more frequent among female Vietnam veterans who experienced war-zone stressors, whereas alcohol abuse and PTSD were more frequently associated with war-zone stress among male veterans. The authors conclude that while PTSD is certainly the most common psychiatric outcome related to war-zone stress exposure, it is not the only outcome. Depression, panic disorder, alcohol abuse, generalised anxiety disorder, obsessive compulsive disorder and anti-social personality disorder can all develop in the aftermath of traumatic war-zone exposures.

The finding of this wide range of psychiatric disorders provides some support for the diathesis-stress model of psychopathology. This model proposes that when individuals are exposed to stress of war they may be more likely to develop psychiatric conditions for which they carry particular vulnerability (Zubin and Spring, 1977).

While the Vietnam war provided an unparalleled opportunity to examine the relation between war related stressor exposure and subsequent psychiatric illness, studies done with Vietnam veterans may not be relevant to stressors experienced by peace keepers in more recent United Nations and NATO peace keeping operations. Weisæth (1998) has examined this issue and observes that peace keepers are exposed to operational stressors frequently quite different to situations they have been trained for as active duty soldiers. The peacekeeper's task is not traditional warfare but rather the capacity to control both aggression and fighting impulses and to be able to control natural flight responses when faced with threatening situations. A peacekeeper often has to work in provoking and humiliating situations filled with anger and frustration. The role is to act as a buffer between hostile parties rather than engage in regular war activities (Weisæth, 1998). Studies of PTSD and other psychiatric conditions in veterans of peacekeeping operations have been limited in number. The observed prevalence of PTSD

ranges from 5% to 20% approximately six months after redeployment.

Ward (1997) in a study of 117 Australian peace keeping veterans, 15 months after repatriation from duties in Somalia described significantly higher levels of psychiatric morbidity in peace keepers when compared to defence force controls. 24.8% of peace keepers reported symptoms at a level to qualify for psychiatric "caseness" using the General Health Questionnaire assessment tool, as compared to 13% of controls. Approximately 20% of peace keepers reported post traumatic stress disorder symptoms 15 months following their return to Australia.

In a longer-term follow-up Weisæth (1998) studied 1624 Norwegian peace keeping veterans over six years after their service. The prevalence of PTSD was 5.2% but it was as high as 16.1% in the subgroup of peacekeepers who had been prematurely repatriated from peace keeping missions. Using a multiple regression analysis of variables describing peace keeping operation conditions and circumstances following redeployment, Weisæth found that, in addition to the level of stressors experienced during the operation and stressful life events experienced following return, the perceived quality of leadership, the perceived lack of the peace keeping mission and the increased consumption of alcohol were predictors of PTSD at follow-up. Presence of other psychiatric disorders and their relation to peace keeping mission stressors was not covered in this report.

The findings from the NVVRS, the CDC VES and the Australian Veterans Health Study makes up a substantial body of evidence which describes associations between war-zone stressors and a range of psychiatric conditions. As with most such work, it is recognised that these studies are retrospective in nature and that it is possible that currently symptomatic veterans have a more negative view of certain of their war experiences than currently healthy veterans, creating a selective bias in reporting, and difficulties in assessment of specific stressor features. There is an appreciation that severe stressors experienced in war, natural disasters and other immediately life threatening situations can be associated with development of psychiatric illness. Additionally, unexpected death of a loved one or spouse are situations where rates of psychiatric disorder, particularly depressive illness, have been noted to be higher than expected (Byrne, 1998).

Interestingly, the dose-response relationship between stressor exposure and psychiatric disorder may not be straightforward. PTSD appears to demonstrate a relatively linear dose-response relationship with combat exposure in studies of veteran populations but this does not apply when considering the association between combat exposure and the development of other non-PTSD post traumatic disorders. For example, exposures may be quantitatively or qualitatively different for the development of major depression, generalised anxiety disorder, alcohol abuse, panic disorder, obsessive compulsive disorder and anti-social personality disorder in veterans (Keane et al, 1998). Individuals' strengths, vulnerabilities, past experience and comorbidity may contribute to this complex picture.

Conference Participants Summary

Considerable debate and discussion surrounded the issue of post traumatic psychiatric illness. The utility of DSM-IV and ICD-10 nomenclature was considered at length by participants including Professors Henderson, Tennant, McFarlane and Morris. It was agreed that a number of psychiatric conditions may be caused by or contributed to by exposure to severe stressors; and the current RMA statements provided a broad coverage for these. However, at the time of the conference no statements for panic disorder, dysthymia or enduring personality disorder were developed and it was suggested that when these were undertaken exposure to a severe stressor should be considered to have some support for causality for these conditions.

Cardiovascular Disease

The potential relationships between a variety of stressors and cardiovascular disease are of major interest to the general public, clinicians and researchers. The specific stress-cardiovascular disease associations that have received attention over the years have been the associations between psychosocial stressors and sudden cardiac death, arrhythmias, ischaemic heart disease and hypertension.

The formal presentations during the consensus conference, which included detailed literature reviews by Professors Tennant, Don Byrne, Esler and West, as well as results of primary research findings, syndicate and group discussions demonstrated a range of opinion. They also highlighted the need to consider the potential for bias and particularly confounding, in the available data sets. Professor Vaillant's 50 year prospective data sets demonstrated that much retrospectively collected material may support mere association and not causation, and demonstrated the importance of known confounding variables such as alcohol and cigarette consumption when considering cardiovascular disease outcomes.

Observed associations between stressors and cardiovascular disease could also potentially be mediated by an intervening mechanism — the presence of a stressor induced psychiatric disorder, which itself may produce cardiovascular disease. One of the cornerstones to this hypothesis is the answer to the question: Are individuals with psychiatric disorders more at risk for cardiovascular disease? Further, can psychiatric disorders cause cardiovascular disease? Where associations are observed between psychiatric disorders and cardiovascular disease these could be explained by differing mechanisms. They could be evidence of direct causal associations, they could be due to mediating lifestyle factors or be artefactual and spurious.

A range of possible direct mechanisms have been postulated linking psychiatric and cardiovascular disease. These vary from excessive direct sympathetic stimulation of the heart and increased noradrenaline spill-over during a panic attack, to hyperactivity of the noradrenergic nervous system accompanying chronic hyperarousal in PTSD, to alterations of neuro-chemical modulation of the cardiovascular system induced by HPA axis abnormalities in PTSD. Theoretical, indirect pathways include altered lifestyle patterns such as increased use of alcohol or tobacco, weight gain and poor nutritional habits that increase the risk factors for cardiovascular disease. Pathways may also possibly involve poor compliance with medical management of cardiovascular disease due to the presence of a psychiatric disorder.

Exposure to Stressors and Ischaemic Heart Disease

Sudden cardiac death

Consistent reports from Australia and overseas document an increase in sudden cardiac death during and after earthquakes. These suggest that the stressors experienced in that situation produce changes in cardiovascular physiology that might provoke coronary artery spasm or acute arrhythmias, particularly in patients with predisposing coronary heart disease (Leor, 1996; Katsouyanni, 1986; Trichopoulos, 1981; Dobson, 1991). The exact mechanism for this observed increase in sudden cardiac death at these times has not been fully elucidated but a number of hypotheses have been advanced based on more recent understandings of cardiac physiology and the primacy of neural modulation of heart action (Esler, 1998). In states of high arousal (as might be experienced during the terror of an earthquake or during the experience of panic attack) there is massive sympathetic stimulation of the heart and prominent spill-over of noradrenaline. In individuals with pre-existing coronary disease and, possibly, even in healthy individuals, this sympathetic outpouring can produce coronary artery spasm and/or cardiac arrhythmias leading to acute myocardial infarction or sudden death (Esler, 1998; Tennant, 1996).

Ischaemic heart disease other than sudden cardiac death

Beyond the statistical association of sudden death following earthquakes and the frequent anecdotal observation of sudden cardiac death with serious psychosocial stressors in individual patients, there is mounting evidence that the presence or course of ischaemic heart disease may be associated with experience of negative life events.

One mechanism proposed involves alteration of cardiovascular risk factors (lipid profile, diet, exercise, smoking, control of hypertension, and excessive alcohol use). Changes in cardiovascular risk profile lead to a greater risk of ischaemic heart disease through known mechanisms of action.

Another mechanism links psychosocial stressors to major cardiac events through the presence of intense arousal at the time of the stressor with consequent sympathetic stimulation of the heart

producing coronary artery spasm or fatal arrhythmias (Esler, 1998; Tennant, 1996). This mechanism relates to acute responses, with only short time frame between exposure and outcome. Where the stressor and the cardiac event are separated in time there is a heightened need to consider the potential effect of confounding by recognised risk factors for ischaemic heart disease before relying on theories such as neurohumoral activation as a pathway between stress and ischaemic heart disease.

The introduction of newer technology that allows the in-vivo imaging of cardiac function has provided opportunities to test experimentally the relationship between stressor experience and ischaemic heart disease. A number of studies have shown that mental stress (either as mental arithmetic or the experience of negative psychological states) produces coronary artery spasm and myocardial infarction in individuals with pre-existing ischaemic heart disease (Esler, 1998; Tennant, 1996). Another mechanism that might be responsible for the development or exacerbation of ischaemic heart disease in individuals exposed to psychosocial stressors is that of alterations in coagulation factors. Some studies examining subjects with post acute myocardial infarction (AMI) compared with healthy controls show that platelet aggregation, formation of circulating platelet aggregates and circulating Thromboxane BII are increased in the AMI patients following experimental stress. Anti-Thromboxane III is observed to decline following mental stress in coronary artery disease patients and platelet ATP secretion and aggregation are noted to increase following mental stress in healthy men (Tennant, 1996).

Association between chronic work stress and ischaemic heart disease has been described (Karaseck, 1989; Peiper et al, 1989; Marmot et al, 1997). Job-related factors suggested to influence the induction or exacerbation of ischaemic heart disease include perceived job stress, role ambiguity, job autonomy, job change, unemployment, and retirement. However, results are conflicting and causality is controversial (Braunwald, 1992). The means by which chronic stress could cause or accelerate ischaemic heart disease have not been established (Petch, 1996), but suggested mechanisms suggested include an imbalance between sympathetic- and parasympathetic-mediated release of catecholamines, vasospasm and elevation in blood pressure (Sundin et al, 1995; Boyd, 1978). Modification of other recognised ischaemic heart disease risk factors may also contribute to or underpin observed associations (Niaura et al, 1992). The effect of high circulating levels of catecholamines (as result of work stress) on lipolysis in adipose tissue and hepatic synthesis of lipids, as well as neural vasoconstriction, which reduces clearing of blood lipids, are possibilities (Esler 1998). Less plausible hypotheses such as those implicating the stress of vehicle travel have also been explored (Robinson, 1989).

Tennant (1987) noted that *"Conclusions drawn from the research into psychosocial factors and coronary heart disease is limited by a number of problems. First, findings are often inconsistent. Second, interpretation of findings is often limited by methodological inadequacies, especially in retrospective studies. Third, in some areas the findings are sparse. And, finally, in many studies other factors, such as conventional risk factors have not been controlled. Although these factors may mediate stress and coronary heart disease, it is important to know whether stress acts independently of factors such as smoking."* Many of these limitations remain in the available literature a decade later.

Overall, when considering experimental stressors (brief, standardised, replicable, distressing and frustrating activities, for example mathematical manipulation, simulated public speaking) or studies encompassing the effects of natural disasters, life event stress and work stress, support for an association between experiencing acutely stressful events and acute coronary events was found. Negative emotions and certain personality traits may also contribute to negative outcomes in patients with established ischaemic heart disease. The role of stressful experiences long distant in time from the physical disease endpoint is much less clear and the available information is not yet at a level where causality may be inferred.

Psychiatric Disorder and Ischaemic Heart Disease

Panic disorder and phobic anxiety

The most consistent associations encountered in the epidemiological literature relate to the specific

conditions of phobic anxiety and panic disorder with fatal heart disease; while from studies of good quality, the associations are based on small absolute numbers of cases. Data analysed from several prospective cohorts and nested case-control studies have demonstrated such associations. Additionally, a number of other earlier studies have suggested an increased risk of ischaemic heart disease among patients with phobic anxiety or panic disorder (Haines et al, 1987; Coryell et al, 1986; Coryell et al, 1982; Weissman et al, 1990). However, these earlier studies were limited by their cross-sectional design, lack of adequate control for potential confounding variables, selection bias in the choice of clinic populations, or failure to distinguish between sudden and non-sudden coronary death.

The strongest support from prospective literature demonstrates association with fatal rather than non-fatal cardiac events. For example, Kawachi et al (1994) in the Health Professionals follow-up study found the age-adjusted relative risk of fatal coronary heart disease among men with highest levels of phobic anxiety (scoring 4 or higher on the Crown-Crisp index) was 3.01 (95%CI=1.31-6.90) compared with men with the lowest levels of anxiety (scoring 0 or 1 on the phobia index). Risk of fatal coronary heart disease increased with levels of phobic anxiety (P trend =0.002). When fatal coronary heart disease was further categorised into sudden and non-sudden coronary death, the excess risk was confined to sudden death (relative risk among men scoring 3 or higher on the phobia index was 6.08; 95%CI=2.35-15.73). No association was found between phobic anxiety and risk of non-fatal myocardial infarction.

The mechanism by which these disorders could cause adverse cardiac events is not known, but proposals to account for this association include excessive sympathetic outflow to the heart during the time of acute anxiety producing cardiac arrhythmia, or coronary artery spasm. In addition to these specific biological mechanisms, the association may be contributed to by poor compliance with medical treatment and poor health behaviors leading to increased cardiovascular risk factors such as excessive alcohol use, smoking, obesity and poor dietary habits.

Conference attendees Murray Esler and Chris

Studies reporting cardiovascular mortality or morbidity in the psychiatrically ill (Anxiety) (extended from Hayward 1995):

Psychiatric disorder and study	**Sample size and sex** m=male f=female	**Sample type** I=institution C=community	**Design** R=retrospective P=prospective	**Control known for CVD risk factors**	**Estimated relative risk**
Anxiety					
Coryell et al., 1982	42f 71m	I	R	No	2 females; 2 males*
Sims and Prior, 1982	1982m+f	I	R	No	1.7*
Martin et al., 1985	60m+f	I	R	No	-#
Coryell et al., 1986	155m+f	I	R	No	+‖ males only
Weissman et al., 1990	60m+f	C	Cross-sectional	No	OR = 4.5*
Allgulander and Lavori, 1991	685f 255m	I	R	No	1.0 females 1.2 males
Anxiety Scales					
Paffenbarger et al., 1966	41266m	C	P	No	1.6*
Thorne et al., 1968	7685m	C	P	No	-#
Medalie et al., 1973	10059m	C	P	No	2*
Thiel et al., 1973	50m	I	R	No	+*‖
Wardwell and Bahnson, 1973	114m	I	R	No	-#
Haines et al., 1987	1457m	C	P	Yes	3.77*
Kawachi et al., 1994	33999m	C	P	Yes	2.5*
Pratt et al , 1996	1551m+f	C	P	Yes	1.2 NS

* Significant at $p < 0.05$.

Negative finding with relative risk not determinable.

‖ Positive finding with relative risk not determinable.

Tennant considered the association between panic attack and cardiovascular endpoints at length and referred to three case histories described by Mansour et al (1998), and an accompanying editorial by Freeman and Tennant (1998). This data while not definitive, draws further attention to the potential of coronary artery spasm as a cause of chest pain in patients with severe anxiety.

It was considered that much of the literature demonstrated limitations in design and that good prospective literature included only a relatively small absolute number of exposed cases. It was felt that there was inadequate evidence to support any causal association between anxiety in general and ischaemic heart disease; however, panic disorder and phobic anxiety were considered as potentially causally associated with certain ischaemic heart disease end points, most particularly sudden cardiac death. These specific associations were supported by both epidemiological evidence and biologically plausible direct mechanisms of action.

Depressive disorder

It is well recognised that depressive disorder may be precipitated by a range of stressor experiences. Since depression is a common illness, it is important to know whether individuals suffering from depression are more likely to develop cardiovascular disease and what the mechanism might be. There is a growing body of literature which considers the association between clinical depression or scales of depression and morbidity and mortality from cardiovascular disease. There is consistent evidence of an association between depression and ischaemic heart disease from the findings of retrospective studies (Tennant, 1996). Most, but not all, prospective studies find that depression predicts significant cardiac events (arrhythmias, acute myocardial infarction, cardiac death) in patients with existing heart disease (Tennant, 1996). However, the role of confounding factors (smoking, alcohol use and other cardiovascular risk factors) need to be carefully evaluated.

While a number of hypotheses explaining the

Studies reporting cardiovascular mortality or morbidity in the psychiatrically ill (Depression) (Extended from Hayward 1995):

Psychiatric disorder and study	**Sample size/ sex**	**Sample type** I=institution C=community	**Design** R=retrospective P=prospective	**Control for some CV disease risk factors**	**Estimated relative risk**
Depression					
Dreyfuss et al, 1969	365f 150m	I	R	No	5.7m*
Baldwin, 1980	2314m+f	I	R	No	2.0*
Tsuang et al., 1980	225m+f	I	R	No	-#
Martin et al., 1985	139m+f	I	R	No	-#
Murphy et al., 1987	242m+f	C	P	No	= 1.5f* = 2.5m*
Pratt et al, 1996	1551m+f	C	P	Yes	2.07* MDE 4.54*
Depression scales					
Ostfeld et al., 1964	1990m	C	P	No	1
Brozek et al., 1966	258m	C	P	No	1
Thiel et al., 1973	50m+f	I	R	No	+‖
Goldberg et al., 1979	82m+f	C	P matched Case-control	No	-#
Vogt et al., 1994	1386f 1187 m	C	P	Yes	Hazard rate = 0.94
Anda et al, 1993	2832m+f	C	P	Yes	N-F1.6* fatal 1.5*
Barefoot and Schroll,1996	409m 321f	C	P	Yes	1.71*
Aromaa et al, 1994	5355m+f	C	P	Yes	3.36*
Ford et al, 1994	1198	C	P	Yes	1.59 NS

* Significant at $p < 0.05$.

\# Negative finding with relative risk not determinable.

‖ Positive finding with relative risk not determinable.

link between depressive illness and cardiovascular disease exist, evidence for a causal association needs to be tempered by the fact that many of the studies of this association are retrospective in design. There is considerable scope for confused interpretation when the possibility of disease causing depression or common causal or contributory factors are factored into the process. Several prospective studies (Ford et al, 1994; Pratt et al, 1996; Aromaa et al, 1994) each with certain strengths and weaknesses and all using methods to at least partially control for a range of potential confounding factors have demonstrated this association. However, other prospective research has proved negative (Vogt et al, 1994). The control of potential confounding factors (such as age, alcohol use, smoking and other cardiovascular risk factors) has not been consistently applied in the studies. Therefore, the possibility that associations are due to confounding or bias cannot be excluded. The possibility for residual confounding, the difficulty in considering a "dose" of depression, and the lack of a unified mechanism of action not through lifestyle or associated factors suggest that causality is as yet inadequately supported.

The conference participants considered that while the association was a possibility, the potential for confounding weakened the case for causality and this association should be the subject of further detailed and critical analysis as new literature becomes available.

Post traumatic stress disorder

While the subject of much conjecture, evidence relevant to whether PTSD is a cause of cardiovascular disease is very limited. A broad review of the literature was conducted by Friedman and Schnurr (1995). This review provided support for an association between PTSD and self-reported ill health, including cardiovascular symptoms. The report was based on a number of studies of veterans from the United States, New Zealand, Israel and Canada. In a follow-up article, Schnurr (1996) provided a critical review of the methodology of many of these studies. She noted that all of the data were correlational and most based on self-reports of physical health. In many studies control groups were not identified clearly, making comparisons with the veteran patient groups difficult. With respect to cardiovascular disease there are few reports that address this issue directly. The papers by Boscarino and Eisen described below were not available to the conference participants, they do however extend the available data on the issue.

Using CDC Vietnam Experience Study data, Boscarino (1997) has examined the medical histories of 1,399 male Vietnam veterans approximately 20 years after combat exposure. After controlling for pre-military, military and post-military factors as well as the standard cardiovascular risk factors, he found that veterans with PTSD had a higher frequency of circulatory diseases (not defined) than non-PTSD veterans. However, another study of Vietnam veterans using the Vietnam Era Twin Registry (1965–1975) did not find any association between PTSD and hypertension or other cardiovascular diseases (Eisen et al, 1998). The major contribution to the presence of conditions such as hypertension was genetic influences rather than PTSD or combat exposure. The only conditions that differed between the combat exposed twin and the other twin were skin problems and hearing impairment.

The use of self-report to identify cardiovascular illness raises the possibility of differential reporting. Individuals suffering from PTSD may report more physical symptoms but may not actually suffer from more cardiovascular disease when this is measured objectively. The findings of CDC VES (1989) and Boscarino (1997) suggest that some individuals with psychological symptoms have multiple somatic complaints including somatoform disorder and that these may or may not reflect underlying physical disease. This proposal needs to be tested or controlled for in studies examining the association between PTSD and cardiovascular disease.

There is a paucity of evidence supporting an association between PTSD and cardiovascular diseases. Only a few studies exist, most are retrospective, and few have taken into account confounding factors and the possibility of selection and other biases. A range of potential causal mechanisms have been suggested however these have not yet been adequately investigated. Therefore, at this stage the hypothesis that PTSD is causally associated with cardiovascular disease remains to be substantiated.

Conference Participants Summary

Possible pathways connecting stressor exposure and IHD were considered. These pathways included stressor exposure leading directly to IHD, exposure leading to behavior change and then to IHD and exposure leading to psychiatric illness and possible further links to IHD.

Evidence was considered to support exposure to severe stressors as an acute precipitant for sudden cardiac death and cardiac arrhythmias. Panic attack in panic disorder and possibly panic attack in other psychiatric disease was considered as potentially associated with certain ischaemic heart disease endpoints, most particularly sudden cardiac death.

Behavioural change was considered to be of relevance however it was considered that smoking and other behavioural risk factors were already addressed in the Statements of Principles.

Exposure to Stressors and Hypertension

One of the more controversial issues related to stress and cardiovascular disease is the question of whether essential hypertension is caused by exposure to stressors. Reviews by Don Byrne (1998), Malcolm West (1998) and Murray Esler (1998) provided a comprehensive coverage of the relevant literature for the conference participants.

For many in the community, the term linking 'hyper' and 'tension' implies that stress or tension causes, or at least contributes to, high blood pressure. Transient elevations in blood pressure are associated with anxiety and can be reliably produced by experimental stress situations. Therefore, there is a perception that exposure to an acute stressful event or events, and chronic stress can result in persistent elevation of blood pressure causing essential hypertension. One of the mechanisms hypothesised has been that repeated stressful stimuli, each producing a transient elevation in blood pressure, ultimately leads to persistent hypertension with pathological changes in the small arteries characteristic of essential hypertension (Byrne 1998; West 1998; Esler 1998).

Hypertension is widespread in the middle-aged populations of most Western urbanised countries and its central role as a risk factor for both cardiovascular and cerebrovascular disease is no longer in dispute. A large number of medical conditions may give rise to hypertension, however around 90% of all detected cases of hypertension are said to be primary, essential or idiopathic hypertension (Byrne, 1998).

Ambulatory studies have demonstrated that there is considerable variation of blood pressure during the course of the day. Blood pressure is influenced by a range of factors including age, sex, race, family history of hypertension, physical activity, other physical states such as pain or cold, and psychological experiences (Byrne, 1998). Known risk factors for essential hypertension include a positive family history, excess alcohol intake, obesity, physical inactivity and poor dietary habits.

The literature on stress and essential hypertension has focussed on cardiovascular reactivity of subjects to physical and psychological stressful stimuli in laboratory settings, neuroendocrine responses to stressful stimuli, effect of job-strain on blood pressure, life events, personality traits, coping styles, psychiatric disorders (eg chronic anxiety states, depression) and stress therapy in managing hypertension. Most studies have not adequately controlled for confounders such as family history and other life-style factors which may be associated with hypertension.

The literature has not been able to consistently identify any specific stressor that contributes independently to the development of hypertension (West, 1998). The evidence relating to psychiatric disorders is also inconsistent. Indeed, modest statistical associations between psychological factors and hypertension often disappear when control of confounding factors is undertaken (Byrne, 1998).

A comprehensive review of the evidence linking stressors with hypertension has been reported by Byrne (1998). This review analysed the evidence using the Branford Hill criteria for testing causal associations. While Byrne noted that the strength of any association between psychological factors and hypertension was modest and disappeared when confounding factors were taken into account, two epidemiological studies were highlighted. One study showed that the stress of migration was associated with the onset of blood pressure elevation in groups of immigrants (Paulter et al, 1990). The other, of nuns living in a sheltered and relatively isolated situation for most

of their lives, found that the nuns did not show the expected rise in blood pressure with age that was seen among comparable women in their local community (Timio et al, 1988). This latter study was interpreted to support the concept that a lack of stressors was protective of blood pressure elevations that might have otherwise been expected. Byrne also noted that there was substantial inconsistency in studies, some reporting an association and other studies making negative findings. There is little evidence of specificity of association in that no one type of stressor is associated with hypertension as distinct from other cardiovascular sequelae. While most putative stressors are experienced before the onset of hypertension and therefore satisfy the Bradford Hill criterion of temporality, the majority of studies examining psychological factors and hypertension have been retrospective in design and open to bias (Byrne, 1998; Esler, 1998 and West, 1998). No information was available assess a gradient of effect between dose of stressor exposure and the development or severity of hypertension.

Interestingly, studies of the cardiovascular system demonstrate that overactivity of the sympathetic nervous system is present in a proportion of patients with essential hypertension, particularly younger ones with hypertension in its earlier, developmental phase (Anderson et al, 1989; Esler et al, 1998). In addition to excessive cardiac stimulation, sympathetic activation during stress may also effect the kidneys and long term effects of this stimulation on renal function are suggested as a possible mechanism for blood pressure elevation (Koepke et al, 1988; DiBona et al, 1995). Exaggerated blood pressure responses to psychological stressors or physical stimuli can be demonstrated in some individuals (Falkner, 1996). This phenomena has been called blood pressure "reactivity" and was earlier thought to be a predictor of future hypertension. But, recent large scale studies do not support evidence of blood pressure reactivity in borderline hypertension or in normotensive family members of hypertensive patients (Julius et al, 1991).

Few experimental studies of stressors and hypertension have been undertaken, but studies of the effect of stress management on established hypertension have had quasi-experimental designs. The findings of these studies have not been consistent, some showing a positive effect of stress management on reducing hypertension whereas others have produced negative results (Byrne, 1998). Even if the results were consistent, this evidence is indirect in that reductions in blood pressure due to stress management techniques do not prove that stressor exposure produced hypertension in the first place. The effect of stress management techniques may be general (reduction in weight, improved physical fitness) rather than stress specific. Much of the work supporting an association between stressors and hypertension has been focussed on blood pressure reactivity as the primary dependent variable. From these studies analogy has been used to draw the inference that if psychological factors can produce changes in blood pressure reactivity then they may also produce hypertension. This analogy has been weakened considerably by recent evidence that blood pressure reactivity is not a feature of borderline hypertension, essential hypertension or in normotensive family members of hypertensive patients (Julius et al, 1991). Finally, with respect to hypertension, prospective data from a 50 year follow-up study of American men controlling for relevant confounding factors, failed to establish psychopathology (including stressor exposure) as a predictor of hypertension (Vaillant, 1998).

The three reviews of the link between stressors and hypertension (Byrne, 1998; Esler, 1998; West, 1998) all concluded that the body of evidence regarding associations between hypertension and exposure to stressors is not strong enough to currently support a causal relationship. A crucial finding that would support an association between stressor exposure (including war service) and subsequent hypertension would be presence of early and persistent raised blood pressure following the stressor which continued to increase over time since exposure. This early and persistent rise in blood pressure has not been observed.

Psychiatric Disorder and Hypertension

The reviews presented highlighted the considerable literature concerning this subject. Byrne (1998) provides an overview of the data and their underlying theoretical concepts. Psychiatric ill-

ness is typically accompanied by altered states of autonomic arousal (Rosenhan & Seligman, 1995), and it has been theorised that hypertension may occur as a result of such chronically elevated autonomic arousal. Some research supports an association between hypertension and psychiatric illness, however the direction of the association is not always clear. It has been suggested that psychiatric dysfunction increases as a direct psychological response to the diagnosis of hypertension (Campbell, Bass, Chockalingam, LeBel and Milkovich, 1995; Gurgenian, Pogosova, Vartanian, Vatinian and Nikogosian, 1995). Additionally, other conditions such as phaeochromocytoma have been seen in some cases to underlie both psychiatric symptoms and hypertension (Lambert, 1992; Mann, 1996). Importantly, prospective evidence over a fifty year follow-up has failed to establish psychopathology at outset as an objective predictor of hypertension at some later time (Vaillant and Gerber, 1996).

While theoretically attractive, the association between psychiatric illness and hypertension is by no means clear. Variable exposure measures and the potential for bias and confounding need consideration. Positive evidence must be balanced against evidence which indicates either a null or negative association between anxiety or depression.

Anxiety and hypertension

There is a common perception that anxiety plays a role in the causation of hypertension, and there is some historical support for this view (Byrne, 1992). Byrne details that *"in the more recent literature, hypertension has been associated with both generalised anxiety (Somova, Connolly and Diara, 1995) and panic disorder (Noyes, Woodman, Garvey, Cook, Suelzer, Clancy and Anderson, 1992), and high levels of state anxiety have been shown to predict later incidence of hypertension in individuals normotensive at intake (Jonas, Franks and Ingram, 1997), though one study has restricted this prediction to middle-aged men and not women (Markovitz, Matthews, Kannel, Cobb and D'Agostino, 1993).*

The broadly postulated association between anxiety and hypertension has not, however, been universally supported. In other studies, hypertension has been found to be unrelated to symptoms of anxiety (Jones-Webb, Jacobs, Flack and Liu, 1996), generalised anxiety disorder (Fark, 1993), subjective ratings of anxiety during a painful medical procedure (France, Adler, France and Ditto, 1994), or psychometrically derived assessments of state anxiety (Jamner, Shapiro, Hui, Oakley and Lovett, 1993). In this regard, the more cautious interpretation of the balance of evidence is that anxiety may be associated with transiently elevated blood pressure, and may be co-morbid with, but not necessarily causal or predictive of hypertension".

Overall the evidence linking anxiety with hypertension does not appear consistent, and potential confounders need adequate consideration where association has been described.

Depression and hypertension

Depression too, has been considered as a possible factor in the causation of hypertension. Again, there is some historical support for this view (Byrne, 1992). Byrne reports that the *"risk of hypertension in adolescents has been associated with trait depression as evident from responses to psychometric scales of trait affect (Ewart and Kolodner, 1994) and hypertensive subjects with a positive family history of hypertension report higher levels of depressive symptoms than either those without a family history of hypertension or those who are normotensive (Thyrum, Blumenthal, Madden and Siegel, 1995)."*

Overall the evidence linking depression with hypertension does not appear consistent, and potential confounders need adequate consideration where association has been described. Byrne suggests that *"as with anxiety, a cautious approach to its interpretation is strongly recommended."*

Conference Participants Summary

The conference participants considered that the whole issue of stressor experience, psychiatric illness and hypertension was extremely complex. They commented on the paucity of good prospective studies and that causality could not be inferred from the available data. It was agreed it would not be plausible to suggest that stressor exposure per se would cause prolonged hypertension if normotension was present for some time between the stressor exposure and development of hypertension. While theoretically plausible and attractive more research was needed to determine

if stressor exposure could cause persistently elevated BP which then lead to established hypertension. The participants commented on the lack of controlled data to confirm or refute any relationship between PTSD and hypertension.

Research

In a number of areas the conference participants considered that only poor or limited data was available. Research on military and ex-service populations was felt to be of great import and that several specific areas could be addressed in such populations. Methodology, ethics and competing priorities for the Defence forces were issues canvassed by the participants.

Two areas of particular interest that could be dealt with by considering military populations are:

- Does PTSD increase the risk of developing hypertension in the short and long term? If an increase in the prevalence of hypertension is observed how is this association mediated?
- Does PTSD represent the aetiological path between a stressor and the onset of psychiatric disorder or a significantly increased risk of developing a range of psychiatric disorders?

Summary of Conference Outcomes

- The definition for severe stressor applicable to military service was developed.
- A process of the assessment for potential causal associations between stressor experiences and psychiatric and cardiovascular disorders utilising standard epidemiological practices was agreed.
- Consensus was reached on a number of psychiatric illnesses and cardiovascular diseases where associations between exposure to specified stressors and the illness was agreed to be causally related:

  Psychiatric illnesses that may be associated with exposure to stressors include: post traumatic stress disorder, acute stress disorder, panic disorder, major depressive disorder, dysthymic disorder and alcohol dependence.

  Cardiovascular diseases that may be associated with acute exposure to stressors are sudden cardiac death and cardiac arrhythmias. The body of evidence regarding the association between hypertension and exposure to stressors was not considered indicative of a causal association.

  Panic disorder was considered as potentially associated with certain ischaemic heart disease endpoints, most particularly sudden cardiac death.

- A number of other associations were considered, however high levels of comorbidity and the potential for confounding weakened the case for causality and necessitated further detailed and critical analysis. Post traumatic stress disorder was considered of particular interest by the participants, however the limited published data available and the frequent comorbidity with substance use and other disorders precluded the attribution of any specific causal associations between PTSD and cardiovascular outcomes.
- The participants reached a consensus that a number of direct and indirect pathways may link acute stressors with certain psychiatric and cardiovascular outcomes. Overall, however, it was clear that the psychoneuroendocrine responses associated with stressors are complex and are subject to considerable intra and interindividual variability and are not fully elucidated at this time.

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PART ONE

Is there an association between exposure to stressors and psychiatric illness, cardiovascular disease and other diseases?

Perspectives on Stress and Resilience

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"Pull yourself together or you'll die!" I thought.

I had collapsed to the dirt, rolling about, shocked by the pain in my right leg. The sound of the mine exploding had surprised me. It was a sharp clap like a nearby car back fire. It was totally unexpected even though I had knowingly jumped into a mine field to assist the wounded survivors of an earlier explosion, and had, only a short while previously, observed a sapper dig up and defuse a mine.

Both denial and suppression were at work, for I was aware of the danger and risk. I had been very careful to place my feet in another's foot prints and to keep within the marked-off cleared area which was free of mines. I was already operating under stress, but then I became a direct victim of an incident. After the initial shock and mental confusion my thoughts settled into a coping pattern. I began trying to apply first aid to myself.

I had often mentally rehearsed my approach to treating penetrating injuries. It had never occurred to me that I would be the patient. This state of mind is of course why the young are sent off to war. They are reckless, and mortality and morbidity seldom seem immediate for them.

Someone came to my aid and assisted me to apply a field dressing to my leg — I had a compound fracture of the right tibia. I also had wounds elsewhere, including my face and my vision was obscured by redness which I thought was just blood. My attention was focussed on my leg, probably because of the pain coupled with the memory of a young boy I had only just recently seen, who had bled to death from a single bullet wound through his femoral artery. I was fearful of dying, but at the same time I was reassured by the assistance I received.

In the US Army hospital there was more stress as I thought I would undergo a craniotomy. I did not think it was necessary because I was thinking so lucidly. Fortunately X-Rays did not reveal that any fragments had penetrated my skull and I was spared a craniotomy. My eyes were covered with bandages when I awoke from the anaesthetic and I just waited. One eye had been removed, and the surgeon was trying to be reassuring. When the bandage came off and I could not even perceive light, I knew that I was blind, but I did not bother to argue with attempts to reassure me that I still had one eye. I was preoccupied with having my pain and other discomfort relieved and for a short time was delirious due to steroids. Two weeks later, after I had been flown back to Australia, my remaining eye was removed.

A consultant psychiatrist, with whom I had become acquainted, told me of another doctor who lost his sight and trained as a psychiatrist. He said to keep this in mind, as I had previously discussed training options in psychiatry with him. This brief communication gave me hope, for it allowed me to preserve an ambition. Of course at the time I had no idea how I might achieve such an ambition, nor what it was going to require.

I was aware that most people did not speak about my blindness, but implied that they would need to wait until I arrived back in Australia. In a sense this did not matter, I came to realize how much doctors in particular need reassurance from their patients.

With not much experience in psychiatry, but an interest acquired long before my loss of sight, I focussed my attention on recovery and adaptation. My approach was practical, and the first thing I asked for was a Braille watch which was quickly supplied by the Red Cross. This in itself was a revelation to me, for I had never seen one before. I had a lot of time to reflect, and it soon became very clear that while much sympathy was forthcoming from many quarters, it was going to be up to me to cope by my own efforts. An old soldier who had been blinded in the First World War, visited me and told me I must prepare for a life with time on my hands. I was presented with a solitaire set to help me while away the hours.

I was not then aware of PTSD, the term had not been invented, but I knew a little about grief and grief work. I had been involved with a platoon of New Zealanders whose section commander had been killed. The whole group went into mourning and the group became dysfunctional as soldiers. They were mostly Maoris who were warriors, and in talking to them about their feelings, I learnt much. My view at the time was rather simplistic, regarding suppressed or unresolved anger and feelings of loss as the major sticking points in dealing with loss. I talked to my wife and tried to explain that she would become angry, as well as depressed, about what had occurred and what I

had done, and urged her to be open about her feelings. Of course this is much more easily said than done. Counselling was not routinely offered in those days and I am not sure that either of us would have availed ourselves of it had it been offered. Pride protected us, but also at times probably disadvantaged us.

An infant welfare nurse told my wife that having a baby and a blind husband on top of having recently experienced the death of her own mother was "too much to bear ... your milk will dry up!".

No doubt this was an indication of sympathy and an attempt at empathy, but the effect was to make Janice feel that the nurse did not really understand and that she was not going to be of much help. This seemed to add insult to injury. Not only did we feel abandoned to fend for ourselves and therefore frightened, but we felt angry. Perhaps the anger turned to defiance and made us more determined to succeed. This has made me aware that what is actually required under such circumstances are helpful acts or advice within a context of sympathy and understanding, rather than statements which simply reflect shock and horror. A common reaction to being confronted with horrifying circumstances is to run away, and this is what a number of people either said or implied that Janice should do. Such a view point was not entirely negative, for in the context of other advice and her own feelings, it provided a sense of choice of whether to stay and work together or to separate.

What spurred me on was the drive to adapt and learn ways of overcoming or diminishing the problem of being blind. The rewards for me were two fold, i.e. learning about techniques such as Braille and discovering what I could and could not do. While I learnt new techniques and information, I worked through my losses with my wife and friends. The most painful losses were loss of functions which required vision. There are some things one cannot do at all, and there are other things which can be done, but the time involved and the complicated means of doing them, makes the action unworthwhile. However there is no real way of substituting for the loss of sight as a means of aesthetic appraisal. Thus I gave up and adjusted to my losses, and at other times I put my mind to solving problems.

At that time not being able to see my wife and baby daughter distressed me most sharply. Later I found that my wife's distress caused by the knowledge that I could not actually see her and our children upset me more than my own loss of vision. Vision is more of a reciprocal sense than one imagines. There is seeing and being seen. I have learnt to live with loss of my own sight, but not so well the loss suffered by my family. A particularly distressing episode was when my toddler aged son was described to me walking about the house with his eyes shut. He was obviously trying to discover what it was like for me. Later he taught himself to visually read Braille.

Being unable to actually see pictures and the bush distressed me at times and I felt an overwhelming sadness. I recall keeping my eyes shut when I awoke and then opening them suddenly as though I might catch the light before it darted away.

Most of these experiences were transient and I did not suffer from prolonged periods of sadness. Fear and a pervasive anxiety were my most abiding feelings. I felt anxious about how I was going to do things. Even eating food became an ordeal. Not knowing what was on my plate or where it was, nor how large the pieces, created enormous frustrations, and I often felt like resorting to scrabbling with my fingers. Occasionally I did so, driven by hunger and frustration.

I feared failure. I was conscious of sweating and trembling with the tension. Frustration led to anger and rage and I have had to take a break and calm myself. The only thought which kept me going at times was the view that I could get better and more skilled.

My main attention was focussed on rehabilitation/retraining strategies. People waited for me to crash. Many told my wife that my state of emotional stability would not last and there would inevitably be a delayed reaction. On the other hand, there were times when I was astonished at the level of acceptance of my ambitions without question. People at the university said, "How can I help?" In a sense I was astonished at my own audacity at simply believing I could proceed with post graduate studies. This was particularly so as I struggled to make notes of tape recorded lectures and other information.

After talking with various people, I had made a

decision not to invest a lot of time in trying to become fluent in Braille, as it was clear that everything would need to be translated one way or another, and material can be read onto tape at nearly twice the speed of the quickest Braille reader. Braille itself is a simple code, but the acquisition of fluency in reading is difficult and requires much practice. Like my piano playing as a child, I did not persist enough to become a fluent Braille reader, I made a deliberate decision not to invest the time needed to practice this art. Instead, I tried to develop my touch typing skills and to learn to "read" by listening.

Mastering the layout of a type-writer key-board was the easy part. Typing notes was a nerve wracking process, for I never knew if what I thought I was typing was registering on the page. There were many occasions when I discovered that there was no type. The reasons were several, including a worn out or jammed ribbon, or the setting being accidentally moved to stencil. Synthetic speech and computers provide me with feed back of what I have written, and the work is much less stressful.

I discovered that it is possible to speed up a tape recording and train oneself to listen and comprehend the information at up to twice the speed at which it has been read in the first instance. Of course not all speech can be comprehended at such speeds, but for me, taped texts were immediately more accessible and faster than Braille. I have used Braille to make brief notes to myself and to label things.

There was much that I took for granted, particularly the emotional support from my wife, family and friends at an intimate level, and from the medical and hospital community in a wider sense. It was clear that most people wanted to help me and felt sympathetic towards me. I became aware that these relationships are very interactive. At times I was acutely conscious of having a role to play in comforting my carers, a term not in vogue at that time. Many people were afraid and found it difficult and even impossible to approach and speak to me. I realized that it was up to me to make it easier for them, and to learn how to be precise when seeking help, and not just to signal my need by exaggerating my helplessness. I became especially aware of the burden felt by a surgeon who has to remove eyes no matter how damaged. This knowledge has made me aware how much patients try to protect doctors and nurses from the burden of their suffering. This need for constraint and understanding has been an additional source of frustration at times, which I had not previously considered.

Knowing this is all very well, but my impatience has often got the better of me. I have become irritated with my helpers and yearn to be able to see in order to show what I want done. My irritation finds expression in sharp and sarcastic comments, then I feel guilty and ashamed. Simple things like asking directions in an unfamiliar building, or looking up a reference in a book, can thus become situations of such distress that larger matters seem insurmountable by comparison. The only thing to do is to take a deep breath, apologise for being rude, and vow to stay cool and patient and return to the problem with a new resolve. Sometimes I just quit and think it will never work. I recall my grand mother's cautionary words — "Don't say 'damn it!', say 'darn it!' ... patience is seldom found in women, and never in men."

Looking back on those early months following my injuries, the important factors in my recovery were both external and internal. I was provided with quick, effective and skilled treatment, which stabilized my physical condition and minimized further damage. This in itself was comforting and supportive emotionally in addition to the support and encouragement from many other quarters which gave me hope to work towards the goal of recovery and a new career.

Prior to my injuries I had been physically fit and healthy. I was also well fitted emotionally. People generally liked me, which was something I had never really thought about until more recently. Those who work in clinical medicine will all have some experiences of "the unattractive patient". These people are most unfortunate because there is usually something about their personality which means they are overlooked or not given adequate attention. They are often actively rejected. That aspect of my personality had been shaped for me, and I can claim no credit for it, but it has been very important, because as I said before, I have found that most people want to help me in whatever way they can. I think it was Winston Churchill who said that the first act in war

should be to secure the assistance of your allies, and I have certainly found this to be true.

Because vision is so important in obtaining feed back, it is not easy to be sure where, and who one's allies are. Once I was walking my guide dog on a grassy verge to allow him to urinate. A man drove up on a motor bike and asked did I need any help. I politely said "No thank you."

He repeated his question and I gave the same reply. When he persisted and asked the question a third time, I snarled at him, "Why don't you piss off and leave me in peace!" He replied, "I'm a policeman." and with that he kicked his motor bike into life and roared off.

Another way in which I was fortunate was that I was a rare case and in many respects, the "system" in general, did not have a set plan for how to deal with me, and in a more particular sense, individuals were often at a loss about what directions and advice to offer me. I found that most people were very receptive to just about any reasonable suggestion I made in reference to my rehabilitation. Perhaps I was more insistent than I imagine, and people did not know how to refuse. However, the result was that I was able to set my own pace and choose my own course and direction in rehabilitation without the persuasive pressure of experts telling me I should hold back until I had undergone a formal assessment to see if I was "ready" to shift to the next stage.

An occupational therapist came to my bedside and asked if there was anything I needed. I told her she could teach me to type. She obtained an old, heavy office manual type writer and using a training manual as a guide, taught me the layout of the typewriter and I was on my way.

There were times when I became engrossed in problem solving puzzles that a sighted person does not face. For example I have gone for a walk late at night with my guide dog and become lost. The streets were deserted and there was no sun to give me a directional clue. I kept walking until a familiar sound pattern provided me with a marker. Sound patterns are not always as individually distinctive as visual cues, so I would need to cross reference. Being lost under such circumstances can only be described as terrifying. I would become saturated with a cold sweat. The worst aspect is to cross an unfamiliar road and find it is much wider than I had imagined. There can be only one thing to do, and that is to trust my guide dog. When using a cane, I am entirely on my own. Having solved such a navigational problem I felt not only a sense of relief, but a sense of pride and achievement at having solved the problem on my own. Then I thought what a trivial skill this is in the overall perspective of life. Such situations often left me feeling dejected with the realisation of how much more useful work I could have achieved with the same effort involved, if I had retained my eye sight.

This has been my own particular perspective on some factors which I have felt have been important in my own survival and adaptation. Putting aside for the moment the circumstances which placed me in the predicament, I was fortunate that in the first instance skilled, practical assistance was immediately provided. This was emotionally reassuring as well as being life saving. I was also provided with hope; general, because my medical attendants were experienced and had optimistic expectations about recovery, and specific, because people were prepared to entertain and encourage my personal ambition.

Emotional support or comfort by way of sympathy and offers of help and encouragement continued to be provided, but I think most important was that I was allowed and permitted to shape my own destiny. In other words, I was able to maintain a considerable degree of personal control. This issue is dynamic, for I have always tended to be the sort of person who accepts responsibility for my own actions, and I think it would have been more difficult for me if I had been given less autonomy.

Both my wife and I were fortunate in that we were able to give each other emotional support and to focus attention outside our relationship on overcoming practical difficulties. We did not feel we needed to seek much support of an emotional nature outside ourselves and our small circle of family and friends.

We tended to keep our conflicts to ourselves, and sought to work them out between us. We were not always supportive, and have been quite cruel to each other at times. It has not always been clear to me how much my lack of vision, impaired hearing, and my painful limp have been so distressing to my wife and family. Pain and other discomforts tend to turn one's attention inwards,

and thus alienate the people most inclined to be of help and support. The situation is often very ambiguous. We get angry with each other out of frustration: me because I cannot see and do, she because she cannot be seen.

Although much of the literature seems to focus on psycho-social issues in relationship to responding to stress, I feel that material security has been very important. It was a relief not to have to be overly concerned about finances. There was a reasonably effective compensation system in place. We did not have to be concerned about briefing lawyers etc.

Blindness has been a series of puzzles and problems requiring solutions as well as new skills and techniques to be learnt. I have embraced this as a way of making blindness interesting. Being unable to attend to the visual, I must attend to what I can hear, and to other sensory cues. People have a great desire to be listened to, and in this way, I have been able to turn my disability to advantage. This does not outweigh the disadvantages, but it helps.

In addition, I have found some personal revelations and insights from being blind. It has forced me to be more methodical and better organized in defining what is relevant or not. Just about everything takes longer when one is blind. I try to be less critical of others, and I have become more appreciative of the predicament and feelings of those in our society who are disempowered and not given a fair go, by virtue of prejudice about gender, race, physical and health status.

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Do War Zone Stressors Predict the Development of Psychiatric Disorders?

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Introduction

Questions regarding the long-term psychological effects of combat duty are frequently raised following military deployments. Typically, the most salient issues involve compensation for those unable to support themselves and their dependents due to physical or psychological injuries. For physical injuries, the damage and disability are more readily reconciled due to the more visible nature of the evidence. Psychological injuries are, by nature, more difficult to observe and require different processes and procedures in order to document their presence and the level of disability associated with them.

In the past, debates about the long-term psychological effects of combat asserted that pre-combat personality factors and experiences determined outcome. Another perspective emphasized the position that the effects were short lived or "evaporated," given a period of quiescence following exposure. In the absence of a comprehensive study of the psychological effects of war, different opinions proved difficult to reconcile, debates continued, and in many countries, including the United States, war veterans received neither adequate services nor appropriate levels of compensation.

In 1984, the United States Congress mandated a study of the psychological effects of the Vietnam War on citizens who served there. This study, referred to as the National Vietnam Veterans Readjustment Study (NVVRS; Kulka et al. 1988), sought to understand how pre-military, military, and post-military experiences predicted measures of psychological adjustment and functioning. Completed in 1988, this study provided estimates of posttraumatic stress disorder (PTSD) among Vietnam theater veterans, Vietnam era veterans, and a group of civilians. The strikingly high findings of 30% lifetime PTSD and 15% current PTSD among theater veterans measured some twenty years after the war led to the development of new programs and the strengthening of existing programs assigned the responsibility of caring for the psychological problems of war veterans.

Subsequent analyses of these data with structural equation modeling indicated that pre-military factors and post-military conditions often influenced who developed PTSD and who didn't, but the primary contributing factors consisted of experiences in the war zone (King, King, Foy & Gudanowski, 1996; King et al., in press; King et al., under review). These experiences included factors such as traditional combat exposure, atrocity exposure, perception of life threat and the malevolent environment to which combatants are exposed.

However, PTSD is not the only psychological outcome associated with experiencing traumatic life events. War, natural disasters, transportation accidents, terrorist attacks, technological disasters and sexual assault all lead to the development of PTSD, but also lead to measurable rates of phobic reactions, depression, generalized anxiety disorders, substance abuse disorders, and, under the most severe stress, psychotic conditions (Breslau, Davis, Andreski, & Peterson, 1991; Kessler, Sonnega, Bromet, Hughes, & Nelson 1995). Yet few studies have actually focused upon these conditions as outcomes of exposure to traumatic events.

An important exception to this is a report from the NVVRS by Jordan et al. (1991). These researchers found that those men most highly exposed to combat reported elevated rates of current depression, panic, obsessive-compulsive disorder, generalized anxiety disorder, alcohol abuse and antisocial personality disorder when compared to those exposed to low/moderate levels of combat. Current drug abuse and mania did not distinguish between these two groups of subjects. They also observed differences between the high versus low/moderate exposed veterans for lifetime measures of depression, dysthymia, obsessive-compulsive disorder, generalized anxiety disorder, alcohol abuse and antisocial personality disorder. Measures of mania, panic disorder, or drug abuse did not reach statistical significance using a between-subjects analysis.

For women veterans, measures of current depression and panic separated high versus low/moderate exposed subject while measures of lifetime depression, dysthymia, and panic disorder distinguished the two groups. Measures of mania, obsessive compulsive disorder, generalized anxiety disorder, alcohol abuse, drug abuse, and antisocial personality disorder failed to differ significantly between the two groups.

The purpose of the present paper was to more

closely examine the relationships among the four war-zone stressors (i.e. traditional combat, atrocities, perceived life threat, and malevolent environment) that we have empirically established in prior analyses and psychiatric outcomes. In addition, the Jordan et al. (1991) study recognized the problem of multiple comorbidities associated with PTSD (cf., Keane & Kaloupek, 1997), but did not take this into account in their data analytic plan. We were concerned about the potential for overlap in their findings (e.g. PTSD and depression occurring in the same person) and the implications this would have for clear interpretations of the relationship between war-zone stressors and psychiatric outcomes other than PTSD. Accordingly, we created one variable for the presence of any disorder including PTSD and a second variable for the presence of any disorder excluding PTSD; we did this for current disorders as well as lifetime disorders, thus creating an additional four variables.

On the basis of previous analyses of the NVVRS, we expected differences in the prediction of disorders for men and women. We therefore included gender and its interaction with war-zone stressors in the prediction equations. Moreover, the analyses were conducted with all four stressors entered concomitantly and then each individually, giving us the opportunity to examine the psychiatric effects of each of these stressors both independently and in concert with one another.

Methods

Data Source

Data for the current study were taken from the National Vietnam Veterans Readjustment Study (NVVRS; Kulka et al., 1990a, 1990b), a U. S. Congressionally-mandated investigation of the adjustment and well-being of those who served in the Vietnam War, as compared to their contemporaries who served in the military but not in the war zone or who did not serve at all. Data were gathered over a 3-year period in the mid-1980s. The first reports of findings were released in the early 1990s, and other studies using the database continue to appear in the professional and scientific literature.

The subsample used for the analyses reported in this document consisted of 1,632 Vietnam veterans who served in the Southeast Asia theater of war operations for one or more tours of duty between August 1964 and May 1975. The subsample was comprised of 1,200 (74%) men and 432 (26%) women. Women (primarily registered nurses), African Americans, Hispanic Americans, and individuals with service-connected disabilities were oversampled. Response rates were 83% overall, 86% for women, and 82% for men. Veterans were individually administered an interview of approximately 5 hours duration; topics included retrospective accounts of family background and prewar functioning, experiences in both the military in general and the war zone in particular, and postwar events and adjustment to civilian life. Emphasis was placed on the assessment of current mental health, particularly PTSD, but other conditions were evaluated as well. More specific information about the sampling methodology and characteristics of the sample can be found in two volumes (Kulka et al., 1990a, 1990b) and in several published articles (e.g., Jordan et al., 1991; Kulka et al., 1991; Schlenger et al., 1992; Weiss et al., 1992).

Variables and Their Measurement

Predictors: War Zone Stressors

Four indexes of war zone stressor events and circumstances were developed from a collection of over 100 inquiries from the "Vietnam Experiences" portion of the NVVRS interview protocol. Full details on the conceptualization and development of these stressor measures are provided in the published article by King, King, Gudanowski, and Vreven (1995).

Exposure to Traditional Combat was defined as the extent to which the veteran reported events or circumstances in Vietnam that would be considered observable, stereotypical warfare experiences. For example, items referred to receiving enemy fire, seeing injured or dead Americans, going on special missions or patrols, and firing weapons. The 36-item traditional combat scale had an internal consistency reliability coefficient (alpha) of 0.94.

Exposure to Atrocities or Episodes of Extraordinarily Abusive Violence was defined in terms of reports of observable events or circum-

stances that might be considered extremely deviant or beyond "normal" war zone experiences. These items assessed the veteran's exposure to or involvement in the terrorizing, wounding, or killing of noncombatants, mutilation of bodies, and similar situations. The coefficient alpha for the 9-item atrocities-abusive violence scale was 0.89.

Subjective or Perceived Threat was defined in terms of individual appraisals or assessments as to whether war-zone events or circumstances were frightening, perilous, or potentially harmful to personal safety. Examples in this stressor category included judgments of fear and degree of danger. The 9-item perceived threat scale had a coefficient alpha of 0.84.

General Milieu of a Harsh or Malevolent Environment was defined in terms of the extent to which the veteran rated daily war zone living conditions as particularly bothersome, annoying, or uncomfortable. As examples, a number of these items asked how unpleasant the veteran perceived various day-to-day Vietnam situations, such as the lack of privacy, inadequate food, bad climate, and the insects, disease and filth. The coefficient alpha for the 18-item malevolent environment scale was 0.91.

Outcome: Psychiatric Diagnoses

Ten psychiatric diagnoses were examined in this study, nine of which were assessed by the Diagnostic Interview Schedule; PTSD was assessed by the Mississippi Scale.

Diagnostic Interview Schedule. The Diagnostic Interview Schedule (Robins, Helzer, Croughan, & Ratcliff, 1980) is a structured survey intended to be administered by trained personnel, though not necessarily clinical experts. It was developed as a part of the U. S. National Institute of Mental Health's Epidemiological Catchment Area Survey (Regier et al., 1984) and provides diagnoses (present/absent) for a broad range of psychiatric conditions. For the present analyses, we employed both current and lifetime diagnoses, using the NVVRS's scoring algorithm: Current signifies that the condition has been diagnosed in the past and at least one symptom was present within the last six months, and lifetime simply signifies that the condition has met diagnostic criteria at some point. We focused on nine DSM-III-R (American Psychiatric Association, 1987) diagnoses: alcohol abuse/dependence, drug abuse/dependence, major depressive episode, generalized anxiety disorder, antisocial personality disorder, manic episode, panic disorder, obsessive compulsive disorder and dysthymic disorder. For all but dysthymic disorder, we used both the current and lifetime diagnoses; for dysthymic disorder, only a lifetime diagnosis was available.

Mississippi Scale. The Mississippi Scale for Combat-Related PTSD (Keane, Caddell, & Taylor, 1988) is a 35-item self-report instrument that employs a 5-item Likert response format. Items assess the reexperiencing, avoidance and numbing, and hyperarousal criteria for PTSD, along with the associated features of substance abuse, depression, and suicidality. The Mississippi Scale has an established record for reliable and valid PTSD assessment (see the psychometric studies by Hyer, Davis, Boudewyns, & Woods, 1991; Keane et al. 1988; King, King, Fairbank, Schlenger, & Surface, 1993; McFall, Smith, MacKay, & Tarver, 1990; McFall, Smith, Roszell, Tarver, & Malas, 1990). It proved to have the highest sensitivity and specificity among several candidate screening devices in a preliminary validation investigation for the NVVRS and then served as the primary measure of PTSD in the national survey (Kulka et al., 1990a, 1990b). Coefficient alpha for the Mississippi Scale was 0.94 with the sample used in these analyses. Consistent with the recommendations of the NVVRS researchers, a score of 94 or above was deemed indicative of a positive diagnosis of PTSD. The time reference for the item statements in the Mississippi Scale do not allow a clear demarcation as to whether the diagnosis should be classified as current or lifetime.

Overview of Analyses

Our initial data analysis task was to compute for each study participant several dichotomous variables representing the presence or absence of any psychiatric condition. There were four such variables, two reflecting one or more current diagnoses and two reflecting one or more lifetime diagnoses. Within each of these categories, one variable included PTSD and the other variable did not include PTSD. Thus, the four additional dichotomous outcomes were (a) presence or ab-

sence of any current disorder, including a diagnosis of PTSD; (b) presence or absence of any lifetime disorder, including PTSD; (c) presence or absence of any current disorder, other than PTSD; and (d) presence or absence of any lifetime disorder, other than PTSD.

Descriptive statistics were then derived for the sample as a whole and then separately for each gender. These included means and standard deviations for the four war zone stressors (traditional combat, atrocities-abusive violence, perceived threat, and malevolent environment) and frequencies and percentages for each of the 22 psychiatric outcomes (8 current and 9 lifetime diagnoses from the Diagnostic Interview Schedule, the Mississippi Scale diagnosis for PTSD, and the 4 created combination variables indexing any disorder).

Next, we employed logistic regression to ascertain the influence of the war zone stressors on each psychiatric outcome, while also considering the possibilities that gender had an effect on outcomes and that relationships between stressors and outcomes might differ as a function of gender. For each of the psychiatric outcomes, five hierarchical logistic regression analyses were performed. In the first analysis, the dichotomous psychiatric outcome was regressed simultaneously on the four war zone stressors (Step 1); gender (women coded 1 and men coded 0) was then added to the equation (Step 2); and the set of four war zone stressor-gender interaction (product) terms was entered (Step 3). This analysis allowed for the evaluation of the unique contribution of each war zone stressor (and its interaction with gender) to the outcome, in the presence of the other stressors (and their interactions with gender). When evaluating the significance of the interactions, we adopted Cohen and Cohen's (1983) protected t procedure to guard against Type 1 error. That is, significant individual interactions were examined only after determining that the full set of four interaction terms achieved significance.

In the second hierarchical logistic regression analysis for each psychiatric outcome, the dichotomous outcome was regressed on traditional combat (Step 1), gender (Step 2), and the traditional combat-gender product term (Step 3). The third, fourth, and fifth logistic regression analyses involved procedures that paralleled this analysis for traditional combat, for the war zone stressors of atrocities-abusive violence, then perceived threat, and finally malevolent environment. Each of these logistic regression analyses was intended to document the effect of a war zone stressor (and its interaction with gender) without regard to any collinearity or relationships between that stressor and the other stressors.

Results

Table 1 presents the means and standard deviations for the four war zone stressors. Because the collection of war zone stressor items had varying numbers of response options (some dichotomous and others 3-, 4-, and 5-point polytomous), all items were converted to a standard metric, z-scores, each having a mean of 0 and a standard deviation of 1. Then, scale scores were computed as the sum across the several sets of item z-scores. Hence, scale means approximated 0; because of missing data, when a summative score across items was computed for all respondents, a scale mean of exactly 0 did not obtain for the measure. As shown in Table 1, female veterans' scores on each of the war zone stressors averaged consistently below those of male veterans.

Table 2 provides frequency data for all of the psychiatric outcomes. For the full sample, the

Table 1. Means and Standard Deviations of the War Zone Stressors

Variable	Full Sample			Men			Women		
	M	SD	n	M	SD	n	M	SD	n
Traditional Combat	0.08	20.33	1619	1.09	22.25	1187	-2.70	13.41	432
Atrocities – Abusive Violence	0.02	6.43	1612	0.27	6.78	1180	-0.65	5.32	432
Perceived Threat	0.01	6.05	1621	0.15	6.23	1189	-0.38	5.52	432
Malevolent Environment	0.00	11.18	1621	0.28	11.50	1190	-0.77	10.21	431

Table 2. Frequencies for Psychiatric Outcomes

Variable	Full Sample			Men			Women		
	Present	Absent	n	Present	Absent	n	Present	Absent	n
Alcohol Abuse/Dependence Current	**162 (10.0%)**	1454 (90.0%)	1616	**152 (12.8%)**	1034 (87.2%)	1186	**10 (2.3%)**	420 (97.7%)	430
Alcohol Abuse/Dependence Lifetime	**528 (32.5%)**	1097 (67.5%)	1625	**487 (40.8%)**	708 (59.2%)	1195	**41 (9.5%)**	389 (90.5%)	430
Drug Abuse/Dependence Current	**24 (1.5%)**	1594 (98.5%)	1618	**24 (2.0%)**	1167 (98.0%)	1191	**0 (0.0%)**	427 (100.0%)	427
Drug Abuse/Dependence Lifetime	**84 (5.2%)**	1534 (94.8%)	1618	**80 (6.7%)**	1111 (93.3%)	1191	**4 (.9%)**	423 (99.9%)	427
Major Depressive Episode Current	**73 (4.5%)**	1556 (95.5%)	1629	**55 (4.6%)**	1143 (95.4%)	1198	**18 (4.2%)**	413 (95.8%)	431
Major Depressive Episode Lifetime	**130 (8.0%)**	1499 (92.0%)	1629	**78 (6.5%)**	1120 (93.5%)	1198	**52 (12.1%)**	379 (87.9%)	431
Generalized Anxiety Disorder Current	**86 (5.3%)**	1540 (94.7%)	1626	**69 (5.8%)**	1128 (94.2%)	1197	**17 (4.0%)**	412 (96.0%)	429
Generalized Anxiety Disorder Lifetime	**274 (16.9%)**	1352 (83.1%)	1626	**205 (17.1%)**	992 (82.9%)	1197	**69 (16.1%)**	360 (83.9%)	429
Antisocial Personality Disorder Current	**33 (2.0%)**	1582 (98.0%)	1615	**33 (2.8%)**	1151 (97.2%)	1184	**0 (0%)**	431 (100.0%)	431
Antisocial Personality Disorder Lifetime	**130 (8.0%)**	1496 (92.0%)	1626	**129 (10.8%)**	1066 (89.2%)	1195	**1 (.2%)**	430 (99.8%)	431
Manic Episode Current	**13 (.8%)**	1614 (99.2%)	1627	**11 (.9%)**	1185 (99.1%)	1196	**2 (.5%)**	429 (99.5%)	431
Manic Episode Lifetime	**17 (1.0%)**	1610 (99.0%)	1627	**12 (1.0%)**	1184 (99.0%)	1196	**5 (1.2%)**	426 (98.8%)	431
Panic Disorder Current	**23 (1.4%)**	1606 (98.6%)	1629	**16 (1.3%)**	1182 (98.7%)	1198	**7 (1.6%)**	424 (98.4%)	431
Panic Disorder Lifetime	**42 (2.6%)**	1587 (97.4%)	1629	**30 (2.5%)**	1168 (98.5%)	1198	**12 (2.8%)**	419 (97.2%)	431
Obsessive Compulsive Disorder Current	**26 (1.6%)**	1602 (98.4%)	1628	**22 (1.8%)**	1175 (98.2%)	1197	**4 (.9%)**	427 (99.1%)	431
Obsessive Compulsive Disorder Lifetime	**34 (2.1%)**	1594 (97.9%)	1628	**28 (2.3%)**	1169 (97.7%)	1197	**6 (1.4%)**	425 (98.6%)	431
Dysthymic Disorder Lifetime	**92 (5.7%)**	1532 (94.3%)	1624	**72 (6.0%)**	1121 (94.0%)	1193	**20 (4.6%)**	411 (95.4%)	431
PTSD[a]	**270 (16.7%)**	1349 (83.3%)	1619	**242 (20.3%)**	948 (79.7%)	1190	**28 (6.5%)**	401 (93.5%)	429
Any Disorder, Including PTSD Current	**461 (28.3%)**	1169 (71.7%)	1630	**396 (33.1%)**	802 (66.9%)	1198	**65 (15.0%)**	367 (85.0%)	432
Any Disorder, Including PTSD Lifetime	**807 (49.8%)**	801 (50.2%)	1608	**676 (57.0%)**	509 (43.0%)	1185	**131 (31.0%)**	292 (69.0%)	423
Any Disorder, Not Including PTSD Current	**286 (18.0%)**	1306 (82.0%)	1592	**245 (21.0%)**	923 (79.0%)	1168	**41 (9.7%)**	383 (90.3%)	424
Any Disorder, Not Including PTSD Lifetime	**759 (47.0%)**	856 (53.0%)	1615	**631 (53.0%)**	559 (47.0%)	1190	**128 (30.1%)**	297 (69.9%)	425

Note: Current indicates diagnosis within the six months prior to interview; both lifetime and current diagnoses were assessed by the Diagnostic Interview Schedule.

[a]Ascertained by score of 94 or higher on the 35-item Mississippi Scale for Combat-Related PTSD.

individual diagnosis with the highest rate was alcohol abuse/dependence-lifetime (32.5%). This was followed by generalized anxiety disorder-lifetime, with a rate of 16.9%, and then PTSD, with a rate of 16.7%. For men, the same three individual diagnoses had the highest rates of occurrence: For alcohol abuse/dependence-lifetime, the rate was (40.8%); this was followed by PTSD (20.3%) and generalized anxiety disorder-lifetime (17.1%). For women, the individual diagnosis with the highest rate of occurrence was generalized anxiety disorder-lifetime (16.1%), followed by major depressive episode-lifetime (12.1%) and alcohol abuse/dependence-lifetime (9.5%).

The fairly high rates for the four combination variables indexing the presence of any disorder (the lower portion of Table 2) are noteworthy. For the full sample, the rate of any disorder, including PTSD-lifetime was 49.8%, and the rate of any disorder, not including PTSD-lifetime was 47.0%. For men, these lifetime rates were even higher: for any diagnosis, including PTSD, 57.0%, and for any diagnosis, not including PTSD, 53.0%. For women, the rates were almost identical, 31.0% and 31.1%, respectively. (The rate for any disorder, including PTSD-lifetime was slightly lower than the rate for any disorder, not including PTSD-lifetime due to missing data; more cases were listwise-deleted when PTSD was included.) With regard to current conditions, the differential between any diagnosis, including PTSD, and any diagnosis, not including PTSD, was somewhat greater: For the full sample, the rate for any disorder, including PTSD-current was 28.3%, and the rate for any disorder, not including PTSD-current was 18.0%. For men, the parallel rates were 33.1% and 21.0%, respectively; for women, they were 15.0% and 9.7%, respectively.

Tables 3 through 14 (all of which appear at the end of this text) present the findings of the sequence of hierarchical logistic regression analyses. The results pertaining to individual psychiatric diagnoses derived from the Diagnostic Interview Schedule are presented as Tables 3 through 11. The results for analyses involving the Mississippi Scale-based PTSD diagnosis as the dependent variable are displayed in Table 12. And the last two sets of tables contain the findings for the presence of any disorder, both including PTSD (Table 13) and not including PTSD (Table 14). For each of the tables, the results are arranged as follows: logistic regression analysis for current diagnosis when all four war zone stressors are simultaneously included, separate regression analyses for current diagnosis when each of the four war zone stressors is considered individually, logistic regression analysis for lifetime diagnosis when all four war zone stressors are simultaneously included, and separate regression analyses for lifetime diagnosis when each of the four war zone stressors is considered individually.

Careful scrutiny of these many results reveals some important trends:

1. First, war zone exposure, as represented by the set of four war zone stressor variables (traditional combat, atrocities-abusive violence, perceived threat, and malevolent environment) consistently predicted the presence or absence of psychiatric outcomes. That is, when all four war zone stressors were simultaneously entered into the logistic regression equation at Step 1, the reduction in error as represented by the model (2 was significant. This finding was upheld for all current and lifetime individual diagnoses based on the Diagnostic Interview Schedule, the Mississippi Scale-based PTSD diagnosis, and the two current and two lifetime combination variables indexing any disorder.
2. Likewise, with only one marginal exception (the regression of alcohol abuse/dependence-lifetime on perceived threat, p=.06; see Table 3d), each of the individual war zone stressors separately predicted the psychiatric outcomes. Throughout the series of tabled results, one finds that the Step 1 entry of all individual war zone stressors yielded a significant model.
3. In the analyses involving simultaneous entry of all four war zone stressors, only four stressor-gender interaction sets were statistically significant: those predicting alcohol abuse/dependence-current, alcohol abuse/dependence-lifetime, manic episode-lifetime, and any disorder, not including PTSD-lifetime. Given the coding of the gender variable (women coded 1 and men coded 0) and the signs and values of the coefficients at Step 3 for each of these analyses, the role of gender in qualifying the stressor-psychiatric outcome relationships is as follows: (a) The relationship between traditional combat and alcohol abuse/dependence-current (Table 3a), between traditional combat and alcohol abuse/dependence-lifetime (Table 3c), and between traditional combat and manic episode-lifetime (Table 8c) is stronger for men than for

women. (b) The relationship between perceived threat and alcohol abuse/dependence-lifetime (Table 3c) is stronger for women than for men. (c) The relationship between malevolent environment and alcohol abuse/dependence-lifetime (Table 3c) and between malevolent environment and any disorder, not including PTSD-lifetime (Table 14c) is stronger for women than for men. (d) No interactions between atrocities-abusive violence and gender were significant.

4. Regarding main effects for gender in the logistic regression analyses, there were six individual psychiatric outcomes for which fewer than 5 female veterans were classified as having the disorder (see Table 2): drug abuse/dependence-current, drug abuse/dependence-lifetime, antisocial personality disorder-current, antisocial personality disorder-lifetime, manic episode-current, and obsessive compulsive disorder-current. Due to these low frequencies, gender comparisons were not advisable and thus were not conducted. Among the remaining individual psychiatric outcomes, there were five significant effects for gender in the equations involving the simultaneous consideration of the four war zone stressors. The outcomes for which there was a gender effect were alcohol abuse/dependence-current, alcohol abuse/dependence-lifetime, major depressive episode-lifetime, panic disorder-current, and PTSD. The odds ratios associated with these gender effects indicate that, independent of stressor exposure, male veterans were 6.00 times more likely than female veterans to suffer from alcohol abuse/dependence-current (Table 3a), 6.56 times more likely to be classified as alcohol abuse/dependence-lifetime (Table 3c), and 3.48 times more likely to meet the criterion for PTSD (Table 12a). On the other hand, women were 2.59 times more likely to be diagnosed with major depressive disorder-lifetime (Table 5c) and 3.10 times more likely to have a panic disorder-current diagnosis (Table 9a).
5. Also, the analyses in which the combination variables for any disorder were separately regressed on the set of four war zone stressors, gender, and their interactions yielded consistently significant main effects for gender. In all cases, men were more likely than women to be classified with one or more diagnoses. The gender-effect odds ratio for any disorder, including PTSD-current was 2.67 (Table 13a); for any disorder, including PTSD-lifetime, the ratio was 2.98 (Table 13c); for any disorder, not including PTSD-current, the ratio was 2.26 (Table 14a), and for any disorder, not including PTSD-lifetime, it was 2.58 (Table 14c).
6. Tables 3a through 14d also provide values for odds ratios for the continuous war zone stressor variables. These values represent the change in the odds — the probability of having a diagnosis relative to the probability of not having the diagnosis — as a function of a single unit's change in the war zone stressor predictor. To facilitate the interpretation of these odds ratios, one might want to think in terms of the odds concomitant with a change in more familiar standard deviation units. To illustrate, the reader is referred to Table 5a, which gives the results of the logistic regression analysis for major depressive episode-current on the four war zone stressors, gender, and their interactions. As shown in the table, the effect for gender (Step 2) and the stressor-gender interactions (Step 3) were nonsignificant (all ps> 0.25). The accepted model would therefore be the one reported at Step 1, where the odds ratios for the atrocities-abusive violence, perceived threat, and malevolent environment variables are 1.07, 1.12, and 1.04, respectively. To calculate the odds of 1 standard deviation unit's change in each of these stressors, we first refer to Table 1 to determine the standard deviations of the predictors: for atrocities-abusive violence, 6.43; for perceived threat, 6.05; and for malevolent environment, 11.18. Next, we multiply the coefficient for each predictor from Table 5a by its respective standard deviation, and then take the antilog of each of these products.

   Atrocities-abusive violence:
   .07 x 6.43 = .45
   e.45 = 1.57

   Perceived threat:
   .12 x 6.05 = .73
   e.74 = 2.08

   Malevolent environment:
   .04 x 11.18 = .45
   e.45 = 1.57

   Thus, holding constant the other war zone stressors, an increase of 1 standard deviation unit or 6.43 points on the atrocities-abusive violence scale would result in an individual being 1.57 times more likely to be diagnosed with current depression. Similarly, holding constant the other stressors, an increase in 6.05 units on the perceived threat scale would make a person 2.08 times more likely to have current depression, and an increase in 11.18 points on the malevolent

environment scale would raise the odds by a factor of 1.57. Comparable calculations may be derived for all significant stressor effects across all psychiatric outcomes.

Discussion

In this representative sample of male and female Vietnam theater veterans war zone stressor variables consistently predicted all of the psychiatric conditions measured. In general, the more an individual was exposed to the four dimensions of traumatic stress (traditional combat, atrocities-abusive violence, perceived life threat, and malevolent environment), the more likely s/he would be to develop any of these psychiatric conditions. Elevations in the four dimensions in aggregate predicted the development of these psychiatric conditions, and elevations in each of the four independently predicted these psychiatric conditions as well.

Previous studies of the effects of exposure to war zone stressors have primarily focused upon the relationship of stressor exposure to the development of PTSD. The present set of analyses strongly suggest that greater exposure to war zone stressors predicts the development of a much wider range of psychiatric disturbances. Virtually every diagnostic category measured in this study could be successfully predicted by the exposure variables examined. All diagnostic conditions were, in part, a function of exposure to the stressors of war.

Final interpretation of these data must be made in light of the findings of Jordan, et al. (1991) who observed that only PTSD and Major Depression differentiated the Theater from the Era veterans in terms of overall prevalence. However, when they divided their groups into High versus Low/Moderate levels of war zone stressor exposure, many additional diagnostic differences emerged (e.g. panic disorder, OCD, alcohol abuse). Their findings are explored more fully and substantiated by the present set of analyses. By disaggregating the war zone stressor construct, we were able to more completely examine those components of service in a war zone that contribute to the development of PTSD and other psychiatric conditions. In so doing we can conclude that all components of the variable war zone stressor contribute to the development of PTSD and the other psychiatric conditions.

The analyses of gender differences provide important new information. First, the prevalence rates in women theater veterans for drug abuse, antisocial personality disorder, manic disorder, and OCD were so low that analyses were not conducted. These conditions are of extremely low prevalence in women of the Vietnam Theater following war zone exposure. Secondly, Major Depression and Panic Disorder were more common outcomes for women than for men. Thirdly, alcohol abuse and PTSD were more likely outcomes for men exposed to war zone stressors. Thus, men and women who serve in a war zone may ultimately express their psychiatric distress in different ways. In drawing these conclusions, however, one must bear in mind that the stressors to which men and women were exposed in Vietnam were different in some important ways. Women in Vietnam were assigned different responsibilities such as nursing and clerical duties. In today's military many of these gender based differences in military functioning are disappearing and further study of differential outcomes based upon similar exposures is warranted.

In concluding, these analyses provide substantive support for the premise that the development of a wide range of psychiatric disorders can be directly related to war zone exposure. While PTSD is certainly the most common psychiatric outcome related to exposure, it is by no means the only outcome. Depression, panic, substance abuse, generalized anxiety disorder, OCD, mania, and antisocial personality disorder can all develop as a function of war zone stressor exposure. These findings may also be viewed as epidemiological support for a diathesis-stress model of psychopathology. Individuals, when exposed to the massive stressors of war, may be more likely to develop psychiatric conditions for which they carry a particular vulnerability (Zubin & Spring, 1977). These findings have important implications for the compensation of war veterans in the United States who develop conditions other than PTSD following their military service and who are disabled as a result.

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Table 3a. Logistic Regressions for Alcohol Abuse/Dependence — Current (n=1596): All War Zone Stressors

Variables in the Equation		Variable				Model		
		Coefficient	SE	p	OR	X^2	df	p
Step 0:	CONSTANT in the model					1026.19		
Step 1:	Traditional Combat	-0.00	0.01	0.67	1.00			
	Atrocities - Abusive Violence	0.06	0.01	0.00	1.07			
	Perceived Threat	-0.01	0.03	0.60	1.01			
	Malevolent Environment	0.01	0.01	0.53	1.01	26.78	4	0.00
Step 2:	Traditional Combat	-0.01	0.01	0.29	1.01			
	Atrocities - Abusive Violence	0.07	0.01	0.00	1.07			
	Perceived Threat	-0.01	0.03	0.80	1.09			
	Malevolent Environment	0.01	0.01	0.49	1.01			
	Gender	-1.79	0.34	0.00	6.00	71.90	5	0.00
Step 3:	Traditional Combat	-0.00	0.01	0.83	1.00			
	Atrocities - Abusive Violence	0.06	0.02	0.00	1.06			
	Perceived Threat	-0.01	0.03	0.61	1.01			
	Malevolent Environment	0.00	0.01	0.75	1.00			
	Gender	-2.86	0.66	0.00	17.54			
	Traditional Combat x Gender	-0.15	0.06	0.01	1.17			
	Atrocities - Abusive Violence x Gender	0.05	0.06	0.38	1.05			
	Perceived Threat x Gender	0.11	0.10	0.27	1.11			
	Malevolent Environment x Gender	0.06	0.04	0.15	1.06	83.42	9	0.00

Table 3b. Logistic Regressions for Alcohol Abuse/Dependence — Current: Individual War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
	n = 1603					1032.07		
Step 0:	CONSTANT in the model	0.01	0.00	0.00	1.01	8.02	1	0.00
Step 1:	Traditional Combat	0.01	0.00	0.02	1.01			
Step 2:	Traditional Combat	-1.76	0.33	0.00	5.83	52.83	2	0.00
	Gender	0.01	0.00	0.01	1.01			
Step 3:	Traditional Combat	-1.99	0.41	0.00	7.33			
	Gender	-0.05	0.03	0.10	1.05	56.04	3	0.00
	Traditional Combat x Gender							
	n = 1598					1026.61		
Step 0:	CONSTANT in the model	0.06	0.01	0.00	1.06	25.45	1	0.00
Step 1:	Atrocities - Abusive Violence	0.05	0.01	0.00	1.05			
Step 2:	Atrocities - Abusive Violence	-1.76	0.33	0.00	5.78	69.33	2	0.00
	Gender	0.05	0.01	0.00	1.05			
Step 3:	Atrocities - Abusive Violence	-1.83	0.35	0.00	6.20			
	Gender	0.03	0.03	0.36	1.03	70.14	3	0.00
	Atrocities - Abusive Violence x Gender							
	n = 1605					1032.49		
Step 0:	CONSTANT in the model	0.03	0.01	0.03	1.03	4.73	1	0.03
Step 1:	Perceived Threat	0.03	0.01	0.05	1.03			
Step 2:	Perceived Threat	-1.79	0.33	0.00	5.97	51.42	2	0.00
	Gender	0.03	0.01	0.07	1.03			
Step 3:	Perceived Threat	-1.79	0.33	0.00	6.01			
	Gender	0.01	0.06	0.84	1.01	51.47	3	0.00
	Perceived Threat x Gender							
	n = 1605					1041.32		
Step 0:	CONSTANT in the model	0.02	0.01	0.01	1.02	6.60	1	0.01
Step 1:	Malevolent Environment	0.02	0.01	0.02	1.02			
Step 2:	Malevolent Environment	-1.80	0.33	0.00	6.02	53.93	2	0.00
	Gender	0.01	0.01	0.05	1.02			
Step 3:	Malevolent Environment	-1.90	0.36	0.00	6.67			
	Gender	0.04	0.03	0.22	1.04	55.41	3	0.00
	Malevolent Environment x Gender							

Step 3:	Malevolent Environment	0.01	0.01	0.03	1.02			
	Gender	-1.90	0.36	0.00	6.67			
	Malevolent Environment x Gender	0.04	0.03	0.22	1.04	55.41	3	0.00

Table 3c. Logistic Regressions for Alcohol Abuse/Dependence — Lifetime (n=1605): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
Step 0:	CONSTANT in the model					2021.78		
Step 1:	Traditional Combat	-0.00	0.00	0.34	1.00			
	Atrocities - Abusive Violence	0.04	0.01	0.00	1.04			
	Perceived Threat	-0.01	0.02	0.57	1.01			
	Malevolent Environment	0.01	0.01	0.08	1.01	22.61	4	0.00
Step 2:	Traditional Combat	-0.01	0.01	0.06	1.01			
	Atrocities - Abusive Violence	-0.04	0.01	0.00	1.04			
	Perceived Threat	-0.00	0.02	0.96	1.00			
	Malevolent Environment	0.01	0.01	0.08	1.01			
	Gender	-1.88	0.18	0.00	6.56	182.02	5	0.00
Step 3:	Traditional Combat	-0.00	0.01	0.39	1.00			
	Atrocities - Abusive Violence	0.05	0.01	0.00	1.05			
	Perceived Threat	-0.02	0.02	0.40	1.02			
	Malevolent Environment	0.01	0.01	0.25	1.01			
	Gender	-2.21	0.23	0.00	9.13			
	Traditional Combat x Gender	-0.07	0.02	0.00	1.07			
	Atrocities - Abusive Violence x Gender	-0.05	0.03	0.15	1.05			
	Perceived Threat x Gender	0.11	0.05	0.02	1.12			
	Malevolent Environment x Gender	0.05	0.02	0.04	1.05	199.45	9	0.00

Table 3d. Logistic Regressions for Alcohol Abuse/Dependence — Lifetime: Individual War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
	n = 1612							
Step 0:	CONSTANT in the model					2030.21		
Step 1:	Traditional Combat	0.01	0.00	0.03	1.01	4.82	1	0.03
Step 2:	Traditional Combat	0.00	0.00	0.22	1.00			
	Gender	-1.86	0.17	0.00	6.44	163.61	2	0.00
Step 3:	Traditional Combat	0.00	0.00	0.13	1.00			
	Gender	-1.93	0.19	0.00	6.90			
	Traditional Combat x Gender	-0.02	0.01	0.14	1.02	166.03	3	0.00
	n = 1607							
Step 0:	CONSTANT in the model					2023.35		
Step 1:	Atrocities - Abusive Violence	0.03	0.01	0.00	1.04	18.24	1	0.00
Step 2:	Atrocities - Abusive Violence	0.03	0.01	0.00	1.03			
	Gender	-1.85	0.18	0.00	6.40	175.12	2	0.00
Step 3:	Atrocities - Abusive Violence	0.03	0.01	0.00	1.03			
	Gender	-1.86	0.18	0.00	6.41			
	Atrocities - Abusive Violence x Gender	-0.03	0.03	0.41	1.03	175.88	3	0.00
	n = 1614							
Step 0:	CONSTANT in the model					2033.24		
Step 1:	Perceived Threat	0.02	0.01	0.06	1.02	3.64	1	0.06
Step 2:	Perceived Threat	0.01	0.01	0.14	1.01			
	Gender	-1.87	0.17	0.00	6.48	164.54	2	0.00
Step 3:	Perceived Threat	0.01	0.01	0.29	1.01			
	Gender	-1.88	0.18	0.00	6.56			
	Perceived Threat x Gender	0.04	0.03	0.23	1.04	165.97	3	0.00
	n = 1614							
Step 0:	CONSTANT in the model					2036.04		
Step 1:	Malevolent Environment	0.01	0.00	0.00	1.01	9.13	1	0.00
Step 2:	Malevolent Environment	0.01	0.00	0.01	1.01			
	Gender	-1.87	0.17	0.00	6.48	169.71	2	0.00
Step 3:	Malevolent Environment	0.01	0.01	0.06	1.01			
	Gender	-1.91	0.18	0.00	6.77			
	Malevolent Environment x Gender	0.03	0.02	0.06	1.03	173.16	3	0.00

	Malevolent Environment	0.01	0.01	0.06	1.01			
	Gender	-1.91	0.18	0.00	6.77			
	Malevolent Environment x Gender	0.03	0.02	0.06	1.03	173.16	3	0.00

Table 4a. Logistic Regressions for Drug Abuse/Dependence — Current (n=1598): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0:	CONSTANT in the model					232.26		
Step 1:	Traditional Combat	0.02	0.02	0.21	1.02			
	Atrocities - Abusive Violence	0.06	0.03	0.04	1.06			
	Perceived Threat	0.00	0.07	0.97	1.00			
	Malevolent Environment	0.03	0.03	0.33	1.03	24.15	4	0.00
Step 2:	Traditional Combat	0.00	0.02	0.81	1.00			
	Atrocities - Abusive Violence	0.07	0.03	0.02	1.08			
	Perceived Threat	0.02	0.07	0.75	1.02			
	Malevolent Environment	0.03	0.03	0.32	1.03			
	Gender	-8.11	20.40	0.69	3333.33	35.35	5	0.00
Step 3:	Traditional Combat	0.00	0.02	0.81	1.00			
	Atrocities - Abusive Violence	0.07	0.03	0.02	1.08			
	Perceived Threat	0.02	0.07	0.75	1.02			
	Malevolent Environment	0.03	0.03	0.32	1.03			
	Gender	-7.77	22.12	0.73	2500.00			
	Traditional Combat x Gender	-0.00	2.28	1.00	1.00			
	Atrocities - Abusive Violence x Gender	-0.07	4.75	0.99	1.08			
	Perceived Threat x Gender	-0.02	5.68	1.00	1.02			
	Malevolent Environment x Gender	-0.03	2.69	0.99	1.03	35.35	9	0.00

Table 4b. Logistic Regressions for Drug Abuse/Dependence — Current: Individual War Zone Stressors

Variables in the Equation		Variable				Model		
		Coefficient	SE	p	OR	X_2	df	p
	n = 1606					249.41		
Step 0:	CONSTANT in the model					21.40	1	0.00
Step 1:	Traditional Combat	0.04	0.01	0.00	1.04			
Step 2:	Traditional Combat	0.04	0.01	0.00	1.04	32.39	2	0.00
	Gender	-6.96	12.84	0.59	1111.11			
Step 3:	Traditional Combat	0.04	0.01	0.00	1.04			
	Gender	-6.93	13.35	0.60	1000.00			
	Traditional Combat x Gender	-0.04	0.98	0.97	1.04	32.29	3	0.00
	n = 1600					232.31		
Step 0:	CONSTANT in the model					18.35	1	0.00
Step 1:	Atrocities - Abusive Violence	0.10	0.02	0.00	1.10			
Step 2:	Atrocities - Abusive Violence	0.10	0.02	0.00	1.11	31.76	2	0.00
	Gender	-8.28	20.39	0.68	3333.33			
Step 3:	Atrocities - Abusive Violence	0.10	0.02	0.00	1.11			
	Gender	-6.90	13.20	0.60	1000.00			
	Atrocities - Abusive Violence x Gender	-0.10	2.46	0.97	1.11	31.76	3	0.00
	n = 1607					249.44		
Step 0:	CONSTANT in the model					16.41	1	0.00
Step 1:	Perceived Threat	0.14	0.04	0.00	1.15			
Step 2:	Perceived Threat	0.13	0.04	0.00	1.14	30.00	2	0.00
	Gender	-7.16	12.69	0.57	1250.00			
Step 3:	Perceived Threat	0.13	0.04	0.00	1.14			
	Gender	-6.99	13.13	0.59	1111.11			
	Perceived Threat x Gender	-0.13	2.37	0.95	1.14	30.00	3	0.00
	n = 1607					249.44		
Step 0:	CONSTANT in the model					18.13	1	0.00
Step 1:	Malevolent Environment	0.08	0.02	0.00	1.08			
Step 2:	Malevolent Environment	0.08	0.02	0.00	1.08	31.62	2	0.00
	Gender	-7.14	12.64	0.57	1250.00			
Step 3:	Malevolent Environment	0.08	0.02	0.00	1.08			
	Gender	-6.95	13.16	0.60	1000.00			
	Malevolent Environment x Gender	-0.08	1.28	0.95	1.08	31.62	3	0.00

	Gender	-6.95	13.16	0.60	1000.00			
	Malevolent Environment x Gender	-0.08	1.28	0.95	1.08	31.62	3	0.00

Table 4c. Logistic Regressions for Drug Abuse/Dependence — Lifetime (n=1598): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0:	CONSTANT in the model					646.76		
Step 1:	Traditional Combat	-0.00	0.01	0.94	1.00			
	Atrocities - Abusive Violence	0.05	0.02	0.01	1.05			
	Perceived Threat	0.01	0.04	0.73	1.01			
	Malevolent Environment	0.04	0.01	0.00	1.04	44.99	4	0.00
Step 2:	Traditional Combat	-0.01	0.01	0.32	1.01			
	Atrocities - Abusive Violence	0.05	0.02	0.00	1.05			
	Perceived Threat	0.03	0.04	0.48	1.03			
	Malevolent Environment	0.04	0.01	0.00	1.05			
	Gender	-2.02	0.53	0.00	7.52	70.12	5	0.00
Step 3:	Traditional Combat	-0.01	0.01	0.32	1.01			
	Atrocities - Abusive Violence	0.06	0.02	0.00	1.06			
	Perceived Threat	0.02	0.04	0.62	1.02			
	Malevolent Environment	0.05	0.02	0.00	1.05			
	Gender	-2.29	0.76	0.00	9.89			
	Traditional Combat x Gender	-0.01	0.05	0.90	1.01			
	Atrocities - Abusive Violence x Gender	-0.08	0.07	0.23	1.08			
	Perceived Threat x Gender	0.12	0.13	0.39	1.12			
	Malevolent Environment x Gender	0.02	0.06	0.80	1.02	72.26	9	0.00

Table 4d. Logistic Regressions for Drug Abuse/Dependence — Lifetime: Individual War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
	n = 1606					659.24		
Step 0:	CONSTANT in the model	0.03	0.01	0.00	1.03	25.92	1	0.00
Step 1:	Traditional Combat	0.02	0.01	0.00	1.02			
Step 2:	Traditional Combat	-1.90	0.52	0.00	6.67	49.27	2	0.00
	Gender	0.02	0.01	0.00	1.02			
Step 3:	Traditional Combat	-1.92	0.53	0.00	6.80			
	Gender	0.01	0.03	0.84	1.01	49.31	3	0.00
	Traditional Combat x Gender							
	n = 1600					646.97		
Step 0:	CONSTANT in the model	0.08	0.01	0.00	1.08	29.24	1	0.00
Step 1:	Atrocities - Abusive Violence	0.07	0.01	0.00	1.08			
Step 2:	Atrocities - Abusive Violence	-1.97	0.52	0.00	7.16	54.49	2	0.00
	Gender	0.07	0.01	0.00	1.08			
Step 3:	Atrocities - Abusive Violence	-1.88	0.53	0.00	6.57			
	Gender	-0.03	0.06	0.59	1.03	54.86	3	0.00
	Atrocities - Abusive Violence x Gender							
	n = 1607					659.35		
Step 0:	CONSTANT in the model	0.10	0.02	0.00	1.10	27.29	1	0.00
Step 1:	Perceived Threat	0.09	0.02	0.00	1.10			
Step 2:	Perceived Threat	-1.99	0.52	0.00	7.30	54.02	2	0.00
	Gender	0.09	0.02	0.00	1.09			
Step 3:	Perceived Threat	-2.22	0.66	0.00	9.25			
	Gender	0.07	0.09	0.45	1.07	54.61	3	0.00
	Perceived Threat x Gender							
	n = 1607					659.35		
Step 0:	CONSTANT in the model	0.06	0.01	0.00	1.07	39.69	1	0.00
Step 1:	Malevolent Environment	0.06	0.01	0.00	1.06			
Step 2:	Malevolent Environment	-1.97	0.52	0.00	7.19	65.74	2	0.00
	Gender	0.06	0.01	0.00	1.06			
Step 3:	Malevolent Environment	-2.12	0.65	0.00	8.30			
	Gender	0.02	0.05	0.66	1.02	65.94	3	0.00
	Malevolent Environment x Gender							

	Malevolent Environment x Gender	0.02	0.05	0.66	1.02	65.94	3	0.00

Table 5a. Logistic Regressions for Major Depressive Episode — Current (n=1607): All War Zone Stressors

Variables in the Equation		Variable				Model		
		Coefficient	SE	p	OR	X^2	df	p
Step 0:	CONSTANT in the model					581.78		
Step 1:	Traditional Combat	-0.01	0.01	0.42	1.01			
	Atrocities - Abusive Violence	0.07	0.02	0.00	1.07			
	Perceived Threat	0.12	0.04	0.00	1.12			
	Malevolent Environment	0.04	0.02	0.01	1.04	99.39	4	0.00
Step 2:	Traditional Combat	-0.01	0.01	0.54	1.01			
	Atrocities - Abusive Violence	0.07	0.02	0.00	1.07			
	Perceived Threat	0.11	0.04	0.00	1.12			
	Malevolent Environment	0.04	0.02	0.01	1.04			
	Gender	0.25	0.31	0.42	1.29	100.03	5	0.00
Step 3:	Traditional Combat	-0.01	0.01	0.46	1.01			
	Atrocities - Abusive Violence	0.07	0.02	0.00	1.08			
	Perceived Threat	0.15	0.05	0.00	1.16			
	Malevolent Environment	0.04	0.02	0.04	1.04			
	Gender	0.69	0.38	0.07	2.00			
	Traditional Combat x Gender	-0.01	0.03	0.70	1.01			
	Atrocities - Abusive Violence x Gender	-0.02	0.04	0.57	1.02			
	Perceived Threat x Gender	-0.09	0.08	0.29	1.09			
	Malevolent Environment x Gender	-0.00	0.04	0.98	1.00	105.42	9	0.00

Table 5b. Logistic Regressions for Major Depressive Episode — Current: Individual War Zone Stressors

Variables in the Equation		Variable				Model		
		Coefficient	SE	p	OR	X_2	df	p
	n = 1616					588.73		
Step 0:	CONSTANT in the model	0.04	0.01	0.00	1.04	59.25	1	0.00
Step 1:	Traditional Combat	0.05	0.01	0.00	1.05			
Step 2:	Traditional Combat	0.34	0.30	0.25	1.41	60.54	2	0.00
	Gender	0.05	0.01	0.00	1.05			
Step 3:	Traditional Combat	0.57	0.32	0.08	1.77			
	Gender	-0.03	0.02	0.07	1.03	64.25	3	0.00
	Traditional Combat x Gender							
	n = 1609					581.96		
Step 0:	CONSTANT in the model	0.11	0.01	0.00	1.12	63.17	1	0.00
Step 1:	Atrocities - Abusive Violence	0.11	0.01	0.00	1.12			
Step 2:	Atrocities - Abusive Violence	0.15	0.30	0.61	1.16	63.42	2	0.00
	Gender	0.13	0.02	0.00	1.13			
Step 3:	Atrocities - Abusive Violence	0.32	0.31	0.30	1.38			
	Gender	-0.05	0.03	0.12	1.05	65.75	3	0.00
	Atrocities - Abusive Violence x Gender							
	n = 1618					588.92		
Step 0:	CONSTANT in the model	0.19	0.02	0.00	1.21	80.40	1	0.00
Step 1:	Perceived Threat	0.19	0.02	0.00	1.21			
Step 2:	Perceived Threat	0.10	0.29	0.73	1.11	80.52	2	0.00
	Gender	0.23	0.03	0.00	1.26			
Step 3:	Perceived Threat	0.67	0.36	0.06	1.96			
	Gender	-0.13	0.05	0.01	1.14	86.42	3	0.00
	Perceived Threat x Gender							
	n = 1618					595.03		
Step 0:	CONSTANT in the model	0.09	0.01	0.00	1.10	69.36	1	0.00
Step 1:	Malevolent Environment	0.09	0.01	0.00	1.10			
Step 2:	Malevolent Environment	0.06	0.29	0.83	1.06	69.41	2	0.00
	Gender	0.11	0.01	0.00	1.11			
Step 3:	Malevolent Environment	0.40	0.35	0.26	1.48			
	Gender	-0.04	0.03	0.12	1.04	71.77	3	0.00
	Malevolent Environment x Gender							

	Gender	0.40	0.35	0.26	1.48		
	Malevolent Environment x Gender	-0.04	0.03	0.12	1.04	71.77	3	0.00

Table 5c. Logistic Regressions for Major Depressive Episode — Lifetime (n=1607): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0:	CONSTANT in the model					893.23		
Step 1:	Traditional Combat	-0.02	0.01	0.02	1.02			
	Atrocities - Abusive Violence	0.06	0.02	0.00	1.06			
	Perceived Threat	0.10	0.03	0.00	1.10			
	Malevolent Environment	0.04	0.01	0.00	1.04	98.42	4	0.00
Step 2:	Traditional Combat	-0.01	0.01	0.13	1.01			
	Atrocities - Abusive Violence	0.06	0.02	0.00	1.06			
	Perceived Threat	0.09	0.03	0.00	1.09			
	Malevolent Environment	0.04	0.01	0.00	1.04			
	Gender	0.95	0.21	0.00	2.59	118.21	5	0.00
Step 3:	Traditional Combat x Gender	-0.02	0.01	0.05	1.02			
	Atrocities - Abusive Violence	0.07	0.02	0.00	1.07			
	Perceived Threat	0.14	0.04	0.00	1.15			
	Malevolent Environment	0.04	0.02	0.02	1.04			
	Gender	1.17	0.24	0.00	3.21			
	Traditional Combat x Gender	0.01	0.02	0.58	1.01			
	Atrocities - Abusive Violence x Gender	-0.04	0.03	0.25	1.04			
	Perceived Threat x Gender	-0.10	0.06	0.09	1.10			
	Malevolent Environment x Gender	0.01	0.02	0.69	1.01	124.34	9	0.00

Table 5d. Logistic Regressions for Major Depressive Episode — Lifetime: Individual War Zone Stressors

Variables in the Equation	Variable				Model		
	Coefficient	SE	p	OR	X_2	df	p
n = 1616					899.61		
Step 0: CONSTANT in the model	0.03	0.00	0.00	1.03	42.37	1	0.00
Step 1: Traditional Combat	0.03	0.00	0.00	1.03			
Step 2: Traditional Combat	0.98	0.20	0.00	2.65	64.68	2	0.00
Gender	0.04	0.01	0.00	1.04			
Step 3: Traditional Combat	1.05	0.21	0.00	2.86			
Gender	-0.02	0.01	0.16	1.02	66.67	3	0.00
Traditional Combat x Gender							
n = 1609					893.56		
Step 0: CONSTANT in the model	0.09	0.01	0.00	1.09	53.91	1	0.00
Step 1: Atrocities - Abusive Violence	0.10	0.01	0.00	1.10			
Step 2: Atrocities - Abusive Violence	0.90	0.20	0.00	2.47	73.32	2	0.00
Gender	0.11	0.01	0.00	1.11			
Step 3: Atrocities - Abusive Violence	0.99	0.21	0.00	2.68			
Gender	-0.04	0.03	0.10	1.04	75.92	3	0.00
Atrocities - Abusive Violence x Gender							
n = 1618					899.95		
Step 0: CONSTANT in the model	0.13	0.02	0.00	1.14	72.04	1	0.00
Step 1: Perceived Threat	0.14	0.02	0.00	1.15			
Step 2: Perceived Threat	0.86	0.20	0.00	2.36	89.99	2	0.00
Gender	0.18	0.02	0.00	1.19			
Step 3: Perceived Threat	1.15	0.23	0.00	3.15			
Gender	-0.09	0.04	0.01	1.09	96.48	3	0.00
Perceived Threat x Gender							
n = 1618					904.83		
Step 0: CONSTANT in the model	0.07	0.01	0.00	1.08	72.92	1	0.00
Step 1: Malevolent Environment	0.08	0.01	0.00	1.08			
Step 2: Malevolent Environment	0.85	0.20	0.00	2.34	90.62	2	0.00
Gender	0.09	0.01	0.00	1.09			
Step 3: Malevolent Environment	1.00	0.23	0.00	2.71			
Gender	-0.02	0.02	0.19	1.03	92.30	3	0.00
Malevolent Environment x Gender							

Table 6a. Logistic Regressions for Generalized Anxiety Disorder — Current (n=1605): All War Zone Stressors

Variables in the Equation		Variable				Model		
		Coefficient	SE	p	OR	X^2	df	p
Step 0:	CONSTANT in the model					664.92		
Step 1:	Traditional Combat	-0.00	0.01	0.66	1.00			
	Atrocities - Abusive Violence	0.04	0.02	0.03	1.04			
	Perceived Threat	0.03	0.03	0.45	1.03			
	Malevolent Environment	0.05	0.01	0.00	1.06	57.61	4	0.00
Step 2:	Traditional Combat	-0.01	0.01	0.54	1.01			
	Atrocities - Abusive Violence	0.04	0.02	0.02	1.04			
	Perceived Threat	0.03	0.04	0.41	1.03			
	Malevolent Environment	0.05	0.01	0.00	1.06			
	Gender	-0.27	0.29	0.35	1.31	58.51	5	0.00
Step 3:	Traditional Combat	-0.01	0.01	0.44	1.01			
	Atrocities - Abusive Violence	0.06	0.02	0.01	1.06			
	Perceived Threat	0.04	0.04	0.36	1.04			
	Malevolent Environment	0.05	0.02	0.00	1.05			
	Gender	-0.35	0.36	0.33	1.42			
	Traditional Combat x Gender	-0.01	0.03	0.70	1.01			
	Atrocities - Abusive Violence x Gender	-0.07	0.04	0.11	1.07			
	Perceived Threat x Gender	-0.01	0.08	0.91	1.01			
	Malevolent Environment x Gender	0.04	0.03	0.29	1.04	62.77	9	0.00

Table 6b. Logistic Regressions for Generalized Anxiety Disorder — Current: Individual War Zone Stressors

Variables in the Equation		Variable				Model		
		Coefficient	SE	p	OR	X_2	df	p
	n = 1613					671.55		
Step 0:	CONSTANT in the model	0.03	0.01	0.00	1.03	26.61	1	0.00
Step 1:	Traditional Combat	0.03	0.01	0.00	1.03			
Step 2:	Traditional Combat	-0.22	0.28	0.44	1.24	27.22	2	0.00
	Gender	0.03	0.01	0.00	1.03			
Step 3:	Traditional Combat	-0.19	0.29	0.51	1.21			
	Gender	-0.01	0.02	0.47	1.01	27.76	3	0.00
	Traditional Combat x Gender							
	n = 1607					665.13		
Step 0:	CONSTANT in the model	0.08	0.01	0.00	1.08	30.88	1	0.00
Step 1:	Atrocities - Abusive Violence	0.08	0.01	0.00	1.08			
Step 2:	Atrocities - Abusive Violence	-0.30	0.28	0.30	1.34	32.02	2	0.00
	Gender	0.09	0.01	0.00	1.09			
Step 3:	Atrocities - Abusive Violence	-0.20	0.29	0.50	1.22			
	Gender	-0.05	0.04	0.16	1.05	34.38	3	0.00
	Atrocities - Abusive Violence x Gender							
	n = 1615					671.77		
Step 0:	CONSTANT in the model	0.11	0.02	0.00	1.12	34.98	1	0.00
Step 1:	Perceived Threat	0.11	0.02	0.00	1.12			
Step 2:	Perceived Threat	-0.32	0.28	0.26	1.37	36.33	2	0.00
	Gender	0.12	0.02	0.00	1.12			
Step 3:	Perceived Threat	-0.22	0.30	0.46	1.25			
	Gender	-0.04	0.05	0.46	1.04	36.87	3	0.00
	Perceived Threat x Gender							
	n = 1615					671.77		
Step 0:	CONSTANT in the model	0.07	0.01	0.00	1.07	46.81	1	0.00
Step 1:	Malevolent Environment	0.07	0.01	0.00	1.07			
Step 2:	Malevolent Environment	-0.29	0.28	0.30	1.34	47.96	2	0.00
	Gender	0.07	0.01	0.00	1.07			
Step 3:	Malevolent Environment	-0.36	0.34	0.28	1.44			
	Gender	0.01	0.03	0.68	1.01	48.12	3	0.00
	Malevolent Environment x Gender							

	Gender	-0.36	0.34	0.28	1.44			
	Malevolent Environment x Gender	0.01	0.03	0.68	1.01	48.12	3	0.00

Table 6c. Logistic Regressions for Generalized Anxiety Disorder — Lifetime (n=1605): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0:	CONSTANT in the model					1454.32		
Step 1:	Traditional Combat	-0.01	0.01	0.32	1.01			
	Atrocities - Abusive Violence	0.05	0.01	0.00	1.05			
	Perceived Threat	0.03	0.02	0.21	1.03			
	Malevolent Environment	0.04	0.01	0.00	1.04	96.94	4	0.00
Step 2:	Traditional Combat	-0.01	0.01	0.34	1.01			
	Atrocities - Abusive Violence	0.05	0.01	0.00	1.05			
	Perceived Threat	0.03	0.02	0.22	1.03			
	Malevolent Environment	0.04	0.01	0.00	1.04			
	Gender	0.04	0.16	0.78	1.04	97.02	5	0.00
Step 3:	Traditional Combat	-0.01	0.01	0.12	1.01			
	Atrocities - Abusive Violence	0.05	0.01	0.00	1.05			
	Perceived Threat	0.06	0.03	0.03	1.06			
	Malevolent Environment	0.03	0.01	0.00	1.03			
	Gender	0.09	0.16	0.59	1.09			
	Traditional Combat x Gender	0.01	0.02	0.64	1.01			
	Atrocities - Abusive Violence x Gender	-0.02	0.03	0.54	1.02			
	Perceived Threat x Gender	-0.08	0.04	0.06	1.08			
	Malevolent Environment x Gender	0.01	0.02	0.61	1.01	102.70	9	0.00

Table 6d. Logistic Regressions for Generalized Anxiety Disorder — Lifetime: Individual War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
	n = 1613					1466.85		
Step 0:	CONSTANT in the model							
		0.02	0.00	0.00	1.02	46.64	1	0.00
Step 1:	Traditional Combat							
		0.02	0.00	0.00	1.02			
Step 2:	Traditional Combat					46.74	2	0.00
		0.05	0.16	0.75	1.05			
	Gender							
		0.02	0.00	0.00	1.02			
Step 3:	Traditional Combat							
		0.05	0.16	0.73	1.06			
	Gender							
		-0.01	0.01	0.26	1.01	48.06	3	0.00
	Traditional Combat x Gender							
	n = 1607					1455.06		
Step 0:	CONSTANT in the model							
		0.07	0.01	0.00	1.08	60.71	1	0.00
Step 1:	Atrocities - Abusive Violence							
		0.07	0.01	0.00	1.08			
Step 2:	Atrocities - Abusive Violence					60.74	2	0.00
		0.03	0.16	0.85	1.03			
	Gender							
		0.08	0.01	0.00	1.08			
Step 3:	Atrocities - Abusive Violence							
		0.05	0.16	0.75	1.05			
	Gender							
		-0.03	0.02	0.23	1.03	62.15	3	0.00
	Atrocities - Abusive Violence x Gender							
	n = 1615					1467.59		
Step 0:	CONSTANT in the model							
		0.09	0.01	0.00	1.09	59.25	1	0.00
Step 1:	Perceived Threat							
		0.09	0.01	0.00	1.09			
Step 2:	Perceived Threat					59.27	2	0.00
		-0.02	0.16	0.91	1.02			
	Gender							
		0.10	0.01	0.00	1.11			
Step 3:	Perceived Threat							
		0.07	0.16	0.67	1.07			
	Gender							
		-0.07	0.03	0.01	1.07	66.23	3	0.00
	Perceived Threat x Gender							
	n = 1615					1467.59		
Step 0:	CONSTANT in the model							
		0.05	0.01	0.00	1.05	75.29	1	0.00
Step 1:	Malevolent Environment							
		0.05	0.01	0.00	1.05			
Step 2:	Malevolent Environment					75.29	2	0.00
		0.00	0.16	1.00	1.00			
	Gender							
		0.06	0.01	0.00	1.06			
Step 3:	Malevolent Environment							
		0.04	0.16	0.79	1.04			
	Gender							
		-0.01	0.01	0.32	1.01	76.26	3	0.00
	Malevolent Environment x Gender							

	[illegible]	-0.01	0.01	0.32	1.01	76.26	3	0.00

Table 7a. Logistic Regressions for Antisocial Personality Disorder — Current (n=1594): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0:	CONSTANT in the model					321.23		
Step 1:	Traditional Combat	0.03	0.01	0.02	1.03			
	Atrocities - Abusive Violence	0.05	0.02	0.05	1.05			
	Perceived Threat	-0.05	0.06	0.33	1.06			
	Malevolent Environment	0.04	0.02	0.11	1.04	33.58	4	0.00
Step 2:	Traditional Combat	0.02	0.02	0.17	1.02			
	Atrocities - Abusive Violence	0.06	0.03	0.04	1.06			
	Perceived Threat	-0.05	0.06	0.42	1.05			
	Malevolent Environment	0.04	0.02	0.11	1.04			
	Gender	-7.36	12.62	0.56	1666.67	49.61	5	0.00
Step 3:	Traditional Combat	0.02	0.02	0.17	1.02			
	Atrocities - Abusive Violence	0.06	0.03	0.04	1.06			
	Perceived Threat	-0.05	0.06	0.42	1.05			
	Malevolent Environment	0.04	0.02	0.11	1.04			
	Gender	-7.24	13.37	0.59	1428.57			
	Traditional Combat x Gender	-0.02	1.38	0.99	1.02			
	Atrocities - Abusive Violence x Gender	-0.06	2.87	0.98	1.06			
	Perceived Threat x Gender	0.05	3.44	0.99	1.05			
	Malevolent Environment x Gender	-0.04	1.63	0.98	1.04	49.61	9	0.00

Table 7b. Logistic Regressions for Antisocial Personality Disorder — Current: Individual War Zone Stressors

Variables in the Equation		Variable				Model		
		Coefficient	SE	p	OR	X_2	df	p
	n = 1602					321.56		
Step 0:	CONSTANT in the model					26.80	1	0.00
Step 1:	Traditional Combat	0.04	0.01	0.00	1.04			
Step 2:	Traditional Combat	0.04	0.01	0.00	1.04	42.42	2	0.00
	Gender	-7.33	12.80	0.57	1428.57			
Step 3:	Traditional Combat	0.04	0.01	0.00	1.04			
	Gender	-7.31	13.31	0.58	1428.57			
	Traditional Combat x Gender	-0.04	0.97	0.97	1.04	42.42	3	0.00
	n = 1596					321.31		
Step 0:	CONSTANT in the model					23.02	1	0.00
Step 1:	Atrocities - Abusive Violence	0.09	0.02	0.00	1.10			
Step 2:	Atrocities - Abusive Violence	0.10	0.02	0.00	1.10	43.03	2	0.00
	Gender	-7.66	12.50	0.54	2000.00			
Step 3:	Atrocities - Abusive Violence	0.10	0.02	0.00	1.10			
	Gender	-7.39	13.14	0.57	1666.67			
	Atrocities - Abusive Violence x Gender	-0.10	2.45	0.97	1.10	43.03	3	0.00
	n = 1604					321.64		
Step 0:	CONSTANT in the model					15.97	1	0.00
Step 1:	Perceived Threat	0.12	0.03	0.00	1.13			
Step 2:	Perceived Threat	0.11	0.03	0.00	1.12	35.28	2	0.00
	Gender	-7.53	12.75	0.55	2000.00			
Step 3:	Perceived Threat	0.11	0.03	0.00	1.12			
	Gender	-7.43	13.08	0.57	1666.67			
	Perceived Threat x Gender	-0.11	2.36	0.96	1.12	35.28	3	0.00
	n = 1604					321.64		
Step 0:	CONSTANT in the model					17.82	1	0.00
Step 1:	Malevolent Environment	0.07	0.02	0.00	1.07			
Step 2:	Malevolent Environment	0.06	0.02	0.00	1.07	36.97	2	0.00
	Gender	-7.52	12.73	0.55	2000.00			
Step 3:	Malevolent Environment	0.06	0.02	0.00	1.07			
	Gender	-7.40	13.10	0.57	1666.67			
	Malevolent Environment x Gender	-0.06	1.28	0.96	1.07	36.97	3	0.00

Table 7c. Logistic Regressions for Antisocial Personality Disorder — Lifetime (n=1605): All War Zone Stressors

Variables in the Equation		Variable				Model		
		Coefficient	SE	p	OR	X^2	df	p
Step 0:	CONSTANT in the model					897.78		
Step 1:	Traditional Combat	0.01	0.01	0.06	1.01			
	Atrocities - Abusive Violence	0.06	0.02	0.00	1.06			
	Perceived Threat	-0.04	0.03	0.22	1.04			
	Malevolent Environment	0.02	0.01	0.04	1.02	60.65	4	0.00
Step 2:	Traditional Combat	0.01	0.01	0.47	1.01			
	Atrocities - Abusive Violence	0.06	0.02	0.00	1.07			
	Perceived Threat	-0.03	0.03	0.40	1.03			
	Malevolent Environment	0.03	0.01	0.03	1.03			
	Gender	-3.90	1.01	0.00	49.50	126.26	5	0.00
Step 3:	Traditional Combat	0.01	0.01	0.56	1.01			
	Atrocities - Abusive Violence	0.07	0.02	0.00	1.07			
	Perceived Threat	-0.02	0.03	0.46	1.02			
	Malevolent Environment	0.03	0.01	0.04	1.03			
	Gender	-7.83	5.71	0.17	2500.00			
	Traditional Combat x Gender	0.09	0.13	0.48	1.10			
	Atrocities - Abusive Violence x Gender	-1.26	1.41	0.37	3.51			
	Perceived Threat x Gender	-0.26	0.34	0.45	1.29			
	Malevolent Environment x Gender	0.07	0.12	0.57	1.07	129.23	9	0.00

Table 7d. Logistic Regressions for Antisocial Personality Disorder — Lifetime: Individual War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
	n = 1613					899.11		
Step 0:	CONSTANT in the model					41.00	1	0.00
Step 1:	Traditional Combat	0.03	0.00	0.00	1.03			
Step 2:	Traditional Combat	0.02	0.00	0.00	1.02	104.94	2	0.00
	Gender	-3.82	1.00	0.00	45.45			
Step 3:	Traditional Combat	0.02	0.00	0.00	1.02			
	Gender	-3.83	1.03	0.00	45.87			
	Traditional Combat x Gender	-0.02	0.08	0.75	1.02	105.05	3	0.00
	n = 1607					898.11		
Step 0:	CONSTANT in the model					50.37	1	0.00
Step 1:	Atrocities - Abusive Violence	0.08	0.01	0.00	1.09			
Step 2:	Atrocities - Abusive Violence	0.08	0.01	0.00	1.08	119.71	2	0.00
	Gender	-3.96	1.01	0.00	52.63			
Step 3:	Atrocities - Abusive Violence	0.08	0.01	0.00	1.08			
	Gender	-5.68	3.64	0.12	294.12			
	Atrocities - Abusive Violence x Gender	-0.71	0.92	0.44	2.03	121.69	3	0.00
	n = 1615					899.45		
Step 0:	CONSTANT in the model					24.69	1	0.00
Step 1:	Perceived Threat	0.08	0.02	0.00	1.08			
Step 2:	Perceived Threat	0.07	0.02	0.00	1.07	95.93	2	0.00
	Gender	-3.92	1.00	0.00	50.25			
Step 3:	Perceived Threat	0.07	0.02	0.00	1.07			
	Gender	-3.99	1.14	0.00	54.05			
	Perceived Threat x Gender	-0.16	0.20	0.43	1.17	96.63	3	0.00
	n = 1615					899.45		
Step 0:	CONSTANT in the model					29.79	1	0.00
Step 1:	Malevolent Environment	0.05	0.01	0.00	1.05			
Step 2:	Malevolent Environment	0.04	0.01	0.00	1.04	100.37	2	0.00
	Gender	-3.91	1.00	0.00	49.75			
Step 3:	Malevolent Environment	0.04	0.01	0.00	1.04			
	Gender	-3.87	1.03	0.00	48.08			
	Malevolent Environment x Gender	-0.01	0.09	0.91	1.01	100.38	3	0.00

				0.91	1.01	100.38	3	0.00

Table 8a. Logistic Regressions for Manic Episode — Current (n=1605): All War Zone Stressors

Variables in the Equation		Variable				Model		
		Coefficient	SE	p	OR	X^2	df	p
Step 0:	CONSTANT in the model					151.11		
Step 1:	Traditional Combat	0.05	0.02	0.01	1.06			
	Atrocities - Abusive Violence	0.07	0.03	0.05	1.07			
	Perceived Threat	0.03	0.10	0.75	1.03			
	Malevolent Environment	0.06	0.04	0.12	1.07	50.26	4	0.00
Step 2:	Traditional Combat	0.06	0.02	0.01	1.06			
	Atrocities - Abusive Violence	0.06	0.03	0.06	1.07			
	Perceived Threat	0.03	0.10	0.76	1.03			
	Malevolent Environment	0.06	0.04	0.11	1.07			
	Gender	0.20	0.89	0.82	1.22	50.31	5	0.00
Step 3:	Traditional Combat	0.09	0.03	0.00	1.09			
	Atrocities - Abusive Violence	0.01	0.05	0.79	1.01			
	Perceived Threat	0.02	0.12	0.87	1.02			
	Malevolent Environment	0.08	0.05	0.10	1.09			
	Gender	-0.63	3.15	0.84	1.88			
	Traditional Combat x Gender	-0.09	0.06	0.15	1.10			
	Atrocities - Abusive Violence x Gender	0.36	0.19	0.06	1.44			
	Perceived Threat x Gender	-0.23	0.36	0.51	1.26			
	Malevolent Environment x Gender	-0.27	0.16	0.10	1.31	62.82	9	0.00

Table 8b. Logistic Regressions for Manic Episode — Current: Individual War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
	n = 1614					151.25		
Step 0:	CONSTANT in the model	0.09	0.02	0.00	1.09	40.15	1	0.00
Step 1:	Traditional Combat	0.09	0.02	0.00	1.09			
Step 2:	Traditional Combat	0.21	0.85	0.81	1.23	40.21	2	0.00
	Gender	0.11	0.02	0.00	1.12			
Step 3:	Traditional Combat	2.07	1.22	0.09	7.93			
	Gender	-0.08	0.04	0.07	1.08	44.63	3	0.00
	Traditional Combat x Gender							
	n = 1607					151.14		
Step 0:	CONSTANT in the model	0.14	0.03	0.00	1.16	29.08	1	
Step 1:	Atrocities - Abusive Violence	0.14	0.03	0.00	1.15			
Step 2:	Atrocities - Abusive Violence	-0.80	0.91	0.38	2.22	29.98	2	0.00
	Gender	0.14	0.03	0.00	1.16			
Step 3:	Atrocities - Abusive Violence	-0.76	1.14	0.51	2.13			
	Gender	0.00	0.06	0.95	1.00	29.98	3	0.00
	Atrocities - Abusive Violence x Gender							
	n = 1616					151.29		
Step 0:	CONSTANT in the model	0.31	0.06	0.00	1.37	34.41	1	0.00
Step 1:	Perceived Threat	0.31	0.06	0.00	1.37			
Step 2:	Perceived Threat	-0.45	0.79	0.57	1.56	34.76	2	0.00
	Gender	0.36	0.08	0.00	1.44			
Step 3:	Perceived Threat	1.09	1.25	0.38	2.97			
	Gender	-0.20	0.15	0.17	1.22	36.59	3	0.00
	Perceived Threat x Gender							
	n = 1616					151.29		
Step 0:	CONSTANT in the model	0.15	0.03	0.00	1.16	28.59	1	0.00
Step 1:	Malevolent Environment	0.15	0.03	0.00	1.16			
Step 2:	Malevolent Environment	-0.48	0.78	0.54	1.62	29.01	2	0.00
	Gender	0.17	0.04	0.00	1.19			
Step 3:	Malevolent Environment	0.91	1.11	0.41	2.48			
	Gender	-0.11	0.08	0.14	1.12	31.20	3	0.00
	Malevolent Environment x Gender							

	Gender	0.91	1.11	0.41	2.48		
	Malevolent Environment x Gender	-0.11	0.08	0.14	1.12	31.20	3	0.00

Table 8c. Logistic Regressions for Manic Episode — Lifetime (n=1605): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0:	CONSTANT in the model					188.44		
Step 1:	Traditional Combat	0.04	0.02	0.05	1.04			
	Atrocities - Abusive Violence	0.06	0.03	0.05	1.06			
	Perceived Threat	-0.03	0.08	0.72	1.03			
	Malevolent Environment	0.08	0.03	0.01	1.09	44.18	4	0.00
Step 2:	Traditional Combat	0.04	0.02	0.02	1.05			
	Atrocities - Abusive Violence	0.05	0.03	0.08	1.05			
	Perceived Threat	-0.03	0.08	0.69	1.03			
	Malevolent Environment	0.08	0.03	0.01	1.09			
	Gender	0.97	0.61	0.11	2.64	46.46	5	0.00
Step 3:	Traditional Combat	0.09	0.03	0.00	1.09			
	Atrocities - Abusive Violence	0.01	0.05	0.89	1.01			
	Perceived Threat	-0.01	0.11	0.92	1.01			
	Malevolent Environment	0.08	0.05	0.08	1.08			
	Gender	2.47	1.17	0.03	11.88			
	Traditional Combat x Gender	-0.14	0.07	0.04	1.14			
	Atrocities - Abusive Violence x Gender	0.11	0.07	0.15	1.11			
	Perceived Threat x Gender	-0.06	0.17	0.75	1.06			
	Malevolent Environment x Gender	-0.02	0.07	0.83	1.02	58.11	9	0.00

Table 8d. Logistic Regressions for Manic Episode — Lifetime: Individual War Zone Stressors

Variables in the Equation	Variable				Model		
	Coefficient	SE	p	OR	X_2	df	p
n = 1614					188.63		
Step 0: CONSTANT in the model	0.06	0.01	0.00	1.07	31.25	1	0.00
Step 1: Traditional Combat	0.07	0.01	0.00	1.07			
Step 2: Traditional Combat	0.93	0.59	0.11	2.53	33.54	2	0.00
Gender	0.10	0.02	0.00	1.11			
Step 3: Traditional Combat	2.58	0.97	0.01	13.15			
Gender	-0.10	0.04	0.01	1.10	42.63	3	0.00
Traditional Combat x Gender							
n = 1607					188.48		
Step 0: CONSTANT in the model	0.12	0.02	0.00	1.13	26.18	1	0.00
Step 1: Atrocities - Abusive Violence	0.13	0.02	0.00	1.13			
Step 2: Atrocities - Abusive Violence	0.30	0.58	0.61	1.35	26.43	2	0.00
Gender	0.14	0.03	0.00	1.15			
Step 3: Atrocities - Abusive Violence	0.51	0.67	0.44	1.67			
Gender	-0.03	0.05	0.54	1.03	26.80	3	0.00
Atrocities - Abusive Violence x Gender							
n = 1616					188.67		
Step 0: CONSTANT in the model	0.23	0.05	0.00	1.25	26.60	1	0.00
Step 1: Perceived Threat	0.23	0.05	0.00	1.26			
Step 2: Perceived Threat	0.37	0.55	0.50	1.45	27.03	2	0.00
Gender	0.33	0.07	0.00	1.38			
Step 3: Perceived Threat	1.85	0.86	0.03	6.33			
Gender	-0.25	0.11	0.02	1.28	32.88	3	0.00
Perceived Threat x Gender							
n = 1616					188.67		
Step 0: CONSTANT in the model	0.13	0.03	0.00	1.14	31.38	1	0.00
Step 1: Malevolent Environment	0.13	0.03	0.00	1.14			
Step 2: Malevolent Environment	0.38	0.55	0.49	1.46	31.84	2	0.00
Gender	0.16	0.04	0.00	1.18			
Step 3: Malevolent Environment	1.33	0.90	0.14	3.77			
Gender	-0.07	0.06	0.19	1.08	33.58	3	0.00
Malevolent Environment x Gender							

Gender	1.33	0.90	0.14	3.77			
Malevolent Environment x Gender	-0.07	0.06	0.19	1.08	33.58	3	0.00

Table 9a. Logistic Regressions for Panic Disorder — Current (n=1607): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0:	CONSTANT in the model	..				232.50		
Step 1:	Traditional Combat	0.02	0.02	0.28	1.02			
	Atrocities - Abusive Violence	0.06	0.03	0.03	1.06			
	Perceived Threat	0.09	0.07	0.22	1.09			
	Malevolent Environment	0.06	0.03	0.04	1.06	60.94	4	0.00
Step 2:	Traditional Combat	0.03	0.02	0.11	1.03			
	Atrocities - Abusive Violence	0.06	0.03	0.05	1.06			
	Perceived Threat	0.08	0.07	0.25	1.09			
	Malevolent Environment	0.06	0.03	0.03	1.07			
	Gender	1.13	0.55	0.04	3.10	64.79	5	0.00
Step 3:	Traditional Combat	0.02	0.02	0.41	1.02			
	Atrocities - Abusive Violence	0.07	0.04	0.08	1.07			
	Perceived Threat	0.10	0.10	0.28	1.11			
	Malevolent Environment	0.06	0.04	0.10	1.07			
	Gender	1.19	0.96	0.22	3.28			
	Traditional Combat x Gender	0.02	0.04	0.66	1.02			
	Atrocities - Abusive Violence x Gender	-0.02	0.06	0.70	1.02			
	Perceived Threat x Gender	-0.05	0.14	0.74	1.05			
	Malevolent Environment x Gender	0.01	0.06	0.91	1.01	65.09	9	0.00

Table 9b. Logistic Regressions for Panic Disorder — Current: Individual War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
	n = 1616					241.27		
Step 0:	CONSTANT in the model					45.23	1	0.00
Step 1:	Traditional Combat	0.07	0.01	0.00	1.07			
Step 2:	Traditional Combat	0.07	0.01	0.00	1.08	49.23	2	0.00
	Gender	1.08	0.52	0.04	2.95			
Step 3:	Traditional Combat	0.08	0.01	0.00	1.08			
	Gender	1.31	0.74	0.08	3.69			
	Traditional Combat x Gender	-0.01	0.02	0.66	1.01	49.19	3	0.00
	n = 1609					232.56		
Step 0:	CONSTANT in the model					37.92	1	0.00
Step 1:	Atrocities - Abusive Violence	0.14	0.02	0.00	1.15			
Step 2:	Atrocities - Abusive Violence	0.14	0.02	0.00	1.15	38.94	2	0.00
	Gender	0.52	0.51	0.30	1.69			
Step 3:	Atrocities - Abusive Violence	0.15	0.03	0.00	1.16			
	Gender	0.67	0.60	0.27	1.95			
	Atrocities - Abusive Violence x Gender	-0.02	0.05	0.67	1.02	39.12	3	0.00
	n = 1618					241.33		
Step 0:	CONSTANT in the model					50.11	1	0.00
Step 1:	Perceived Threat	0.28	0.05	0.00	1.32			
Step 2:	Perceived Threat	0.28	0.05	0.00	1.33	51.10	2	0.00
	Gender	0.49	0.48	0.31	1.63			
Step 3:	Perceived Threat	0.31	0.06	0.00	1.36			
	Gender	1.00	0.86	0.25	2.72			
	Perceived Threat x Gender	-0.07	0.10	0.48	1.07	51.59	3	0.00
	n = 1618					241.33		
Step 0:	CONSTANT in the model					47.17	1	0.00
Step 1:	Malevolent Environment	0.14	0.02	0.00	1.15			
Step 2:	Malevolent Environment	0.14	0.02	0.00	1.16	48.05	2	0.00
	Gender	0.46	0.48	0.33	1.59			
Step 3:	Malevolent Environment	0.16	0.03	0.00	1.17			
	Gender	0.88	0.83	0.29	2.41			
	Malevolent Environment x Gender	-0.03	0.05	0.54	1.03	48.43	3	0.00

	Malevolent Environment x Gender	0.88	0.83	0.29	2.41			
		-0.03	0.05	0.54	1.03	48.43	3	0.00

Table 9c. Logistic Regressions for Panic Disorder — Lifetime (n=1607): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0:	CONSTANT in the model					381.77		
Step 1:	Traditional Combat	0.00	0.01	0.81	1.00			
	Atrocities - Abusive Violence	0.07	0.02	0.00	1.07			
	Perceived Threat	0.01	0.05	0.87	1.01			
	Malevolent Environment	0.08	0.02	0.00	1.08	66.96	4	0.00
Step 2:	Traditional Combat	0.01	0.01	0.58	1.01			
	Atrocities - Abusive Violence	0.07	0.02	0.01	1.07			
	Perceived Threat	0.00	0.05	0.93	1.00			
	Malevolent Environment	0.08	0.02	0.00	1.08			
	Gender	0.55	0.39	0.16	1.74	68.83	5	0.00
Step 3:	Traditional Combat	0.01	0.02	0.60	1.01			
	Atrocities - Abusive Violence	0.06	0.03	0.06	1.06			
	Perceived Threat	-0.00	0.06	0.94	1.00			
	Malevolent Environment	0.07	0.03	0.01	1.07			
	Gender	-0.33	0.66	0.62	1.40			
	Traditional Combat x Gender	0.01	0.03	0.76	1.01			
	Atrocities - Abusive Violence x Gender	0.03	0.06	0.60	1.03			
	Perceived Threat x Gender	0.04	0.11	0.72	1.04			
	Malevolent Environment x Gender	0.05	0.05	0.33	1.05	73.04	9	0.00

Table 9d. Logistic Regressions for Panic Disorder — Lifetime: Individual War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
	n = 1616					389.50		
Step 0:	CONSTANT in the model	0.04	0.01	0.00	1.05	37.96	1	0.00
Step 1:	Traditional Combat	0.05	0.01	0.00	1.05			
Step 2:	Traditional Combat	0.58	0.37	0.12	1.79	40.28	2	0.00
	Gender	0.04	0.01	0.00	1.05			
Step 3:	Traditional Combat	0.37	0.44	0.40	1.45			
	Gender	0.02	0.02	0.35	1.02	41.17	3	0.00
	Traditional Combat x Gender							
	n= 1609					381.87		
Step 0:	CONSTANT in the model	0.11	0.02	0.00	1.12	42.10	1	0.00
Step 1:	Atrocities - Abusive Violence	0.12	0.02	0.00	1.12			
Step 2:	Atrocities - Abusive Violence	0.36	0.37	0.34	1.43	42.98	2	0.00
	Gender	0.10	0.02	0.00	1.11			
Step 3:	Atrocities - Abusive Violence	0.10	0.43	0.82	1.10			
	Gender	0.05	0.04	0.21	1.05	44.58	3	0.00
	Atrocities - Abusive Violence x Gender							
	n = 1618					389.61		
Step 0:	CONSTANT in the model	0.17	0.03	0.00	1.19	40.46	1	0.00
Step 1:	Perceived Threat	0.18	0.03	0.00	1.19			
Step 2:	Perceived Threat	0.27	0.35	0.44	1.32	41.04	2	0.00
	Gender	0.16	0.03	0.00	1.17			
Step 3:	Perceived Threat	-0.02	0.51	0.97	1.02			
	Gender	0.06	0.07	0.40	1.06	41.75	3	0.00
	Perceived Threat x Gender							
	n = 1618					389.61		
Step 0:	CONSTANT in the model	0.12	0.02	0.00	1.12	58.55	1	0.00
Step 1:	Malevolent Environment	0.12	0.02	0.00	1.12			
Step 2:	Malevolent Environment	0.33	0.36	0.36	1.39	59.34	2	0.00
	Gender	0.10	0.02	0.00	1.11			
Step 3:	Malevolent Environment	-0.28	0.60	0.64	1.32			
	Gender	0.05	0.04	0.18	1.05	61.24	3	0.00
	Malevolent Environment x Gender							

Step 3:	Malevolent Environment	0.10	0.02	0.00	1.11			
	Gender	-0.28	0.60	0.64	1.32			
	Malevolent Environment x Gender	0.05	0.04	0.18	1.05	61.24	3	0.00

Table 10a. Logistic Regressions for Obsessive Compulsive Disorder — Current (n=1607): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0:	CONSTANT in the model					266.03		
Step 1:	Traditional Combat	0.03	0.02	0.10	1.04			
	Atrocities - Abusive Violence	0.03	0.03	0.00	1.03			
	Perceived Threat	-0.06	0.06	0.00	1.00			
	Malevolent Environment	0.07	0.03	0.15	1.08	37.82	4	0.00
Step 2:	Traditional Combat	0.03	0.02	0.04	1.03			
	Atrocities - Abusive Violence	0.03	0.03	0.33	1.03			
	Perceived Threat	-0.06	0.06	0.37	1.06			
	Malevolent Environment	0.07	0.03	0.01	1.08			
	Gender	-0.24	0.57	0.68	1.27	38.00	5	0.00
Step 3:	Traditional Combat	0.03	0.02	0.15	1.03			
	Atrocities - Abusive Violence	0.03	0.03	0.32	1.04			
	Perceived Threat	-0.05	0.08	0.49	1.05			
	Malevolent Environment	0.09	0.03	0.00	1.10			
	Gender	0.33	0.66	0.62	1.39			
	Traditional Combat x Gender	-0.01	0.05	0.89	1.00			
	Atrocities - Abusive Violence x Gender	0.00	0.10	1.00	1.00			
	Perceived Threat x Gender	-.00	0.15	1.00	1.00			
	Malevolent Environment x Gender	-0.10	0.71	0.14	1.11	42.36	9	0.00

Table 10b. Logistic Regressions for Obsessive Compulsive Disorder — Current: Individual War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
	n = 1615							
Step 0:	CONSTANT in the model					266.29		
Step 1:	Traditional Combat	0.05	0.01	0.00	1.05	28.08	1	0.00
Step 2:	Traditional Combat	0.05	0.01	0.00	1.05			
	Gender	-0.25	0.57	0.66	1.28	28.28	2	0.00
Step 3:	Traditional Combat	0.05	0.01	0.00	1.05			
	Gender	0.02	0.61	0.98	1.02			
	Traditional Combat x Gender	-0.04	0.03	0.29	1.04	29.67	3	0.00
	n = 1608							
Step 0:	CONSTANT in the model					266.06		
Step 1:	Atrocities - Abusive Violence	0.09	0.02	0.00	1.10	17.90	1	0.00
Step 2:	Atrocities - Abusive Violence	0.09	0.02	0.00	1.09			
	Gender	-0.63	0.56	0.26	1.88	19.35	2	0.00
Step 3:	Atrocities - Abusive Violence	0.11	0.02	0.00	1.11			
	Gender	-0.35	0.57	0.54	1.42			
	Atrocities - Abusive Violence x Gender	-0.07	0.07	0.27	1.08	21.26	3	0.00
	n = 1617							
Step 0:	CONSTANT in the model					266.35		
Step 1:	Perceived Threat	0.15	0.04	0.00	1.16	19.79	1	0.00
Step 2:	Perceived Threat	0.15	0.04	0.00	1.16			
	Gender	-0.57	0.55	0.29	1.77	21.00	2	0.00
Step 3:	Perceived Threat	0.18	0.04	0.00	1.20			
	Gender	-0.12	0.60	0.84	1.27			
	Perceived Threat x Gender	-0.19	0.10	0.06	1.21	24.73	3	0.00
	n = 1618							
Step 0:	CONSTANT in the model					266.38		
Step 1:	Malevolent Environment	0.10	0.02	0.00	1.10	28.36	1	0.00
Step 2:	Malevolent Environment	0.10	0.02	0.00	1.10			
	Gender	-0.54	0.55	0.33	1.71	29.43	2	0.00
Step 3:	Malevolent Environment	0.12	0.02	0.00	1.13			
	Gender	0.18	0.63	0.78	1.20			
	Malevolent Environment x Gender	-0.12	0.05	0.02	1.32	34.98	3	0.00

Malevolent Environment x Gender	-0.12	0.05	0.02	1.32	34.98	3	0.00

Table 10c. Logistic Regressions for Obsessive Compulsive Disorder --- Lifetime (n=1607): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0:	CONSTANT in the model					329.47		
Step 1:	Traditional Combat	0.03	0.01	0.03	1.03			
	Atrocities - Abusive Violence	0.03	0.02	0.20	1.03			
	Perceived Threat	-0.04	0.06	0.52	1.04			
	Malevolent Environment	0.07	0.02	0.00	1.07	52.68	4	0.00
Step 2:	Traditional Combat	0.03	0.01	0.03	1.03			
	Atrocities - Abusive Violence	0.03	0.02	0.20	1.03			
	Perceived Threat	-0.04	0.06	0.53	1.04			
	Malevolent Environment	0.07	0.02	0.00	1.07			
	Gender	-0.05	0.48	0.92	1.05	52.70	5	0.00
Step 3:	Traditional Combat	0.03	0.02	0.06	1.03			
	Atrocities - Abusive Violence	0.03	0.03	0.34	1.03			
	Perceived Threat	-0.03	0.07	0.67	1.03			
	Malevolent Environment	0.08	0.03	0.00	1.08			
	Gender	0.38	0.58	0.51	1.47			
	Traditional Combat x Gender	-0.03	0.04	0.50	1.03			
	Atrocities - Abusive Violence x Gender	0.02	0.06	0.71	1.02			
	Perceived Threat x Gender	-0.02	0.13	0.89	1.02			
	Malevolent Environment x Gender	-0.04	0.06	0.53	1.04	54.85	9	0.00

Table 10d. Logistic Regressions for Obsessive Compulsive Disorder — Lifetime: Individual War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
	n = 1615							
Step 0:	CONSTANT in the model					329.81		
Step 1:	Traditional Combat	0.05	0.01	0.00	1.05	38.85	1	0.00
Step 2:	Traditional Combat	0.05	0.01	0.00	1.05			
	Gender	-0.05	0.48	0.92	1.05	38.86	2	0.00
Step 3:	Traditional Combat	0.05	0.01	0.00	1.05			
	Gender	0.25	0.52	0.63	1.28			
	Traditional Combat x Gender	-0.03	0.03	0.22	1.03	40.64	3	0.00
	n = 1608							
Step 0:	CONSTANT in the model					329.51		
Step 1:	Atrocities - Abusive Violence	0.10	0.02	0.00	1.10	26.56	1	0.00
Step 2:	Atrocities - Abusive Violence	0.10	0.02	0.00	1.10			
	Gender	-0.44	0.47	0.35	1.55	27.51	2	0.00
Step 3:	Atrocities - Abusive Violence	0.11	0.02	0.00	1.11			
	Gender	-0.24	0.49	0.63	1.27			
	Atrocities - Abusive Violence x Gender	-0.04	0.04	0.30	1.04	28.64	3	0.00
	n = 1617							
Step 0:	CONSTANT in the model					329.89		
Step 1:	Perceived Threat	0.16	0.03	0.00	1.18	30.37	1	0.00
Step 2:	Perceived Threat	0.16	0.03	0.00	1.17			
	Gender	-0.39	0.46	0.39	1.48	31.17	2	0.00
Step 3:	Perceived Threat	0.19	0.04	0.00	1.21			
	Gender	0.09	0.52	0.86	1.10			
	Perceived Threat x Gender	-0.14	0.08	0.09	1.15	34.09	3	0.00
	n = 1618							
Step 0:	CONSTANT in the model					329.94		
Step 1:	Malevolent Environment	0.10	0.02	0.00	1.11	40.20	1	0.00
Step 2:	Malevolent Environment	0.10	0.02	0.00	1.11			
	Gender	-0.37	0.46	0.43	1.44	40.87	2	0.00
Step 3:	Malevolent Environment	0.12	0.03	0.00	1.12			
	Gender	0.17	0.56	0.76	1.19			
	Malevolent Environment x Gender	-0.06	0.04	0.15	1.06	42.92	3	0.00

	Malevolent Environment x Gender	-0.06	0.04	0.15	1.06	42.92	3	0.00

Table 11a. Logistic Regressions for Dysthymic Disorder (n=1604): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0:	CONSTANT in the model					693.33		
Step 1:	Traditional Combat	-0.00	0.01	0.89	1.00			
	Atrocities - Abusive Violence	0.05	0.02	0.00	1.05			
	Perceived Threat	0.10	0.04	0.00	1.11			
	Malevolent Environment	0.04	0.01	0.00	1.04	115.53	4	0.00
Step 2:	Traditional Combat	-0.00	0.01	0.92	1.00			
	Atrocities - Abusive Violence	0.05	0.02	0.00	1.05			
	Perceived Threat	0.10	0.04	0.00	1.10			
	Malevolent Environment	0.04	0.01	0.00	1.04			
	Gender	0.05	0.29	0.87	1.05	115.56	5	0.00
Step 3:	Traditional Combat	-0.00	0.01	0.93	1.00			
	Atrocities - Abusive Violence	0.05	0.02	0.02	1.05			
	Perceived Threat	0.12	0.04	0.01	1.13			
	Malevolent Environment	0.04	0.02	0.02	1.04			
	Gender	0.18	0.35	0.60	1.20			
	Traditional Combat x Gender	-0.01	0.02	0.82	1.01			
	Atrocities - Abusive Violence x Gender	0.02	0.04	0.63	1.02			
	Perceived Threat x Gender	-0.05	0.08	0.47	1.06			
	Malevolent Environment x Gender	0.01	0.03	0.86	1.01	116.74	9	0.00

Table 11b. Logistic Regressions for Dysthymic Disorder: Individual War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
	n = 1612							
Step 0:	CONSTANT in the model					699.90		
Step 1:	Traditional Combat	0.04	0.01	0.00	1.05	75.35	1	0.00
Step 2:	Traditional Combat	0.04	0.01	0.00	1.05			
	Gender	0.14	0.28	0.61	1.15	75.61	2	0.00
Step 3:	Traditional Combat	0.05	0.01	0.00	1.05			
	Gender	0.23	0.30	0.44	1.26			
	Traditional Combat x Gender	-0.01	0.01	0.43	1.01	76.23	3	0.00
	n = 1606							
Step 0:	CONSTANT in the model					693.56		
Step 1:	Atrocities - Abusive Violence	0.11	0.01	0.00	1.11	67.03	1	0.00
Step 2:	Atrocities - Abusive Violence	0.11	0.01	0.00	1.11			
	Gender	-0.08	0.27	0.78	1.08	67.11	2	0.00
Step 3:	Atrocities - Abusive Violence	0.11	0.01	0.00	1.11			
	Gender	-0.06	0.29	0.83	1.06			
	Atrocities - Abusive Violence x Gender	-0.00	0.03	0.89	1.00	67.13	3	0.00
	n = 1614							
Step 0:	CONSTANT in the model					700.13		
Step 1:	Perceived Threat	0.19	0.02	0.00	1.21	95.31	1	0.00
Step 2:	Perceived Threat	0.19	0.02	0.00	1.21			
	Gender	-0.11	0.27	0.69	1.11	95.47	2	0.00
Step 3:	Perceived Threat	0.20	0.03	0.00	1.23			
	Gender	0.19	0.34	0.58	1.20			
	Perceived Threat x Gender	-0.07	0.05	0.18	1.07	97.26	3	0.00
	n = 1613							
Step 0:	CONSTANT in the model					705.64		
Step 1:	Malevolent Environment	0.09	0.01	0.00	1.10	85.29	1	0.00
Step 2:	Malevolent Environment	0.09	0.01	0.00	1.10			
	Gender	-0.13	0.27	0.62	1.14	85.54	2	0.00
Step 3:	Malevolent Environment	0.10	0.01	0.00	1.10			
	Gender	-0.01	0.33	0.97	1.01			
	Malevolent Environment x Gender	-0.02	0.03	0.56	1.02	85.88	3	0.00

Table 12a. Logistic Regressions for PTSD — Current (n=1599): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0:	CONSTANT in the model					1429.57		
Step 1:	Traditional Combat	-0.01	0.01	0.43	1.01			
	Atrocities - Abusive Violence	0.09	0.01	0.00	1.09			
	Perceived Threat	0.09	0.02	0.00	1.09			
	Malevolent Environment	0.07	0.01	0.00	1.07	362.12	4	0.00
Step 2:	Traditional Combat	-0.01	0.01	0.06	1.01			
	Atrocities - Abusive Violence	0.09	0.01	0.00	1.09			
	Perceived Threat	0.10	0.02	0.00	1.11			
	Malevolent Environment	0.07	0.01	0.00	1.07			
	Gender	-1.25	0.23	0.00	3.48	396.27	5	0.00
Step 3:	Traditional Combat	-0.01	0.01	0.19	1.01			
	Atrocities - Abusive Violence	0.09	0.01	0.00	1.09			
	Perceived Threat	0.09	0.03	0.00	1.09			
	Malevolent Environment	0.07	0.01	0.00	1.07			
	Gender	-1.43	0.34	0.00	4.16			
	Traditional Combat x Gender	-0.02	0.02	0.35	1.02			
	Atrocities - Abusive Violence x Gender	0.03	0.04	0.50	1.03			
	Perceived Threat x Gender	0.08	0.06	0.20	1.09			
	Malevolent Environment x Gender	-0.01	0.03	0.65	1.01	398.27	9	0.00

Table 12b. Logistic Regressions for PTSD — Current: Individual War Zone Stressors

Variables in the Equation		Variable				Model		
		Coefficient	SE	p	OR	X_2	df	p
	n = 1606							
Step 0:	CONSTANT in the model					1441.83		
Step 1:	Traditional Combat	0.05	0.00	0.00	1.05	214.94	1	0.00
Step 2:	Traditional Combat	0.05	0.00	0.00	1.05			
	Gender	-1.01	0.22	0.00	2.75	240.73	2	0.00
Step 3:	Traditional Combat	0.05	0.00	0.00	1.05			
	Gender	-1.00	0.23	0.00	2.71			
	Traditional Combat x Gender	-0.00	0.01	0.85	1.00	240.76	3	0.00
	n = 1599							
Step 0:	CONSTANT in the model					1429.57		
Step 1:	Atrocities - Abusive Violence	0.15	0.01	0.00	1.16	225.31	1	0.00
Step 2:	Atrocities - Abusive Violence	0.14	0.01	0.00	1.15			
	Gender	-1.18	0.22	0.00	3.27	260.03	2	0.00
Step 3:	Atrocities - Abusive Violence	0.14	0.01	0.00	1.15			
	Gender	-1.18	0.24	0.00	3.27			
	Atrocities - Abusive Violence x Gender	-0.00	0.03	0.99	1.00	260.03	3	0.00
	n = 1608							
Step 0:	CONSTANT in the model					1445.78		
Step 1:	Perceived Threat	0.20	0.01	0.00	1.22	251.72	1	0.00
Step 2:	Perceived Threat	0.20	0.01	0.00	1.22			
	Gender	-1.30	0.22	0.00	3.67	294.75	2	0.00
Step 3:	Perceived Threat	0.20	0.02	0.00	1.22			
	Gender	-1.36	0.30	0.00	3.90			
	Perceived Threat x Gender	0.01	0.04	0.74	1.01	294.86	3	0.00
	n = 1610							
Step 0:	CONSTANT in the model					1452.95		
Step 1:	Malevolent Environment	0.11	0.01	0.00	1.12	271.97	1	0.00
Step 2:	Malevolent Environment	0.11	0.01	0.00	1.12			
	Gender	-1.32	0.22	0.00	3.73	315.48	2	0.00
Step 3:	Malevolent Environment	0.11	0.01	0.00	1.12			
	Gender	-1.28	0.29	0.00	3.58			
	Malevolent Environment x Gender	-0.01	0.02	0.82	1.01	315.54	3	0.00

							515.54	3	0.00

Table 12c. Logistic Regressions for PTSD — Lifetime (n=): All War Zone Stressors

	Variable				Model		
Variables in the Equation	**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0: CONSTANT in the model							
Step 1: Traditional Combat							
Atrocities - Abusive Violence							
Perceived Threat							
Malevolent Environment						1	
Step 2: Traditional Combat							
Atrocities - Abusive Violence							
Perceived Threat							
Malevolent Environment							
Gender						5	
Step 3: Traditional Combat							
Atrocities - Abusive Violence							
Perceived Threat							
Malevolent Environment							
Gender							
Traditional Combat x Gender							
Atrocities - Abusive Violence x Gender							
Perceived Threat x Gender							
Malevolent Environment x Gender						9	

Table 12d. Logistic Regressions for PTSD — Lifetime: Individual War Zone Stressors

Variables in the Equation	Variable				Model		
	Coefficient	SE	p	OR	X_2	df	p
n =							
Step 0: CONSTANT in the model						1	
Step 1: Traditional Combat							
Step 2: Traditional Combat						2	
Gender							
Step 3: Traditional Combat							
Gender						3	
Traditional Combat x Gender							
n =							
Step 0: CONSTANT in the model						1	
Step 1: Atrocities - Abusive Violence							
Step 2: Atrocities - Abusive Violence						2	
Gender							
Step 3: Atrocities - Abusive Violence							
Gender						3	
Atrocities - Abusive Violence x Gender							
n =							
Step 0: CONSTANT in the model						1	
Step 1: Perceived Threat							
Step 2: Perceived Threat						2	
Gender							
Step 3: Perceived Threat							
Gender						3	
Perceived Threat x Gender							
n =							
Step 0: CONSTANT in the model						1	
Step 1: Malevolent Environment							
Step 2: Malevolent Environment						2	
Gender							
Step 3: Malevolent Environment							
Gender						3	
Malevolent Environment x Gender							

Table 13a. Logistic Regressions for Any Disorder, Including PTSD — Current (n=1608): All War Zone Stresors

	Variable				Model		
Variables in the Equation	**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0: CONSTANT in the model					1902.69		
Step 1: Traditional Combat	0.00	0.01	0.95	1.00			
Atrocities - Abusive Violence	0.06	0.01	0.00	1.06			
Perceived Threat	0.03	0.02	0.06	1.04			
Malevolent Environment	0.04	0.01	0.00	1.04	214.14	4	0.00
Step 2: Traditional Combat	-0.00	0.01	0.45	1.00			
Atrocities - Abusive Violence	0.06	0.01	0.00	1.06			
Perceived Threat	0.04	0.02	0.02	1.05			
Malevolent Environment	0.04	0.01	0.00	1.04			
Gender	-0.98	0.16	0.00	2.67	257.59	5	0.00
Step 3: Traditional Combat	0.00	0.01	0.96	1.00			
Atrocities - Abusive Violence	0.06	0.01	0.00	1.06			
Perceived Threat	0.03	0.02	0.20	1.03			
Malevolent Environment	0.04	0.01	0.00	1.04			
Gender	-1.07	0.18	0.00	2.92			
Traditional Combat x Gender	-0.03	0.02	0.06	1.03			
Atrocities - Abusive Violence x Gender	-0.03	0.03	0.35	1.03			
Perceived Threat x Gender	0.06	0.04	0.13	1.07			
Malevolent Environment x Gender	0.01	0.02	0.57	1.01	264.88	9	0.00

Table 13b. Logistic Regressions for Any Disorder, Including PTSD — Current: Individual War Zone Stressors

	Variable				Model		
Variables in the Equation	**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
n = 1617							
Step 0: CONSTANT in the model					1921.83		
Step 1: Traditional Combat	0.03	0.00	0.00	1.03	136.96	1	0.00
Step 2: Traditional Combat	0.03	0.00	0.00	1.03			
Gender	-0.89	0.16	0.00	2.44	175.54	2	0.00
Step 3: Traditional Combat	0.03	0.00	0.00	1.03			
Gender	-0.88	0.15	0.00	2.41			
Traditional Combat x Gender	-0.02	0.01	0.13	1.01	177.86	3	0.00
n = 1610							
Step 0: CONSTANT in the model					1907.80		
Step 1: Atrocities - Abusive Violence	0.10	0.01	0.00	1.11	138.75	1	0.00
Step 2: Atrocities - Abusive Violence	0.10	0.01	0.00	1.10			
Gender	-0.95	0.15	0.00	2.58	181.79	2	0.00
Step 3: Atrocities - Abusive Violence	0.10	0.01	0.00	1.11			
Gender	-0.92	0.15	0.00	2.52			
Atrocities - Abusive Violence x Gende	-0.05	0.02	0.06	1.05	185.19	3	0.00
n = 1619							
Step 0: CONSTANT in the model					1925.02		
Step 1: Perceived Threat	0.12	0.01	0.00	1.12	147.85	1	0.00
Step 2: Perceived Threat	0.12	0.01	0.00	1.12			
Gender	-1.02	0.15	0.00	2.76	197.72	2	0.00
Step 3: Perceived Threat	0.12	0.01	0.00	1.13			
Gender	-0.99	0.16	0.00	2.70			
Perceived Threat x Gender	-0.01	0.03	0.65	1.01	197.93	3	0.00
n = 1619							
Step 0: CONSTANT in the model					1925.02		
Step 1: Malevolent Environment	0.07	0.01	0.00	1.07	167.71	1	0.00
Step 2: Malevolent Environment	0.07	0.01	0.00	1.07			
Gender	-1.03	0.15	0.00	2.81	218.46	2	0.00
Step 3: Malevolent Environment	0.07	0.01	0.00	1.07			
Gender	-1.03	0.16	0.00	2.79			
Malevolent Environment x Gender	-0.00	0.02	0.89	1.00	218.48	3	0.00

Gender	-1.03	0.16	0.00	2.79			
Malevolent Environment x Gender	-0.00	0.02	0.89	1.00	218.48	3	0.00

Table 13c. Logistic Regressions for Any Disorder, Including PTSD — Lifetime (n=1589): All War Zone Stressors

	Variable				Model		
Variables in the Equation	**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0: CONSTANT in the model					2202.82		
Step 1: Traditional Combat	-0.01	0.00	0.30	1.01			
Atrocities - Abusive Violence	0.05	0.01	0.00	1.05			
Perceived Threat	0.01	0.02	0.55	1.01			
Malevolent Environment	0.04	0.01	0.00	1.04	122.82	4	0.00
Step 2: Traditional Combat	-0.01	0.01	0.10	1.01			
Atrocities - Abusive Violence	0.05	0.01	0.00	1.05			
Perceived Threat	0.02	0.02	0.33	1.02			
Malevolent Environment	0.04	0.01	0.00	1.04			
Gender	-1.09	0.13	0.00	2.98	203.58	5	0.00
Step 3: Traditional Combat	-0.00	0.01	0.48	1.00			
Atrocities - Abusive Violence	0.06	0.01	0.00	1.06			
Perceived Threat	0.00	0.02	0.84	1.00			
Malevolent Environment	0.03	0.01	0.00	1.03			
Gender	-1.16	0.13	0.00	3.19			
Traditional Combat x Gender	-0.02	0.01	0.10	1.02			
Atrocities - Abusive Violence x Gende	-0.04	0.03	0.13	1.04			
Perceived Threat x Gender	0.04	0.04	0.28	1.04			
Malevolent Environment x Gender	0.03	0.02	0.10	1.03	213.57	9	0.00

Table 13d. Logistic Regressions for Any Disorder, Including PTSD — Lifetime: Individual War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
	n = 1595							
Step 0:	CONSTANT in the model					2211.13		
Step 1:	Traditional Combat	0.02	0.00	0.00	1.02	57.86	1	0.00
Step 2:	Traditional Combat	0.02	0.00	0.00	1.02			
	Gender	-1.04	0.12	0.00	2.83	135.08	2	0.00
Step 3:	Traditional Combat	0.02	0.00	0.00	1.02			
	Gender	-1.06	0.12	0.00	2.88			
	Traditional Combat x Gender	-0.01	0.01	0.21	1.01	136.65	3	0.00
	n = 1589							
Step 0:	CONSTANT in the model					2202.82		
Step 1:	Atrocities - Abusive Violence	0.07	0.01	0.00	1.08	77.24	1	0.00
Step 2:	Atrocities - Abusive Violence	0.07	0.01	0.00	1.07			
	Gender	-1.06	0.12	0.00	2.87	155.49	2	0.00
Step 3:	Atrocities - Abusive Violence	0.08	0.01	0.00	1.08			
	Gender	-1.07	0.12	0.00	2.92			
	Atrocities - Abusive Violence x Gende	-0.04	0.02	0.06	1.04	158.90	3	0.00
	n = 1597							
Step 0:	CONSTANT in the model					2213.90		
Step 1:	Perceived Threat	0.07	0.01	0.00	1.07	66.44	1	0.00
Step 2:	Perceived Threat	0.07	0.01	0.00	1.07			
	Gender	-1.09	0.12	0.00	2.97	150.01	2	0.00
Step 3:	Perceived Threat	0.07	0.01	0.00	1.07			
	Gender	-1.09	0.12	0.00	2.97			
	Perceived Threat x Gender	-0.00	0.02	0.88	1.00	150.04	3	0.00
	n = 1599							
Step 0:	CONSTANT in the model					2216.65		
Step 1:	Malevolent Environment	0.05	0.00	0.00	1.05	102.49	1	0.00
Step 2:	Malevolent Environment	0.05	0.01	0.00	1.05			
	Gender	-1.11	0.12	0.00	3.02	186.89	2	0.00
Step 3:	Malevolent Environment	0.05	0.01	0.00	1.05			
	Gender	-1.12	0.13	0.00	3.05			
	Malevolent Environment x Gender	0.01	0.01	0.30	1.01	187.96	3	0.00

Malevolent Environment x Gender	0.01	0.01	0.30	1.01	187.96	3	0.00

Table 14a. Logistic Regressions for Any Disorder, Not Including PTSD — Current (n=1573): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0:	CONSTANT in the model					1470.37		
Step 1:	Traditional Combat	0.00	0.01	0.77	1.00			
	Atrocities - Abusive Violence	0.05	0.01	0.00	1.05			
	Perceived Threat	0.01	0.02	0.68	1.01			
	Malevolent Environment	0.03	0.01	0.00	1.03	92.47	4	0.00
Step 2:	Traditional Combat	-0.00	0.01	0.80	1.00			
	Atrocities - Abusive Violence	0.05	0.01	0.00	1.05			
	Perceived Threat	0.01	0.02	0.52	1.01			
	Malevolent Environment	0.03	0.01	0.00	1.03			
	Gender	-0.82	0.19	0.00	2.26	114.47	5	0.00
Step 3:	Traditional Combat	0.00	0.01	0.80	1.00			
	Atrocities - Abusive Violence	0.05	0.01	0.00	1.05			
	Perceived Threat	0.01	0.02	0.66	1.01			
	Malevolent Environment	0.02	0.01	0.02	1.02			
	Gender	-0.90	0.20	0.00	2.47			
	Traditional Combat x Gender	-0.02	0.02	0.27	1.02			
	Atrocities - Abusive Violence x Gender	0.00	0.03	0.95	1.00			
	Perceived Threat x Gender	0.01	0.05	0.81	1.01			
	Malevolent Environment x Gender	0.03	0.02	0.20	1.03	117.39	9	0.00

Table 14b. Logistic Regressions for Any Disorder, Not Including PTSD — Current: Individual War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
	n = 1580					1482.30		
Step 0:	CONSTANT in the model					57.76	1	0.00
Step 1:	Traditional Combat	0.02	0.00	0.00	1.02			
Step 2:	Traditional Combat	0.02	0.00	0.00	1.02	79.05	2	0.00
	Gender	-0.79	0.18	0.00	2.20			
Step 3:	Traditional Combat	0.02	0.00	0.00	1.02			
	Gender	-0.78	0.18	0.00	2.19			
	Traditional Combat x Gender	-0.01	0.01	0.55	1.01	79.41	3	0.00
	n = 1574					1470.76		
Step 0:	CONSTANT in the model					71.56	1	0.00
Step 1:	Atrocities - Abusive Violence	0.08	0.01	0.00	1.08			
Step 2:	Atrocities - Abusive Violence	0.07	0.01	0.00	1.08	94.73	2	0.00
	Gender	-0.83	0.18	0.00	2.29			
Step 3:	Atrocities - Abusive Violence	0.08	0.01	0.00	1.08			
	Gender	-0.82	0.19	0.00	2.28			
	Atrocities - Abusive Violence x Gender	-0.00	0.03	0.87	1.00	94.76	3	0.00
	n = 1581					1482.69		
Step 0:	CONSTANT in the model					53.85	1	0.00
Step 1:	Perceived Threat	0.08	0.01	0.00	1.08			
Step 2:	Perceived Threat	0.08	0.01	0.00	1.08	80.01	2	0.00
	Gender	-0.87	0.18	0.00	2.38			
Step 3:	Perceived Threat	0.08	0.01	0.00	1.08			
	Gender	-0.85	0.19	0.00	2.35			
	Perceived Threat x Gender	-0.01	0.03	0.77	1.01	80.09	3	0.00
	n = 1582					1489.18		
Step 0:	CONSTANT in the model					63.16	1	0.00
Step 1:	Malevolent Environment	0.05	0.01	0.00	1.05			
Step 2:	Malevolent Environment	0.05	0.01	0.00	1.05	89.71	2	0.00
	Gender	-0.87	0.18	0.00	2.40			
Step 3:	Malevolent Environment	0.04	0.01	0.00	1.05			
	Gender	-0.93	0.20	0.00	2.54			
	Malevolent Environment x Gender	0.02	0.02	0.37	1.02	90.53	3	0.00

Malevolent Environment x Gender	-0.93	0.20	0.00	2.54			
	0.02	0.02	0.37	1.02	90.53	3	0.00

Table 14c. Logistic Regressions for Any Disorder, Not Including PTSD — Lifetime (n=1596): All War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X^2**	**df**	**p**
Step 0:	CONSTANT in the model					2206.26		
Step 1:	Traditional Combat	-0.01	0.00	0.27	1.01			
	Atrocities - Abusive Violence	0.05	0.01	0.00	1.05			
	Perceived Threat	0.00	0.02	0.98	1.00			
	Malevolent Environment	0.03	0.01	0.00	1.03	85.24	4	0.00
Step 2:	Traditional Combat	-0.01	0.00	0.10	1.01			
	Atrocities - Abusive Violence	0.05	0.01	0.00	1.05			
	Perceived Threat	0.01	0.02	0.72	1.01			
	Malevolent Environment	0.03	0.01	0.00	1.03			
	Gender	-0.95	0.12	0.00	2.58	147.01	5	0.00
Step 3:	Traditional Combat	-0.00	0.01	0.52	1.00			
	Atrocities - Abusive Violence	0.06	0.01	0.00	1.06			
	Perceived Threat	-0.01	0.02	0.80	1.01			
	Malevolent Environment	0.02	0.01	0.00	1.02			
	Gender	-1.01	0.13	0.00	2.76			
	Traditional Combat x Gender	-0.02	0.01	0.11	1.02			
	Atrocities - Abusive Violence x Gender	-0.03	0.03	0.23	1.04			
	Perceived Threat x Gender	0.03	0.03	0.34	1.03			
	Malevolent Environment x Gender	0.04	0.02	0.03	1.04	157.84	9	0.00

Table 14d. Logistic Regressions for Any Disorder, Not Including PTSD — Lifetime: Individual War Zone Stressors

		Variable				Model		
Variables in the Equation		**Coefficient**	**SE**	**p**	**OR**	**X_2**	**df**	**p**
	n = 1603							
Step 0:	CONSTANT in the model					2216.36		
Step 1:	Traditional Combat	0.01	0.00	0.00	1.01	35.42	1	0.00
Step 2:	Traditional Combat	0.01	0.00	0.00	1.01			
	Gender	-0.92	0.12	0.00	2.52	96.47	2	0.00
Step 3:	Traditional Combat	0.01	0.00	0.00	1.01			
	Gender	-0.93	0.12	0.00	2.55			
	Traditional Combat x Gender	-0.01	0.01	0.43	1.01	97.10	3	0.00
	n = 1597							
Step 0:	CONSTANT in the model					2207.52		
Step 1:	Atrocities - Abusive Violence	0.06	0.01	0.00	1.06	59.18	1	0.00
Step 2:	Atrocities - Abusive Violence	0.06	0.01	0.00	1.06			
	Gender	-0.93	0.12	0.00	2.53	120.06	2	0.00
Step 3:	Atrocities - Abusive Violence	0.07	0.01	0.00	1.07			
	Gender	-0.94	0.12	0.00	2.55			
	Atrocities - Abusive Violence x Gender	-0.02	0.02	0.26	1.03	121.32	3	0.00
	n = 1604							
Step 0:	CONSTANT in the model					2217.87		
Step 1:	Perceived Threat	0.05	0.01	0.00	1.05	38.12	1	0.00
Step 2:	Perceived Threat	0.05	0.01	0.00	1.05			
	Gender	-0.96	0.12	0.00	2.61	103.52	2	0.00
Step 3:	Perceived Threat	0.05	0.01	0.00	1.05			
	Gender	-0.96	0.12	0.00	2.61			
	Perceived Threat x Gender	0.01	0.02	0.73	1.01	103.64	3	0.00
	n = 1605							
Step 0:	CONSTANT in the model					2219.61		
Step 1:	Malevolent Environment	0.04	0.00	0.00	1.04	64.78	1	0.00
Step 2:	Malevolent Environment	0.04	0.00	0.00	1.04			
	Gender	-0.96	0.12	0.00	2.62	129.68	2	0.00
Step 3:	Malevolent Environment	0.03	0.01	0.00	1.03			
	Gender	-0.98	0.13	0.00	2.66			
	Malevolent Environment x Gender	0.02	0.01	0.06	1.02	133.27	3	0.00

Military Stress in War and Peace

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Introduction

Until recently standard psychiatric textbooks (Kaplan et al, 1980) limited their coverage of war psychiatry to syndromes related to combat or prisoner-of-war (POW) experiences. This limitation was a reflection of the recent national history of some Western nations (e.g. the United States and Canada) which had made their people regard war primarily as a cluster of events affecting military personnel on foreign soil — and their next of kin at home. Citizens of other countries have experienced additional war-related traumas, such as having homes destroyed by enemy bombs. Still other nations have endured invasions, followed by part- or full occupations which have varied in severity along a continuum from moderate to the most extreme.

The many stressful experiences of war can be placed in a time-phase model; threat, attack, invasion, occupation, liberation, post-war legal action against collaborators and war criminals, and finally peace, with the re-establishment of national institutions. Each of these phases brings characteristic stressors (Eitinger 1990, Weisæth 1997). In spite of increased research on war stress during the last couple of decades there are still significant gaps in the scientific knowledge of the particular vulnerability and protective factors, and the acute-, subacute- and long-term mental health outcome of many of these war experiences.

The relationship between war and mental health is not a simple one. There is an overall association between severity and duration of exposure and the risk for psychiatric consequences. But not all war stresses increase the incidence of mental health problems, some may even have positive effects: During the Nazi occupation of Norway, for example, the prevalence of certain types of psychoses decreased 15% (Ødegård, 1954). A reduction in social isolation may have a preventive effect among civilians, much the same as the strong group cohesion of a tight knit military unit has among the combat soldiers. Strong leadership and motivation, a perception of suffering as more meaningful during war times than during peace, and the stronger sense of importance and control individuals also may experience during war, are likely mediating factors that improve coping during such stressful times.

The line between military and civilian roles becomes less distinct during an occupation as regular military combat after defeat is followed by a broad spectrum of socalled "civilian resistance" activities and other clandestine operations. Different groups of people will be exposed to unique stressors, only some of which have yet been well studied.

Financial compensation

Financial compensation for war disability is a complex problem, and the medical and legal solutions for compensation varies from country to country. Establishing formal principles and practices tends to cause controversy, and often medical, legal and political conflict. Norway has had its fair share of these problems, and seems to have developed original solutions to some of them.

Certain factors created advantageous conditions for progressive Legislation in Norway. First, the Legislation on war disability compensation was continuously influenced by new medical research findings. Back in 1945, however, it was unthinkable that a 50 year perspective would be necessary to fully evaluate the long-term and delayed effects of war traumatic stress as they are known today. During these years medical research has had ample opportunity to develop better understanding of war stressors and their effects on health. In 1957 the Association of War Disabled in Norway contacted the Military Medical Corps and the Medical Faculty at the University of Oslo. A research group called the Board of Doctors of 1957 started an extensive research project which examined KZ survivors from a neurological, psychiatric, psychological, social and medical point of view. The research resulted in original and timely legislation which solved pressing problems for the government, the National Health Insurance Administration and the war veterans and victims. Secondly, Norway has been involved in only one major war in the 20th century. Veterans with constitutionally based rights and duties, such as general compulsory military service were thus unaffected by other accumulating war experiences. Thirdly, detailed health registers had been developed for a homogeneous population as part of a National Health Service, established in 1931, thereby creating

good opportunities for retrospective longitudinal research.

Due to its geographical location at the outskirts of the main WW II theatres, Norway acquired some experiences from war and occupation which include many typical, but also some rather atypical aspects. During the initial phase Norway, a neutral country with a population of only 3.3 million, was overrun by superior German forces. Towns and cities were bombed and burned. Small groups of poorly organized army, navy and airplane units mustered considerable resistance for two months, during the Campaign in Norway until surrender was inevitable.

58 year follow-up of veterans from the campaign in Norway

We have recently carried out a 58 year follow-up of veterans from the Campaign in Norway. It is a study of veterans from a Norwegian infantry battalion (N=797), who are still alive (n=101) which fought the invading German forces in Northern-Norway during April — June 1940: The combat veterans are compared with soldiers from a battalion which was kept in reserve and did not experience combat. During the subsequent occupation of Norway, members of both battalions, however, experienced with their families other war stressors, in particular the scorched earth policy of the retreating Wehrmacht during the fall and winter of 1944/45, in which they lost virtually everything.

During the Campaign in 1940 the combat battalion experienced six weeks of continuous operations in high-mountain terrain under severe winter conditions. The battalion was part of the first allied combined operations during World War II, which ended in the successful liberation of Narvik. They were on the offensive the whole time, suffered few losses — but when the final victory was to be reaped, the allies had to withdraw from Norway because of the critical development on the European continent, and Norway capitulated.

A response rate of 98% has been reached (at the time of writing). The veterans underwent personal physical and psychiatric examinations. The military health records from the war time and throughout their later military service as well as medical data from their civilian lives were studied.

The following preliminary findings have been made:

1. No increase in mortality was found among the combat veterans compared to non-combat veterans and civilian groups matched for age, place of birth and living.
2. No cases within the post-traumatic stress spectrum were identified in the non-combat battalion.
3. About 30% of the combat veterans suffered from partial PTSD with low rates of comorbid disorders.
4. Few of the partial PTSD cases had suffered a diminished work capacity.
5. No cases of late psychic sequels or significantly delayed PTSD were identified, as a rule the post-traumatic stress symptoms had started when they returned to their homes in June 1940 and persisted in many (Weisæth, et al 1998).

The three fronts and disability compensation

The three main "fronts" during the occupation were the outer (exile) front, the home front, and the prisoner front.

A) The outer front comprised the Merchant Navy, the Navy, the Army and the Air Force. The most significant contribution to the allied war effort was undoubtedly delivered by the Norwegian Merchant Navy, managed by the exile government, with 40,000 men on a thousand ships (five hundred of which would be sunk).

B) The home front was slowly built up to a clandestine partisan army of 40,000 military part-time soldiers, in addition to numerous civilian resistance groups. The resistance of the home front spanned from civil disobedience on the one hand to armed combat on the other.

C) The political prisoner population in Norwegian and German camps, sometimes called the "prisoner front", included military and civilian resistance fighters and ethnic minorities, primarily Jews.

The variations in stress experiences on the three fronts contributed to an unprecedented complexity when trying to establish waterproof criteria for awarding war disability compensations. This clearly constitutes a difference from nations whose war experience was limited to professional soldiers deployed overseas and prisoners of war.

In general post-war compensation controversies have focused on various definitions of who is a war veteran, who is a war victim, what is active

participation in war, what is the nature and severity of war stressors and what should be the specific criteria for deciding service related illnesses/injuries, and what should be the criteria for awarding a war disability compensation.

An occupation by enemy forces exposes people to various types of stressors that clearly differ from those of ordinary combat warfare. The heavy involvement of civilians reflected the nature of an occupation. The exact definition of who is an active war participant, was an open question. What about civilian resistance fighters? What about civilians in jobs that carried a great risk, such as coastal seamen, railway personnel etc? And what about accidental victims to war traumas? The introduction of new rules already in 1941for civilian participants and victims, expanded in 1946, went a long way to solve this problem. No doubt, the main difficulty was the problem involved in proving causal relationships between the stressful war experience and the ensuing health failure. This problem increased with time as the distance to the war as a possible cause of illness increased.

Documented causal relationship

After the war the requirement for war disability pension was the demonstration of a direct causal connection between the actual disease/injury and the war stressors. As no general pension scheme existed before the war, two bills were passed in 1946, introducting provisions for war pensioning, one for military personnel and one for civilians. The latter comprised Norwegian citizens in general, regardless of where they had been exposed to the stressors as long as they had not been in the service of the enemy.

The only exception to the strict requirement of causality was the so-called "24 hour rule" which implied that a military person was qualified as long as the injury or disease, regardless of its nature, had been contracted during the war service.

As far as stress related health problems for civilians and occupations at risk were concerned, based upon pre-war perspectives, war stressors were limited to sudden and intense impacts such as torpedo attacks, mine explosions or air attacks, the socalled "war accidents". Health failure after long-term exposure to high risk environment without necessarily experience of severe impacts, was only accepted from 1959. The many patients who developed tuberculosis after the war, but had obviously been infected during the war because of war conditions, necessitated a change in the law from this year. But the change had then few practical consequences for those suffering from mental health problems. The change in the law, however, became a model for the way "the late psychic sequels" were to be assessed. Until this change, Jaspers' "five criteria (Jaspers 1913) for psychogenic reactions" had almost served as axioms in the evaluation of service relatedness of a mental disorder: A significant stressor, a time relationship between event and response, symptoms mirroring the stressor, and a good prognosis if the person had an unremarkable premorbid personality. The delayed debut and the poor prognosis of the disorder did not fit with Jaspers' criteria.

Concentration camp survivors: Mortality and morbidity

The Board of Doctors had published several studies of selected groups of survivors (Eitinger, 1964, Strøm 1968). But in order to throw light on the effects upon the organism of excessive stress brought about by internment in prisons such as concentration camps, it was necessary to investigate a large unselected prisoner population which could be observed over a long period.

A retrospective investigation was carried out into the postwar mortality and morbidity up to the end of 1966 among Norwegians who had been in concentration camps, prisons or penitentiaries in Germany or in the German-occupied countries in Central Europe during WW II, from 1940 to 1945 (Eitinger and Strøm, 1973). A particular research focus was upon the surviving NN prisoners (Nacht und Nebel = Night and Fog) whose intended fate was to be death and total extermination and obliteration. The fate of 4574, or 96% of those who survived imprisoment was known in 1966.

The *mortality* study was based on 719 (94%) of the 763 deaths during the observation period. Compared with the mortality of the Norwegian population — which appeared to be the most suitable basis of comparison since the ex-

Table I. Observed (D) and expected (En) number of deaths for "ordinary" prisoners, NN prisoner, and all prisoners in relation to age, 1945–1966

Age	"Ordinary" prisoners			NN prisoners			All prisoners		
(years)	D	En	D/En	D	En	D/En	D	En	D/En
<30	52	22.6	2.30	6	1.4	(4.29)*	58	24.1	2.41
30–39	55	53.6	1.03	13	4.2	(3.10)	68	58.0	1.17
40–49	112	102.7	1.09	12	7.4	1.62	124	110.4	1.12
50–59	170	147.3	1.15	12	8.4	1.43	182	156.0	1.17
60–69	179	154.2	1.16	8	7.9	1.01	187	162.4	1.15
≥ 70	94	89.1	1.05	6	8.8	0.68	100	98.1	1.02
Total	662	569.5	1.16	57	38.0	1.50	719	608.9	1.18

prisoners came from all parts of Norway — that of the ex-prisoners was much higher (Table I).

The duration of imprisonment did not seem to have an effect on the mortality rate during the obervation period. As expected, the death rate was much higher among the NN prisoners.

The most important causes of the excess mortality among the ex-prisoners were: tuberculosis, other infectious diseases, other and unknown causes of death, coronary heart disease, lung cancer, and violent death (accident and homicide).

The three last causes were especially marked during the later periods. Many of the causes of death that showed a higher death rate than expected among the ex-prisoners, are those for which towns generally have a higher mortality than rural areas. The possibility that the higer mortality was partly caused by the ex-prisoners having adopted a more urbanized way of living was considered.

The case-control *morbidity* study was carried out on a random sample of 498 people selected from the register still alive at the end of 1966. Information on the sick leave, number of days of sick leave, number of hospital admissions, and number of days spent in hospital, and medical diagnoses was gathered from the local health insurance offices to which the ex-prisoners had belonged during the observation period.

Matched control material was selected from the health insurances files by choosing the card nearest that of each selected ex-prisoner belonging to a person of the same age, sex and occupational group. The ex-prisoners had constituted a positive sample in terms of their pre-WWII-health. After the war the ex-prisoners led less stable working lives then the controls, with more frequent changes of job, occupation, and domicile. Among as many as 25.4% there was a transition to less qualified and less well-paid work during the observation persion, as compared to 4.3% for the controls. At the end of the observation period, 17% of the ex-prisoners were receiving invalid pensions because of illness and failing work capacity.The ex-prisoners from the lower socio-economic classes seemed less able to compensate for their failing health than those from the higher occupational groups and therefore more of them had to be pensioned.

The ex-prisoners had more sick periods, longer sick leave and more frequent and longer hospitalization periods than the controls. Only 10% of the ex-prisoners had not been registered as sick during the observation period as compared to 21% of the controls. Thirty percent of the ex-prisoners had more than 365 registered sick days during the observation period as against 8 percent of the controls. The higher morbidity among the ex-prisoners was not connected with any particular diagnosis. The frequency and variety of illness appeared to involve almost all organ systems. As many as 51 of the ex-prisoners had more than 10 different diagnoses during the observation period as against only 6 controls.

In all 14 diagnostic groups there were more registered sick persons among the ex-prisoners than among the controls. The difference was highly statistically significant (p values <0.001 or <0.01) for the following diagnostic groups: tuberculosis, nervousness and neurosis, alcohol and drug abuse, peripheral varicose diseases, diseases of the upper respiratory tract, diseases of the bronchi, lung, etc., diseases of the ventricle and duodenum, other diseases of the digestive organs, diseases of the bones, joints and muscles, injuries and other external traumas, and "all other dis-

Table II. Diagnostic groups

Diagnostic groups	Ex-prisoners (N=498)		Controls (N=498)		
	No. of patients	%	No. of patients	%	P
1. Tuberculosis	45	9.0	9	1.8	<0.001
2. Neurosis, nervousness	121	24.2	47	9.4	<0.001
3. Abuse of alcohol and drugs	35	7.0	8	1.6	<0.001
4. Psychosis	15	3.0	5	1.0	<0.05
5. Cardiovascular diseases	58	11.6	40	8.0	<0.1
6. Peripheral varicose diseases	37	7.4	18	3.6	<0.01
7. Diseases of the upper respiratory tract	195	39.1	49	29.9	<0.01
8. Diseases of bronchi, lungs etc.	104	20.8	71	14.2	<0.01
9. Diseases of ventricle and duodenum	101	20.2	43	8.6	<0.001
10. Other diseases of the disgestive organs	127	25.5	91	18.2	<0.01
11. Diseases of the skin and subcutis	64	12.8	52	10.4	<0.1
12. Diseases of the bones, joints and muscles	237	47.5	172	34.5	<0.001
13. Injuries and other external causes	219	43.9	174	34.9	<0.1
14. Other diagnoses	194	38.9	127	25.5	<0.001

eases". For psychoses the difference was statistically significant at the level of 5%, but for cardiocascular diseases and diseases of the skin and subcutis there was no clear statistically significant difference (Table II).

Tuberculosis had the largest excess mortality and morbidity (45 ex-prisoners as compared with 9 controls). The ex-prisoners' sick periods and hospitalization periods were about three times as long as the controls.

Neurosis and nervousness were diagnosed in almost a quarter of the ex-prisoners as compared with one tenth of the controls. The ex-prisoners' nervous diseases were more serious than those of the controls, with longer sick periods and more frequent hospitalization.

Abuse of alcohol and drugs was registered in 35 ex-prisoners and 8 controls. These figures must be regarded as representing a minimum, a hypothesis which was confirmed during the course of the investigation. The authors consider that the higher morbidity registered for all diagnostic groups among the ex-prisoners was *not* due to the greater number of alcohol abusers, since the difference between the ex-prisoners' and the controls' general morbidity is the same if the alcohol abusers are excluded from the calculations.

None of the findings suggest that the ex-prisoners constitute a group with a greater pre-war morbidity or a negative sample, or that this is the reason for the greater incidence of nervous diseases, alcohol and drug abuse, and (modest) crime to be found among them. The only explanation the authors could find for this high incidence was that it was connected with their imprisonment.

Psychoses were registered in 15 ex-prisoners and 5 controls. In 2 of the ex-prisoners the psychosis almost certainly had nothing to do with the concentration camp imprisonment, in 4 the connection was doubtful, and in three it was highly probable. The remaining 6 had a diagnosis of dementia, and it seems reasonable to assume the existence of an organic dementia resulting from organic brain damage during imprisonment.

Cardiovascular diseases were registered in 58 ex-prisoners and 40 controls. The difference is statistically significant only at the level of 10% but the average number of sick leave episodes per person, sick days per person, and sick days per sick leave episode were greater for the ex-prisoners than for the controls. The findings indicate that the ex-prisoners' resistance was lower than that of the controls; their diseases recidivated more often and lasted longer. The figures for the subdiagnoses (coronary heart disease and vascular lesions of the central nervous system plus hypertension) showed the same tendency.

Both diseases of the upper respiratory tract and those of the bronchi, lungs, etc. were significantly more frequent among the ex-prisoners than among the controls, but there was little difference in the degree of seriousness of the diseases.

Diseases of the ventricle and duodenum (espe-

cially peptic ulcer) were diagnosed in 20% of the ex-prisoners and 8.6% of the controls. The ex-prisoners' diseases were also more serious, with more and longer sick periods per person and more hospital admissions. Other diseases of the digestive organs showed fewer quantitative differences: 25.5% as compared with 18.2%. The tendency towards a greater degree of seriousness was more pronounced, however, with for example, twice as many sick days per sick period among the ex-prisoners than among the controls.

Diseases of the bones, joints, and muscles were registered in about half of the ex-prisoners and in about one third of the controls. This diagnostic group was responsible for 24.5% of the ex-prisoners' sick days and 16.7% of those of the controls. Lumbago-sciatica was the most common disease within this group.

Forty-four per cent of the ex-prisoners and 35% of the controls had received injuries and other external traumas which necessitated sick leave during the observation period. The number of hospital admissions and the number of days spent in hospital was greater for the ex-prisoners than for the controls.

The group "other diseases" showed a greater morbidity among the ex-prisoners than the controls, and a greater degree of seriousness.

It was the authors' opinion that the most natural explanation of the ex-prisoners' higher mortality and morbidity was that the excessive stress they experienced during imprisonment lowered their resistance to infection and lessened their ability to adjust to environmental changes. Even small additional stress situations could upset their labile equilibrium and result in a manifest illness. Such additional stress situations could arise at any time during a person's life and this explained why there was no accumulation of diseases in any particular period, apart from the high incidence of tuberculosis and other infectious diseases shortly after liberation. This weakened resistance and ability to adjust did not seem to have been altered during the observation period; the changes were so profound that recovery did not appear to be possible. This increased vulnerability to all kinds of stress had made the ex-prisoners a group of people who ever since the war have been more frequently and more seriously ill and who have consequently had a lower working capacity, lower incomes, and fewer possibilities for self-realization than a corresponding group of the population who had not experienced the same stressors.

Presumed causal relationship: Excessive war stressors/all disabilities

With findings such as those reported above the research led to a radical change in the understanding of long-term effects of war stress: The findings had shown that an increased post-war mortality and increased general morbidity could be related to what was defined as an excessive war stress experience in individuals without any pre-war vulnerability. Based upon this new insight the Norwegian Parliament adopted the Amendment Act in 1967 stating that such a war experience, clearly beyond "the average expected war experience" for any one taking part in war activities, was sufficient basis for awarding war disability compensation as long as his health problem caused more than 50% reduction of his earning capacity. The new regulation meant that the onus of proof was reversed. Whereas earlier the applicant was required to present evidence of a causal relationship, the burden of proof was shifted on to the authorities. The individual was entitled to compensation unless the authorities could rule out such a cause-effect relationship. Thus, it was possible to solve some embarassing problems, such as the evaluation of service related mental injury in the thousands of disabled war sailors with more than six months of service who had not been exposed to so-called "war accidents", such as torpedoe attacks. They had "only" experienced high risk exposure (in 1942–43 a Norwegian ship was torpedoed every other day) under conditions of high uncertainty and low control in the longest battle during WWII, the battle of the North Atlantic. (It is rather striking that important disorders within the post-traumatic stress spectrum have been first described by doctors who themselves experienced the particular type of stressor and sometimes also suffered from the ensuing disorder: As with the KZ-syndrome, the war sailor syndrome was first described by a doctor who himself had been exposed to the particular aspect of the war (Egede–Nissen, 1978, Askevold 1976–77)).

Effects of the Amendment Act

All ordinary illnesses (heart diseases, backache, cancer, etc) which these individuals contracted during the post-war period until retiring age, are being recognized as "war-related" under this Act. Only occupational diseases, traffic injuries and certain ailments which are obviously due to old age, are actually rejected. While only 543 war sailors had been awarded war disability pension during the years 1945–1966, by 1967 as many as 3519 had qualified!

The 1967 introduction of the Amendment Act dramatically reversed the trend in number of disability compensations: Between 1965 and 1975 there was a threefold increase of military veterans and civilian resistance fighters/prisoners who received war disability pension and a fourteen fold increase (!) in the war sailors receiving this pension.

During the 15 years from 1967 to 1982, the National Health Insurance Administration received nearly 20,000 new applications. As recently as 1994, 250 new applications were received. It must be stated that this is a relatively high figure considering that "time of the injury" is about 50 years ago. By 1995 a total of 58,696 applications had been processed. While the percentage of applications that were approved had been as high as 90% in the 1950s, by 1994 approximately 50% of applications were approved.

Often overlooked is the effect of war disability compensation upon a person's self-esteem, dignity and socio-economic status. What is the relationship between the primary economic purpose of war disability compensation and its additional psychological and social effects? We will quote findings from one such study of the effects of the introduction of the Amendment Act (Strøm, 1978).

A sample of 936 applications for disability compensation by the Amendment Act were studied, half of which had been rejected, half approved. Every other applicant was randomly sampled for a personal examination. Every third applicant was found to have undergone more than one type of war stress exposure. For the majority stress exposures had been long lasting. During the war 65% had had one or more somatic illnesses and 27% a psychiatric disorder. At the time of investigation in 1975 about half had suffered from considerable health failure for more than 10 years.

A positive correlation was found between approval of war disability pension and severity and duration of the war exposure, with degree of morbidity during the war and the duration of the health failure after the war and reduction in social status.

The effect of having been awarded or rejected can be seen from the following table:

The follow-up demonstrated a marked difference between those who had their applications approved and those rejected. Improvements were far more frequent in the first group: Life situation in general, family situation, housing standard, work capacity, financial situation and social contact.

Only 15% of those who had their application rejected accepted the decision. Reasons for rejection were in 63% of the cases that the applicant was not 50% work disabled. At the follow-up less than 30% of these managed relatively well in spite of their failing work capacity; they belonged to liberal professions and were in control of their situation or had understanding employers/work-

Table III. War disability pension
(N=445) Results displayed as percentage.

	Awarded			Rejected		
	Improved	Worsened	Unchanged	Improved	Worsened	Unchanged
Income	64	19	17	5	48	47
Social contact	13	12	75	3	13	84
Housing	31	3	66	18	6	76
Work capacity	5	16	79	0.5	40	59.5
Income	95	3	2	13	20	67
Social contact	13	38	49	0.5	45.5	54

(Strom et al, 1978)

mates. The remaining 70% had severe problems. The rejection had been interpreted to mean that they should work themselves to death. They had entered a vicious circle: for economic reasons and fear of losing their jobs they did not dare to give up their work before they got disability pension, and disability pension they could not get as long as the were employed.

Of those who had their application turned down, 67% did not accept the decision and among the 30% who had their applications rejected because their war experience did not reach the threshold of "excessive stress exposure" 33% had interpreted this as a degrading of their war effort, bitterness and feelings of humiliation were often consequences. While 32% had not understood the explanation for the decision, 22% felt their work capacity had been wrongly evaluated and 12% felt generally disappointed. It was concluded that there had been a severe failure in information from the National Health Insurance Administration.

Presumed causal relationship: War stressors/post-traumatic psychopathology

Four decades after the war a causal relationship naturally had became harder to assess. In particular, this applied to the so-called " late psychological sequels" which affected many veterans and ex-prisoners decades after the end of the war, "late" reflecting that the symptoms became manifest many years after the war.

A proposal from the Eitinger Commission to simplify and speed up the application procedure was implemented in 1990. So long after the war, it was considered possible to make reliable assessments only of two factors: The documented war exposure and the present mental health condition. If a person suffering from symptoms of post-traumatic stress disorder or other stress related psychopathology could document a war stressor satisfying certain criteria, a causal relationship was automatically presumed. Drawing also upon modern research in the field of traumatic stress, an extensive categorization was made by the Eitinger Commisson of the degree of stress experienced by all groups of war participants and victims of World War II (Eitinger et al, 1995). So far, the new practice appears to function as was intended.

War stress

Schematically, most of the severe war stresses upon military personnel can be classified as 1) shock traumas of relatively brief duration, 2) repetitive or serial trauma and 3) prolonged exposures to danger characterized by varying degrees of predictability and control.

Soldiers exposed to any of these stressors have a considerable risk of developing a disorder related to their response to traumatic stress, i.e. a traumatic stress response disorder. Shock traumas often produce PTSD, particularly if the shock was severe and inescapable. The pathogenic effect of inescapable shock traumas is also supported by a long history of laboratory research on animals since the days of Pavlov; shock given in an unpredictable and uncontrollable way seems very difficult to handle. If not exposed previously to trauma and without other psychiatric disorders, the outcome of such exposure is likely to be a "pure" PTSD which is a relatively straight forward disorder.

Series of traumatic events seem to produce PTSD with a high co-morbidity of other psychiatric disorders.

Combinations of year-long extreme stress, constant uncertainty and no possibility of control seem to produce delayed PTSD, enduring personality changes and a broad spectrum of other psychiatric problems, as well as increased general somatic morbidity and increased mortality (Eitinger and Strøm, 1973). The European research of the late sequelae of exposure to severe and prolonged stressors during the Second World War suggests that PTSD may be considered a process and a prognosticator of adjustment processes (Falger et al, 1992; Ørner, 1992). The undisputed finding from these studies of WW II massive traumatisations is, however, the devestating effect upon the subsequent health of excessive and longlasting stress, almost regardless of pre-morbid factors: The concentation camp experience was a complex trauma with severe biological, psychological, social and existential stressors, and, as expected, the health sequels were complex, often a combination of somatic, psychologi-

cal and social health problems. Among the consequences is a diminished ability to tolerate stressors later in life.

Combat stress

Danger to life in military combat has been the classical stress exposure, studied by generations of stress researchers. The severity of combat exposure may be scaled by various objective measures, intensity and duration often being used.

Intensity of combat is traditionally scaled by numbers of soldiers per day killed (KIA) and wounded (WIA) or missing in action (MIA). The ratio of Combat Stress Reactions (CSR, "battle shock", likely to be a form of Acute Stress Reaction as defined by the ICD-10) to KIA and WIA is expected to be 1:1:4 in an "average" battle fought with conventional weapons. The risk of developing PTSD has been shown to be associated with the rate of CSR (Solomon et al, 1987). In a number of recent studies of combat-related PTSD, a relationship has been found between severity of exposure and risk of PTSD (Foy et al, 1984; Laufer et al, 1985; Friedman et al, 1986; Solkoff et al, 1986 Solomon et al 1987; Snow et al, 1988; Green et al, 1989; Solomon et al, 1987; Kulka et al, 1990; O'Brien and Hughes, 1991).

Most studies, but not all, find that being physically injured or wounded constitute a risk factor for the development of CSR and PTSD. Clinical experience indicate that being wounded often adds significantly to the stressor severity, but in some combat situations, a moderate injury may have the effect of reducing the stress exposure. Since the threat to life is such a central part of the PTSD stressor criterion, beliefs and attitudes to life and death could very much influence the core aetiological factor. Such fundamental existential issues differ very much between cultures. Varying rates of traumatic response syndromes were found among UN peace-keeping soldiers relative to cultural background (Weisæth and Sund, 1982).

A fatalistic attitude and belief in reincarnation if killed in battle appeared to be protective factors, for example among Ghurka soldiers. Reflecting the recent history of research in traumatic stress, most of the theory, research and measurements on PTSD have been generated in Western countries.

Peace-keeper stress

In a troubled world there seems to be an increasing need for multinational collaborative military efforts when attempting to create peace or maintain a fragile peace in areas of unrest.

However, this shift of focus for military operations may be hard to comply with. The task is not, as in traditional warfare, to mobilize aggression in order to be able to fight the enemy with all available means. A peace-keeper must, on the contrary, be able to control both aggression and fight impulses *and* be able to control his natural flight impulses when faced with threatened injury or death. Although repeatedly exposed to dangerous, provoking or humiliating situations, the peace-keeper has limited possibilities to express his anger and frustrations. If he should do so, this may lead to serious political problems which could threaten to invalidate the entire peace-keeping mission; which may well be the deliberate purpose of the provocations from conflicting parties. The UN peace-keeping soldier is not expected to engage in regular war activities, but rather to act as buffer between hostile parties. Thus the UN peace-keeping soldier has more complex role and in some crucial respects a task completely different from soldiers traditionally trained for combat. One finding relating to the post-traumatic stress syndrome as it developed in UN soldiers was the particular fear of own aggression (Weisæth and Sund, 1982) which realistically reflected the limitations in his role. Hostility was the most frequently reported dimension among US Somalia veterans (Orsillo et al, 1998).

Only recently, however, have there emerged systematic studies on PTSD in peace-keeping military personnel. Bramsen and coworkers (1997) reported a 5% PTSD prevalence in a sample of Dutch contingents who had participated in UN missions in Bosnia and Lebanon. Litz and coworkers (1997) found that eight percent of a large sample of active duty personnel deployed to Somalia met the criteria for PTSD in a survey conducted on average five months after their return to the United States. In a study of more than one thousand Canadian UN peace-keepers who had served in Bosnia, Passey (1995) found a PTSD prevalence above 20% six months after redeployment. Over a longer follow-up perspec-

tive there might be an even higher prevalence of PTSD, as pointed out by Southwick and coworkers (1995) in a study of veterans from Operation Desert Storm; this indicates that it may take time for the consequences of traumatic exposure to become apparent. On the other hand, studies like these, carried out on populations of active duty personnel having participated in several high and low intensity missions earlier in their military career, might be unable to differentiate the impact of a peace-keeping mission from the other stressful military experiences, all having the possibility of creating PTSD or other mental disorders.

After having contributed to the UN operations with over 50,000 soldiers in various peace-keeping missions since they were first launched in 1949, the Norwegian Armed Forces started in 1991 a study on possible positive and negative consequences for individual soldiers of serving in a peace-keeping mission. One advantage of this study is that our subjects are a veteran population consisting of predominantly reservist personnel, not professional soldiers having experienced a whole range of other more or less traumatic military events. This follow-up study, conducted on average about seven years after UN service, was carried out at our institute. (Aarhaug et al 1993).

Objective

The aim of this study was to determine the long-term prevalence of post-traumatic stress reactions in veterans from a UN peace-keeping mission and to identify predictors of such reactions.

Method

A representative sample of personnel (N=1624) from 26 Norwegian contingents of the UNIFIL (United Nations Interim Force in Lebanon) was investigated on average 6.6 years after service. The subjects completed an extensive questionnaire focusing on stress exposure, leadership, life-events after service and post-traumatic stress reactions.

Results

The overall prevalence of PTSD (classified as a case on the Post-Traumatic Stress Symptom scale (PTSS-10)) was found to be 5.2%, but as high as 16.1% in the subgroup of personnel having been prematurely repatriated from UNIFIL. According to a multiple regression analysis, the following variables and indexes gave separate and significant contributions to the explained variance on the PTSS-10 sumscore: Service stress exposure, perceived quality of leadership, perceived lack of meaningfulness with respect to the military mission, stressful life-events after service and increase of alcohol consumption due to sleeplessness. These factors explained 22.5% (overall sample) and 34.9% (repatriated sample) of the variation in the post-traumatic symptom score.

Conclusions

The present long-term follow-up study confirms previous short-term studies which found that UN peace-keeping personnel run a considerable risk of developing chronic post-traumatic stress reactions. Service-related stress exposure serves as the strongest predictor for such reactions even in a long-term perspective (Mehlum and Weisæth, 1998).

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A 50 Year Prospective Study of the Psychological Sequelae of World War II Comabat

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Abstract

Objective

The authors take advantage of a 50 year prospective study of World War II veterans to examine the predictors and correlates of combat exposure, PTSD symptoms and trait neuroticism (NEO).

Method

The subjects were 107 veterans who had been extensively studied before and immediately after serving overseas in World War II. All served as members of the study until the present time and 91 filled out both questionnaires of PTSD symptoms and neuroticism.

Results

In this study group variables associated with *positive* psychosocial health in adolescence and at age 65 predicted combat exposure. Combat exposure and number of physiological symptoms during combat—but not during civilian stress—predicted symptoms of PTSD in 1946 and 1988. Combat exposure also predicted early death and study attrition. Psychosocial vulnerability in adolescence and at age 65 and physiological symptoms during civilian—but not during combat stress—predicted trait neuroticism at age 65.

Conclusion

Combat exposure predicted symptoms of PTSD but not non-specific measures of psychopathology. Premorbid vulnerability predicted subsequent psychopathology but not symptoms of PTSD.

> "Wheat fell headless in the field
> Till Death did reap enough.
>
> We seek to bury the revealed
> No earth is deep enough.
>
> You cannot wash the stains from minds
> No one can weep enough.
>
> Nor shut the past behind the blinds
> No night has sleep enough."
>
> — Study member

Over the last fifty years investigators have learned a great deal about veterans' emotional response to war. Most of this knowledge comes from the research on Vietnam War veterans that has refined and replaced the WW II diagnosis of "combat fatigue" with the current concept of Post-traumatic Stress Disorder (PTSD). Understandings gleaned from the study of Vietnam veterans have already been used to study WW II veterans[1,2] and their enduring stress reactions.

A major limitation of most studies of PTSD is that they are retrospective and may confuse cause and effect. Recently, three studies have examined PTSD risk factors in three time frames of data collection: prewar, wartime, and postwar.[3–5] However, thus far these studies have only included Vietnam War veterans. To the authors' knowledge, similar studies have not been undertaken among WW II veterans. Judging from research on Vietnam War veterans, combat exposure *per se* appears to be the most reliable wartime predictor of PTSD,[3,6] especially exposure to atrocities.[4,7]

Precombat personality vulnerability to the development of PTSD symptoms, however, remains poorly charted territory. First, few prospective studies have sought psychological risk factors that predispose individuals to the development of PTSD.[3,5] Second, because during the Vietnam War the undereducated and the socially disadvantaged were at greatest risk for combat exposure,[4,7] it was hard to separate the role of these variables from that of combat in the etiology of PTSD.

Data from The Study of Adult Development, initiated in 1938, have allowed us to study prospectively 107 young men as prewar college students, as recently returned WW II overseas veterans, and then, four decades later, as 65 year old grandfathers. In this report, we will first examine whether "chance" alone determines a person's degree of combat exposure, as Hendin & Haas[8] suggest, or whether there are premorbid factors which may predispose vulnerable individuals to participate in dangerous combat. Second, we will seek to identify premorbid variables which either predispose an individual to PTSD symptoms or which protect individuals with high combat exposure against their future development. Third, we will examine the relative contributions of psychological vulnerability *per se* and severe combat trauma *per se* to the development of PTSD symptoms and their persistence into middle life. Finally, we will note the effects of combat and/or PTSD on men's lives at age 65.

Methods

Subjects

The original study group of the "Grant Study of Adult Development" consisted of 268 undergraduates who were chosen by the Harvard University Health Services from the classes of 1939–1944. The men were selected during their sophomore year for being in the top half of their class, being physically and mentally healthy, and being viewed by the college deans as having the potential for success.[9,10] Nineteen of the men withdrew from the study early or died in WW II. Of the remaining 249 men, 152 served overseas and were potentially at risk for combat; 107 of these men were alive and returned questionnaires in 1988.

All of the men were intensively studied in a multidisciplinary fashion before World War II; most were also personally interviewed directly after WW II and again between the ages of 47–57 years. Physical examinations have been obtained every 5 years since age 45 years. The men have also been followed by means of biennially mailed questionnaires for 50 years or until death.

Measures

I. Prewar Variables (n=152)

a. **Social Class of Parents (n=113):** After home visit and family interview the men's family's social class was rated on a five-point scale: 5 = upper, 4 = upper/upper-middle, 3 = upper-middle, 2 = middle, 1 = working class/blue collar.

b. **Childhood environmental strengths (n=151):** The men's childhood environment was rated by two research assistants blind to data from the men's later life. The 20 = excellent, 0 = bleak scale was based on all available data on the men's childhoods and from parental interviews prior to age 20. The scale focused on warmth of relationships with parents, siblings and presence or absence of childhood emotional problems. Methods and reliability are discussed elsewhere.[11]

c. **Psychological Soundness in College (n=149):** After three years of interviews and testing, on the basis of all available data each man was rated by staff consensus 3 = "thoroughly sound", 2 = minor flaws, 1 = definite "emotional or personality handicap."[9]

d. **Active College Sports Participation (n=110):** 3 = active sports participation, 2 = 2–9 hr/wk, 1 = less than 2 hr/wk.

e. **Physical Symptoms with Stress (age 19) (n=150):** The number of different effects of stress on the body was assessed by interview and observation on a 1 to 15 scale. Symptoms included: palpitation, abdominal pain, headaches, diarrhea, constipation, urinary frequency, insomnia and the men's observed response to needle stick.

II. Wartime Variables

Directly after World War II, an elaborate questionnaire with open-ended questions on the men's war experiences was sent out to all participants inducted into the military, with a 97% completion rate. In addition, in 1946 the men were interviewed by the Grant Study staff about their wartime experiences.[12] Both the questionnaire and the interview focused on the effects of the war, the men's exposure to combat, and their descriptions of thoughts and bodily symptoms if and when danger stared them in the face. All wartime variables were scored by a psychiatrist blind to subsequent data.

a. **Attitude toward the military (n=140):** On their war service questionnaire in 1946, the men were asked to rate their "Urge to join the military" and their "Pride of Organization" on a 1 to 7 scale.

b. **Combat Exposure Scale (n=152):** To assess combat exposure we combined data from a sustained danger scale[12] and a scale of combat experiences. Our intent was to tap both the intensity and frequency of combat experience. We selected those variables thought to be important in the development of PTSD.[3,6,13]

The Combat Exposure Scale summed the following experiences scored 0 (no) or 1 (yes): 1. being under enemy fire; 2. firing at the enemy; 3. killing anyone; 4. seeing allies killed or wounded; 5. seeing enemies killed or wounded; 6. being wounded. Points for sustained danger were added as follows: 0 = no days spent in danger level 7 ("In sustained or heavy enemy action") or level 6 ("In light or sporadic action"). 1 = 1–21 days in danger levels 7 and/or 6, and 2 = 22 days or more in levels 7 and/or 6. In addition, each man received one point if level 6 was reported as the highest level of danger, or 2 points if level 7 was the highest level of danger. Thus, the points assigned ranged from 0–10. All variables in the **combat exposure** scale were significantly inter-correlated at $p.<.001$ except that being wounded was not significantly correlated with duration of danger. A combat score >6 = high combat exposure.

c. **Physical Symptoms with Danger (n=150):** In

1946 the men were asked what their bodily symptoms had been "if and when danger stared you straight in the face." Each individual symptom was scored 0 = absent, 1 = present. The number of items (including palpitations, abdominal distress, headaches, diarrhea, constipation, sweating, shaking, general nervousness, fear of going crazy, and feeling paralyzed) were expressed as a sum (range 0–8).

d. **PTSD 1946 Symptoms (n=150):** On the basis of the 1946 interview and questionnaire, 16 symptoms listed in the **DSM-III** definition of Post-traumatic Stress Disorder were rated 0 = absent and 1 = present. The symptoms were as follows: 1) recurrent and distressing recollections of combat; 2) recurrent distressing dreams of combat; 3) sleep difficulties; 4) angry outbursts; 5) exaggerated startle response; 6) restricted range of affect; 7) cannot recall important aspects of traumatic event; 8) diminished interest in significant activities; 9) estrangement from others; 10) avoids activities/situations of trauma; 11) foreshortened future; 12) acts as if traumatic event were recurring; 13) distress at symbol of trauma; 14) difficulty concentrating; 15) hypervigilance; and 16) avoids thought/feelings of trauma. Although the potential score ranged from 0–16, no man reported more than 6 symptoms.

III. Postwar Variables

a. **Number of visits to a psychiatrist by age 65 (n=146):**

b. **Immaturity of Defenses (age 20–47) (n=109):** This was assessed by a nine-point scale (1 = indicating mostly mature and 9 = mostly immature defenses). Examples of adaptive behavior at times of crisis and conflict during the men's young adulthood were labelled as one of 15 different defenses: Immature (schizoid fantasy, projection, passive aggression, hypochondriasis, acting out, and dissociation); Intermediate (intellectualization/isolation, repression, displacement, and reaction formation); and Mature (sublimation, suppression, anticipation, altruism, and humor). Methods, rationale, and reliability are described in detail elsewhere.[10,14]

c. **Physical Symptoms with Stress (age 20–60):** Six times between college and age 60 years, men were asked "When under stress, what do you now notice about your physical reactions? Please check." A list of 8 (insomnia, headaches, abdominal pain, diarrhea, sweating, palpitations, cold hands and feet, can't concentrate) were included. The average number of symptoms reported on each returned questionnaire was multiplied by 6 (the number of questionnaires sent). Scores ranged from 8 to 24. Methods are discussed in detail elsewhere.[15]

d. **Alcohol Abuse/Dependence:** Severity of alcohol abuse was rated for each man based on all available data using the methodology described elsewhere.[16] The scores assigned to the men were as follows: 1 = no alcohol abuse; 2 = met **DSM-III** criteria for alcohol abuse; and 3 = met **DSM-III** criteria for alcohol dependence.

e. **Evidence for Major Depressive Disorder before age 50:** Since the **DSM-III** criteria were not developed until almost 10 years later, each man was rated on objective signs of major depressive disorder present before age 50 years by an independent psychiatrist. Items included: diagnosed significantly depressed by a clinician, relatives with major depression, anti-depressant medication, anergia or anhedonia, suicidal preoccupation, manic symptoms, and neurovegetative signs.[17]

f. **Psychosocial Adjustment (age 30–47 years) (n=110):** On the basis of all reported behavior since college, the men were rated for the presence or absence of 8 variables including: occupational advancement, job satisfaction, marital satisfaction, recreation with others, sick leave, enjoyable vacation, income $20,000.[18]

IV. Late Life Variables

a. **In Who's Who in America (n=152):** 1 = not found in **Who's Who in America**; 2 = found in **Who's Who**.

b. **Psychosocial Adjustment (Age 50–65) (n=147):** On the basis of all reported behavior since age 47 the men were rated for the presence or absence of 10 variables including: occupational decline, little vacation, sick leave, career and marital dissatisfaction, tranquilizer and psychiatrist utilization.[18]

c. **Physical Health (Age 65) (n=147):** A physician blind to all data except from a recent physical examination rated the men's health at age 65. 1 = excellent; 2 = minor health problems (e.g. glaucoma, single joint arthritis); 3 = chronic illness without disability (e.g. diabetes); 4 = chronic illness with disability and/or restricted activity (e.g. multiple sclerosis); 5 = deceased.

d. **PTSD Symptoms (Age 65) (n=107):** In 1988, the surviving men were again sent a special questionnaire which focused on their military experiences. The questionnaire included a checklist of symptoms of PTSD derived from the **DSM-III**. One hundred seven (84%) of the 127 veterans who served overseas **and** survived until 1988 returned questionnaires. The 1988 questionnaire asked the men (age 64–70) questions about the presence of

specific symptoms of PTSD "today". The symptoms were: (1) recurrent and intrusive recollections of combat, (2) recurrent distressing dreams of combat, (3) sleep difficulties, (4) exaggerated startle response, (5) inability to feel emotion (present period only). A total score from 0–5 was assigned by adding the symptoms still present in 1988. (Range = 0–3)

e. **Trait "Neuroticism" (age 65) (n=100):** Obtained by a standardized paper and pencil test, the NEO-Personality Inventory[19,20]; (Mean = 68.3, S.D. 21.1). One of its subscales "Depression" was obtained in the same fashion.

Data Analysis: Because many statistical comparisons were being considered, some could be minimally significant by chance. The Bonferroni correction was not done because it would have been overly conservative; instead we elected to use p.03 as the test of minimal significance.

Results

As shown in Table 1 excluding the 13 drops and 6 WW II deaths, 90% (n=224) of the 249 Grant Study men entered the armed forces at an average age of 22 years. 152 (68%) of these served overseas for at least one month and 54 men were rated high on the Combat Exposure Scale (scores 7–10). All were assessed for symptoms of PTSD in 1946. This group of 152 men will be used in those analyses concerned with the health of the men and where attrition needed to be minimized for statistical power.

Of the 152 men, **25** had died prior to 1988 and **20** did not return the 1988 questionnaire. Tables 2 and 3 focus upon this subset of 107 surviving veterans who served overseas and who responded to the 1988 questionnaire.

The first step in data analysis was to determine the predictors of combat exposure. Potential predictors included mental health, social class, physical fitness and enthusiasm for military life. The second step was to determine the predictors of symptoms of PTSD and determine if these differed from the predictors of combat and of other forms of postwar psychopathology (e.g.

Table 1. Attrition of Study Group

Original Sample		**N = 268**
—	Less 13 dropouts and 6 World War II deaths	N = 249
—	Less 25 men who did not enter service	N = 224
—	Less 72 men who did not go overseas	N = 152
A. First Comparison Group:		
Overseas Veterans at risk for Combat and PTSD		**N = 152**
No Combat	N=45 (6 died, 6 no 1988 response) 1988 Questionnaire Returned	N = 33
Low Combat	N=53 (5 died, 6 no 1988 response) 1988 Questionnaire Returned	N = 42
High Combat	N=54 (14 died, 8 no 1988 response) 1988 Questionnaire Returned	N = 32
B. Second Comparison Group:		
Total Number of Men Returning 1998 Questionnaire		N = 107

Table 2. Premorbid Correlates of Combat, PTSD Symptoms, and Neuroticism

Premorbid Variables (assessed at age 19)	Combat Exposure n=107	PTSD Symptoms (1946) n=107	Trait Neuroticism n=91
Social Class of Parents	.32*	.06	-.18
Warm Childhood Environment	-.12	-.02	-.22*
Psychological Soundness in College	-.03	-.08	-.14
Active Sports Participation	.21*	.03	-.20
Physical Symptoms with Stress (age 19)	.00	.00	.17
Wartime Variables (1946)			
Urge to join the Military	.29**	.11	.00
Pride of Organization	.36**	.05	-.14
Combat Exposure	—	.29**	-.10
Physical Symptoms with *Danger*	.55**	.26*	.12

*p <.03 **pp <.001 Spearman correlation coefficients

Table 3. Postwar Correlates of Combat, PTSD Symptoms and Neuroticism

Wartime Variables (1946)	Combat Exposure n=107	PTSD (1946) n=107	PTSD (Age 65) n=107	Trait Neuroticism n=91
Combat Exposure	—	.29**	.20*	-.10(!)
Physical Symptoms with *Danger*	.55**	.26*	.27*	.12
PTSD Symptoms 1946	.29**	—	.09	.16
Midlife Intervening Variables				
Many Visits to Psychiatrist (age 20–47)	.01	.18	.07	.27*
Mature Defenses (age 20–47) (n=82)	.24*(!)	.10	.02	-.39**
Physical Symptoms with *Stress* (age 19–60)	-.09	.01	.02	.53**
Alcohol Abuse/Dependence (age 19–60)	.08	.11	.09	.29*
Major Depressive Disorder (age 19–50)	-.02	.11	.12	.38**
Poor Psychosocial Adjustment (age 30–44) (n=82)	-.09(!)	.03	.03	.30*
Late Life Outcome Variables				
In *Who's Who in America* (n=82)	.21*	.12	.15	-.09
Poor Psychosocial Adjustment (age 50–65)	-.07(!)	.19*	.03	.34*
PTSD Symptoms 1988 (age 65)	.20*	.09	—	.20*
Trait Depression (age 65)	-.12(!)	.11	.25*	.78**
Poor Physical Health (age 65)[a]	.16*	.11	NA	NA

*p = <.03 **p<.001 Spearman correlation coefficients

(!) Trend toward positive mental health in men exposed to high combat.

a. n = 147 Since many men with high combat died before 1988 the correlation of health and combat and PTSD was based on all men alive in 1946.

trait neuroticism, psychiatric visits, etc.). Potential predictors included combat, and mental health variables (childhood environment, physical symptoms with stress, college soundness and maturity of defense mechanisms). The third step was to examine the consequences of heavy combat exposure and postwar PTSD symptoms; physical health, psychosocial health and persistence of PTSD symptoms were the outcome variables studied.

Predictors of Combat Exposure

Symptoms of PTSD in 1946 were significantly associated with combat exposure (r =.36, p <0.001, n = 152; r =0 .29, p <0.001, n = 107). But a different set of premorbid variables predicted combat exposure than predicted symptoms of PTSD. Men who experienced heavy combat were more active in athletics before the war, were unusually proud of their military organization, reported a strong urge to join the armed forces and tended to come from upper-class families. Thirty-eight (48%) of the 79 men who experienced combat and 15 (60%) of the men with combat scores >7, were classified as "upper class" in college as contrasted to only 20 (27%) of the 73 men who never served overseas (chi square = 6.9, p.<01, df = 1). These variables, however, either bore no or a negative relation to PTSD symptoms and to trait neuroticism. Not surprisingly, high combat exposure was significantly associated with reporting multiple physical symptoms when "danger stared me in the face." But reporting many physiological symptoms under danger was not significantly associated with neuroticism or with reporting physiological symptoms with stress before the war.

Predictors of PTSD

Upon returning to civilian life in 1946 only 17 men of the 152 veterans who served overseas reported two or more PTSD symptoms; 12 of these 17 men had high combat scores. Twenty-one men reported one PTSD symptom; 12 of these men had high combat scores. Of the 11 men who were wounded, all reported subsequent symptoms of PTSD.

Only one veteran met full **DSM-III** criteria for PTSD. After the war he developed both alcoholism and major depressive disorder and eventually killed himself. Four men almost met diagnostic criteria for PTSD. Of these one man remained symptomatic in 1988; another committed suicide unexpectedly; a third was murdered, and a fourth has cut himself off socially and did not complete

the 1988 questionnaire. (The college mental health of these men was average). Thus, four of the six most symptomatic veterans (all with high combat exposure) did not return the 1988 questionnaire. Of the 32 men with high combat who returned the 1988 questionnaire only three currently reported 1 or more symptoms of PTSD. However, of the 11 men with two or more PTSD symptoms in 1946 five had died, two were still symptomatic in 1988, and one did not return a 1988 questionnaire. Thus, only two men with two or more PTSD symptoms in 1946 actually reported no symptoms of PTSD in 1988.

Sixteen men had high combat scores but reported no PTSD symptoms in 1946, and in 1988 still could not recall ever having had such symptoms. When contrasted to men who experienced PTSD symptoms, these 16 resilient men did not manifest less neuroticism; but they did as young adults manifest more mature defenses. Although maturity of defenses was positively correlated with combat exposure, in the high combat group maturity of defenses was negatively correlated (rho = -0.33, p =0.032, df = 31) with symptoms of PTSD. Expressed differently, the 16 men with high combat exposure **and** mature defenses (age 20–47 years) reported an average of 0.19 PTSD symptoms while the 17 men with high combat and less mature defenses reported an average of 1.70 symptoms (t-test 2.75, p =0 .01 two tailed, df = 31).

The Contribution of Psychological Vulnerability to PTSD

Premorbid psychological vulnerability was not associated with combat, but it was with trait neuroticism measured four decades later (Table 2). Civilian stress symptoms were highly correlated with neuroticism (rho=0.53, Table 3). In contrast, the number of PTSD symptoms and physical symptoms with danger was significantly associated with combat but not associated with neuroticism (Table 3). Neither the tendency to experience stress with physiological symptoms before or after the war was significantly associated with symptoms of PTSD in 1946 or number of physiological symptoms reported during combat danger. The exceptions to this generalization were the 11 men were exposed to minimal combat who still reported symptoms of PTSD in 1946 or 1988. At age 19 these men had scored significantly higher on emotional symptoms with stress, 7.0 (SD 2.8), than the 32 men with combat exposure who reported PTSD symptoms, 5.1 (SD 5.1) (t-test 2.1, 41df, p= 0.042 two tailed).

Multiple regression revealed that of the four potential premorbid predictors of PTSD symptoms—poor childhood, psychological soundness in college, physical symptoms with stress and combat exposure, only combat exposure made a significant statistical contribution to PTSD symptoms (t=4.09, df 144, p= .0001).

Table 3 illustrates that symptoms of PTSD reported in 1946 were not significantly correlated with evidence of major depressive disorder, with alcohol abuse, or poor psychosocial adjustment. However, trait neuroticism measured at age 65 years was significantly correlated with these diverse indices of poor mental health measured throughout the life span (including bleak childhood, psychiatrist utilization, immature defenses, and poor psychosocial outcome at age 47 and age 65).

Table 4 further differentiates the experience of symptoms of PTSD as a long-lasting physiological response to overwhelming wartime trauma from the physiological symptoms associated with the trait neuroticism and with nonspecific civilian stress. With the exception of depersonalization, no physiological symptom experienced with combat danger was associated with neuroticism.

Consequences of Combat and of PTSD

Table 3 shows that after the war men with high combat exposure continued to report increased symptoms of PTSD 40 years later. Such men were also more likely to be in *Who's Who in America*, and to enjoy a good psychosocial outcome, mature defenses, and low neuroticism. However, exposure to high combat predicted poor future physical health. Fifty-six percent of the 54 men who experienced heavy combat (and 59% of the subsample of 27 men who experienced heavy combat *and* PTSD symptoms) were chronically ill or dead by age 65. Excluding the 6 war related deaths, only 39% of the remaining 192 men for whom health data was available suffered similar physical morbidity (chi: square 5.6 df = 1, p.<02).

Table 4. Association of Specific Symptoms under Danger with Combat, PTSD Symptoms and Neuroticism

Symptoms in World War II reported in 1946	Combat Exposure n=107	PTSD Symptoms (1946) n=107	Trait Neutoriticism n=91
General nervousness	.47**	.25**	.07
Irritability	.23*	.06	.13
Fear of going crazy	.31**	.11	.11
Muscle tightness	.25*	-.03	-.03
Felt paralyzed	.28*	.11	.11
Cold hands and feet	.23**	.16	.04
Depersonalization	.25*	.22*	.26*
Dyspnea	.09	.18*	.06
Nausea/abdominal distress	.22*	.19*	-.01
Sweating	.19*	.07	-.01
Shaking	.14	.18*	.12

Spearman correlation coefficients

* p = <.03 **p <.001

Discussion

On the one hand, to clarify the enduring effects of wartime stress the present study group has four serious disadvantages. First, it excludes men with four of the most important predisposing factors for PTSD: low socio-economic status, minority group membership, poor education and low military rank.[4,21] Thus, in spite of heavy combat exposure our study group experienced relatively few PTSD symptoms. Second, our PTSD scales had to be derived from information available in 1946 rather than derived from more recently devised assessment tools like the 35 item Mississippi Scale[13] or the **DSM-III**. Third, other researchers have noted that symptoms of PTSD may persist for a lifetime.[1,22,23] However, due to selective attrition and reduced risk factors in our study group, only eight veterans, and only five veterans with combat exposure scale scores greater than 4 reported current symptoms of PTSD in 1988. Fourth, our study group does little to illuminate the so-called delayed onset of PTSD.[22,24] In our study only three men currently report PTSD symptoms who had noted none in 1946. One such man was an ex-marine who had experienced intense combat in the Pacific. In 1988 he could recall that after the war he played music to reduce night fears. Recently, he has begun awakening with bad war memories; he still experiences survivor guilt. His psychosocial adjustment was among the best in the study.

On the other hand, our study group enjoys two redeeming advantages. First, it provides a means of studying the symptoms of PTSD prospectively over the entire life course with the most important confounding variables like antisocial personality, childhood abuse and social disadvantage excluded. Second, our community sample was collected without the distorting effects of psychiatric patienthood or potential secondary gain due to disability claim status.

The present study lends support to the importance of distinguishing post-traumatic dissociative disorders from most anxiety disorders. As the disparate experimental work of both Horowitz[26] and LeDoux[27] suggest, neither psychodynamic nor conventional learning theories are equipped to account for long lasting human response to extreme trauma. Such memories can become vividly and intrusively imprinted and may persist undiminished for decades.[22, 28] In contrast to conventional anxiety symptoms, PTSD symptoms may fail to extinguish as novelty is reduced and as social supports are increased. More important, in contrast to **DSM-III** anxiety disorders, PTSD symptoms while leading to subjective distress may not lead to impaired post morbid function (Table 2).

If post-traumatic morbidity after trauma is defined **not** by the PTSD symptoms in **DSM-III but** by variables like neuroticism, major depressive disorder, substance abuse and (as in McFarlane's[29] study of firefighters) the GHQ[30], then premorbid psychological vulnerability will predict post-traumatic disorders. In such studies

McFarlane's[31] thesis that family histories of depression and anxiety disorders will be elevated is likely to be supported. But the pure PTSD symptoms of our trauma survivors seemed relatively independent of trait anxiety. For example, in our study group the GHQ (available for only 58 men) significantly correlated (rho 0.35, p =0.006, df = 49) with neuroticism but not with PTSD symptoms (rho 0.08, n.s., df = 56).

Again, studies noting the post-traumatic morbidity of PTSD stemming from chaotic childhoods or from situations like the war in Vietnam usually confound co-existing genetic or developmental risk with discrete traumatic events. Thus, in the North Carolina ECA sample, Davidson et al observed that individuals who met diagnostic criteria for PTSD were 20 times more likely to carry the diagnosis of somatization disorder, schizophrenia or panic disorder,[32] but in most of their cases the traumatic events occurred in childhood.

Our data, however, together with that of some investigators,[3,4,7,33] confirm that severity of trauma is the best predictor of who is likely to develop PTSD and that the **distress** of such symptoms does not necessarily produce disability. While it is possible that our results were distorted by the increased mortality of men with high combat and PTSD, in later life we found that the number of PTSD symptoms correlated only minimally with poor psychosocial outcome.

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Experimental Stress and Cardiac Function

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Introduction

Coronary heart disease has long been identified as influenced, both in onset and in course, by psychological and social variables; it is the quintessential psychosomatic disorder. Until the last decade or two, however, this notion has been largely based on clinical observations, descriptive studies, or cross-sectional case control studies. More recently, there has been a large number of published studies that lend increasing weight to a causal role for stress-related factors in CHD. These studies include, first, prospective studies in both normal subjects, in whom incident disease is studied, and in those with CHD, in whom course of illness can be assessed. Second, there are now a number of experimental studies, often employing newer technology, in which a variety of aspects of cardiac function can be reliably assessed in response to stressors. Recent studies in these areas are reviewed.

Experimental Stress and Cardiac Function

As in other domains of research, the experimental model can provide the strongest evidence of a causal relation between stress and cardiac function. The major weakness is that the experimental stressor is usually quite unlike stressors experienced in everyday life; the task is by necessity relatively brief, standardized, replicable, and intended to be distressing and frustrating; examples include an impossible mathematical task, simulated public speaking, or a Stroop word-learning task. However, notwithstanding the fact that the stressor is relatively trivial in comparison to stressors that might occur in daily life, the subject's emotional response (usually anxiety and frustration) is nonetheless similar to responses to normal life events. The fact that significant positive findings are commonly reported lends considerable strength to the view that normal life stressors are likely both to have a marked effect on cardiac function and to influence adverse cardiac events.

These experimental studies embrace relationships between a variety of experimental stressors and a range of outcomes, including blood pressure and heart rate reactivity, ECG changes, coronary blood flow assessed by coronary angiography and, most convincing, radionuclide ventriculography, which assessed the perfusion of cardiac muscle, cardiac wall motility defects, and cardiac output.

Heart rate and blood pressure reactivity

Heart rate and blood pressure reactivity to stressors have been assessed in CHD patients and controls having radionuclide ventriculography. These show that stress-induced blood pressure and heart rate reactivity correlate with severity of perfusion ischemia[1]. Thus, patients with preexisting disease are at greatest risk for blood pressure and heart rate changes. Stressors too may have differing specificity. First, simulated public speaking was found to induce greater change than either an arithmetic or a word-learning task; the former being the most similar to a normal life stressor[1]. Second, it has been shown that there is little correlation between laboratory stress-induced heart rate changes and those changes provoked by work-related activity[2]. Different types of stressors thus have different effects on responsivity.

The changes that do occur, furthermore, may be age or endocrine related. Experimental stress was found to cause greater blood pressure reactivity in postmenopausal women than in premenopausal women and in middle aged men compared with younger men[3]. At a physiological level, in CHD patients at least, these cardiovascular reactivity changes appear to be moderated by vagal activity, because it is the high frequency component (0.16 to 0.4 hz) of heart rate variability (an index of vagal activity) that is most affected by stressors[4]. There is good evidence, furthermore, that vagal activity itself is a predictor of coronary atherosclerosis[5], ischemia[6], sudden cardiac death[7], and mortality following AMI[8]. In normal subjects on a holter monitor, however, sympathetic activity (as assessed by the low frequency/high frequency band ratio) was strongly correlated with daily psychological stress[9]. The neural mechanism for these changes in CHD patients and in normals may thus differ. The importance of direct nerve innervation on the heart, however, is in fact highlighted in a study of cardiac transplant patients (the "denervated heart"), in which the heart rate response to an experimental stressor was significantly diminished[10].

ECG changes

Both experimental stress[11,12] and negative emotions[13] are reported as inducing ECG ischemic changes in studies of CHD patients and indeed, importantly, as inducing these changes at lower blood pressure and heart rates than is the case for exercise-induced ischemia[11,13]. Similarly, stress-induced ischemia is likely to occur in subjects who exhibit ischemia during sedentary activity[14]. The threshold for ischemia, in terms of both physical activity and heart rate and blood pressure changes, is lower in subjects with stress-induced ischemia.

The ECG ischemic changes that are seen are furthermore an underestimate of stress-induced ischemia, since these ECG changes are less frequently seen than are ischemic dysfunctions observed in response to the same psychological stressor, but using radionuclide ventriculography[13,15–18]. Furthermore, those subjects identified as having silent ischemia on exercise had a blunted autonomic response to stress, suggesting somewhat different mechanisms of ischemia following exercise or stress[15].

Angiography

The association between the propensity for stress-induced ischemia and the severity of vessel disease has been shown in several studies. In one study of angiography patients in which the effects on diseased and nondiseased vessels were compared, Yeung and colleagues[19] found that the changes in perfusion overall (in response to a mathematical stress) varied from 29% dilatation (and increase in blood flow of 42%) in normal vessels to 38% constriction (and 48% reduction in blood flow) in the most diseased vessels. The overall effect of stress, nonetheless, in the patient sample, was a reduction in blood flow. These findings were supported in another angiography study of CHD patients[20] in which a quite different stressor was used, namely, recalling an event that had made the patient feel angry. Anger recall correlated with vasoconstriction in diseased vessels, but not in normal vessels. Similarly, in a comparison of patients with mild disease and normal subjects, psychological stress caused microvascular dilatation in normals, but no change in those with mild disease[21]. One study that failed to show dilatation in normal vessels nonetheless showed constriction in diseased vessels[22]. Reduction in perfusion and ischemia in response to stress occurs most commonly where there is underlying arterial disease.

Radionuclide ventriculography studies of cardiac function

These studies provide perhaps the most convincing evidence that experimental stress can affect cardiac function. The evidence derives from patients with CHD who were subjected to experimental stressors such as math tasks, word-learning tests, or recalling angry experiences. Studies, in general, show that stressors significantly reduce coronary perfusion (with reduction on the order of 50%), cause ventricular wall motion anomalies and reduce cardiac output[1,23–29] . These stress-induced wall anomalies are also demonstrable on 2-dimensional echo cardiography[14] and on ambulatory left ventricular function monitoring[30,31]. Indeed, patients with stress-induced cardiac dysfunction are more prone to adverse cardiac outcomes when followed over 1 and 2 years[30].

For the most part, these changes in cardiac function are transient and are present largely during the stressful mental task. As with angiography studies, these ischemic changes occur predominantly in the diseased vessels of patients with CHD[1,19]. In contrast to the changes in patients with CHD, normal subjects may show either no change or an increase in left ventricular ejection fraction during mental stress, as they do during exercise[18,32]. In fact in some normal subjects, the increase in ejection fraction during stress may be greater than that during exercise[28,32]. These findings are consistent with published angiography studies of experimental stress.

In a significant proportion of patients, these stress-induced changes are clinically silent, occurring in the absence of pain[17,23] or ischemic ECG changes[13,15,18]. Silent ischemic changes are furthermore provoked at lower levels of physical activity

or negative emotion[13]. Those patients with silent ischemia indeed appear to have reduced sensitivity to pain and bodily sensations generally[33], and this may be in part due to the fact that psychological stress-induced ischemia is also correlated with higher serum levels of beta-endorphin,

which, in turn, is correlated with pain threshold[34]. The consequences of these silent ischemic changes are significant; they may contribute to immediate cardiac arrest or ventricular tachycardia/fibrillation[35] and to subsequent fatal and nonfatal CHD events in the longer term[36].

Stress-induced vascular perfusion changes are more likely to be found in subjects who also have exercise-induced reduction in cardiac output[18]; the perfusion changes are seen in the same regions of muscle that become ischemic during exercise[29]. These impairments in cardiac function also occur at both a lower heart rate and a lower blood pressure than is the case for exercise[94,26,31,32]. Unlike exercise-induced wall motion anomalies that are diminished by beta-blocking agents, mental stress-induced anomalies are not[26]. Ventricular dysfunction is also more marked when the stressor is more meaningful psychologically[27,28] and is greater in those subjects who have a problem with anger, namely, a tendency to trait anger, less anger control, more aggressive responding, and greater hostile affect[23].

Stress and coagulation factors

There are 3 studies from the one research group assessing experimental stress and coagulation[37–39]. In 10 post-AMI patients and 10 normal controls there were increases in adrenalin levels, platelet aggregation, the formation of circulating aggregates, and circulating Thromboxane B2 in the AMI patients; these returned to baseline at 30 minutes. Similar changes were observed in controls[38]. Similar findings were reported in 25 post-AMI patients and in healthy controls, and an antiplatelet drug (dipyradimole) was found to reduce platelet aggregation in the patient groups[37,38]. Similarly, in the third report, antithrombin II was decreased in normals over 30 minutes, whereas a reduction in antithrombin II I levels in the CHD patients was more persistent[39]. Consistent with this, but in a separate study of normal men[40], an experimental stressor caused an increase in platelet ATP secretion and aggregation. However, one study of patients with stable anger subject to mental stress (word learning) failed to show any effect on platelet aggregation[41]. Finally, Mattiassen and Lingarde[42] found that the stress of imminent job redundancy in 485 workers was linked to serum fibrinogen, the levels of the latter being inversely associated with anxiety, depression, and job stress. Thus, from a small body of evidence it seems reasonable to presume that stress may predispose to thrombus formation by a number of different mechanisms.

Life Events Stress and CHD

Naturalistic studies

There has been a range of studies, both experimental and naturalistic, assessing the effect of acutely stressful experiences on, first, CHD lipid risk variables. Dimsdale and Herd's review of 60 studies[43] concluded that free fatty acids and cholesterol increase in response to many psychological stressors, but there was no consistent finding for triglycerides. A more recent review by Niaura and colleagues[44] concluded that mild forms of normal life stress do not affect lipids or lipoproteins, but severe forms do affect these lipid levels, whereas acute laboratory stress can affect both lipids and lipoproteins, at least in the short term. More recent studies confirm these findings. For example, an experimental study of stressful public speaking showed an increase in serum cholesterol, HDL, LDL and free fatty acids in normal women[45], whereas more naturalistic stressors such as "chronic family stress" were found to be associated with a more adverse lipid profile in boys, but not in girls[46]. Similarly, the threat of redundancy caused elevated serum cholesterol in male shipyard workers[47].

A second group of studies assessed clinical indices of CHD in relation to naturalistic stressors. Assessment of 2 patient groups by Holter monitoring showed that patients who had been caught in a speed trap experienced repetitive ventricular arrhythmias and myocardial ischemia[48], whereas patients facing the stress of bypass surgery also had ischemic episodes, but these caused no symptoms[19].

Two studies have assessed the effects of war. In the first, Dutch World War II resistance fighters were compared with post myocardial infarct patients and surgical controls[49]; the resistance fighters experienced more risk factors than the other two groups, including angina, type A behavior, life stressors, and"vital exhaustion." In the second study (during the Lebanese war)[50], angiographic patients with stenosed vessels were compared

with those with normal vessels and "visitor" control subjects on their exposure to a specific war-related stressor, namely, crossing the "green line," and to other acute war events. In both instances, war stressed were greater in subjects with diseased vessels than in the other two groups. Finally, there have been 2 reports of major natural disasters, namely, earthquakes. The incidence of AMI following earthquakes in Athens[51,52] and in Newcastle (Australia)[53] showed a sudden increase in hospitalizations for AMI in the few days following the disaster. Naturalistic studies of stressful events are thus consistent with findings from experimental studies.

Empirical studies of life event stress

Most empirical studies have used a life events inventory such as the Social Readjustment Rating Scale (SRRS) to measure stress[54]. In retrospective case control studies, a positive relationship to life stress has been shown for myocardial infarction[55–58] and for sudden death[59]. In one prospective study[60], life stress predicted 3-year mortality following AMI. However, in a second prospective study, the SRRS scores in building workers did not predict death or AMI over a 2-year follow-up[61]. A similar but larger study of more than 12,000 men also failed to show that life events predicted either AMI or CHD death over a 6-year follow-up[62].

There are, however, significant methodological limitations with life event checklists[63], and the more comprehensive, sensitive, and specific structured interview method of Brown and Harris[64] is preferred. In 3 such retrospective case control studies, antecedent life events were associated with myocardial infarction[57,65,66]. In a large population-based case-control cohort study[67], a retrospective analysis of 1,194 survivors of AMI revealed no excess of self-reported "unusual events" prior to hospital admission, although physical exertion was found to be a precipitant. Myocardial infarction was also far more common in the first 3 hours following waking in the morning[67]. All retrospective studies of this type are, however, prone to the bias of "effort after meaning," a bias that is not found in prospective studies.

In the only prospective study to date to use the structured interview method, acute and chronic stressors predicted a 3-year reinfarction rate in patients initially admitted with AMI[68]. The relative risks of reinfarction or death in various groups ranged from 2.3 to 4.1. Chronic stressors and those involving goal frustration seemed important, and the effect was more marked in those subjects admitted with a first AMI as compared with those with a prior history of AMI. Empirical studies of life event stress are consistent with experimental and naturalistic studies, showing that life stress influences cardiac outcomes.

Work stress and CHD

Work stress has been shown to influence certain risk factors for coronary heart disease, in particular, lipids and blood pressure. Both increased intake of fat and calories and elevation in serum cholesterol were related to self-reported workload and stress[69], whereas hypercholesteremia was found to be associated with "poor decision latitude" at work, but not with "job demand" per se, based on a meta analysis of 5 studies[70]. In a 2-year prospective study of blue collar workers, Siegriest and colleagues[71] found that "chronic occupation stress" (that is, an interaction between objective and subjective indicators) predicted a more adverse lipid profile (LDL/HDL ratio). However, in a similar prospective study, the threat of unemployment was associated with both higher serum cholesterol[47] and altered fibrinogen levels[42], and levels of fibrinogen were associated with depression, anxiety, and job stress.

Finally, short-cycle repetitive work caused an elevation of cholesterol in women but not in men, suggesting that "hectic" and yet boring work is important in this regard[72]. Blood pressure may also be affected. High job demands and low decision latitude, as well as Type A behavior, were associated with elevated diastolic blood pressure[73]. Another study assessed work stress in relation to a composite risk factor variable[74]. High coronary risk status was defined in 400 blue collar workers as "hypertension in the presence of elevated atherogenic lipids." In this 6-year prospective study, high risk status was independently associated with poor promotion prospects, competitiveness at work and sustained anger. Other studies have also shown that high job strain (higher job demands with less control) are associated with hypertension and LV hypertrophy[75, 76],

whereas increased blood pressure was also associated with specific periods of increased workload and stress[77].

Apart from risk factors such as lipids and blood pressure, work stress may be correlated with AMI incidence. There is, however, some disparity in the results of 3 large prospective studies. In a 6-year follow-up of the same 400 blue collar men[74,78,79], the relative risk of CHD was greater for certain work-related factors, being 4.4 for status inconsistency, 4.5 for need for control, 3.4 for work pressure, and 3.4 for job insecurity[71,74]. These work factors were, themselves, independent predictors, and they were independent of physical and other behavioral risk factors. In the same group of men, Siegrist and colleagues[79] showed that fatal and nonfatal cardiovascular events (AMI and stroke) were increased in those with "status inconsistency" (low reward at work) (OR=3.7) and "immersion" (high effort at work) (OR = 3.6). In contrast to these findings, 2 other large prospective studies of Japanese men over 18 years[80] and U.S. men over 25 years[81] failed to show "high demands" or "low control" to be predictors of CHD events. Indeed in the Japanese men, trends were opposite to those predicted. Genetic and lifestyle or cultural factors may, in part, explain these somewhat discrepant findings. Finally, Hlatky and colleagues[82] have shown in a sample of angiography patients that severity of disease was not associated with job stress as assessed by the Karasek method. Thus, though the evidence is not consistent, there is some evidence that work stress may adversely influence CHD risk factors and CHD events.

Social Isolation, Social Supports

A number of recent studies have shown an association between poor social supports (or indices of social isolation) and CHD. In a prospective study of 1,368 angiography patients with significant stenosis in one vessel or more, 5-year mortality was predicted by lower income, being unmarried, or being married but having no confidant[83]. Similarly, social isolation predicted 3-year mortality and sudden cardiac death in 2,390 post-AMI patients[60]. Furthermore, social isolation, along with self-reports of stress, was found to account for the association found between lower educational status and cardiac mortality in the same sample. Another index of social isolation, namely, "being alone" was a risk factor for 6-month and 2-year recurrence of AMI, but "disrupted marriage" was not associated with increased risk[84]. The beneficial effects of good social networks were reflected in a lower incidence of CHD and better survival from CHD in patients attending a health maintenance organization[85]. Finally, in an experimental study in monkeys, Williams and colleagues[86] showed that chronic social disruption was associated with arteriolar constriction in animals with prior arteriosclerosis and that these changes were not directly related to serum cholesterol.

The mechanisms linking social isolation or related variables to CHD are unclear, given the small number of studies, but one could speculate that certain physical risk factors such as smoking or alcohol use may be mediating variables. Psychological variables with short-term impact, such as depression, are perhaps even more likely, given that increased mortality (including from sudden cardiac deaths) may occur over relatively short follow-up periods. This suggests that longer term pathogenesis, by way of arteriosclerosis, for example, is not the dominant mechanism. Preexisting heart disease, however, seems to be an important precursor upon which social isolation can then affect acute cardiac events.

Psychological Stress

This area of research has, in parts, been poorly researched, largely because the psychological variable under study has often been poorly defined: constructs such as "burn out," "stress," or "vital exhaustion" have been commonly used. Well-defined psychological constructs such as anxiety or depression are more scientifically sound, but have been less commonly employed.

"Burnout," and "vital exhaustion"

These two variables have been assessed in a variety of ways; in some studies minimal descriptive research criteria were used. The strength of these studies, however, rests in their prospective design; in general, "burnout" and "vital exhaustion" seem to predict acute coronary events. For instance, over a 4-year follow-up of 3,900 "normal" mid-

dle-aged men, self-reported "burnout" predicted subsequent AMI[87]. In further follow-up of the same sample, a related variable, "mental and physical exhaustion," predicted AMI over 40 months, with differing increases in relative risk over the various follow-up periods. The risk over the 40-month follow-up was 3.0, increasing progressively to 9.0 over the shorter 10-month follow-up period[88]. This study is consistent with earlier retrospective studies in which AMI patients reported more "vital exhaustion"[89] or "fatigue"[90] than controls. Work stressors, also subsequently identified as associated with AMI in the former study, were found to operate by way of contributing to "vital exhaustion"[89].

Thus, even though "burnout" and "vital exhaustion" are poorly defined, a small number of prospective studies consistently show that these variables can predict AMI even over relatively prolonged periods.

Emotional distress

"Distress," an unpleasant negative emotion, is also more poorly defined as a construct than either depression or anxiety; indeed, it may well embrace both of these conditions. "Distress" may have significant long-term effects, and there have been 3 long-term prospective studies linking distress to CHD indices. Over a 2-year period, distress was shown to predict cardiac events in post-AMI subjects, with distressed patients having a relative risk of 3.4 compared to the non distressed[91]. Similarly, but over an even longer period of 12 years, the presence of distress (measured as a lack of well-being) was associated with CHD onset in a large epidemiological study of some 3000 normal men[92], while over a similar period, Rosengren and colleagues[93] found that "perceived stress" (tension, anxiety, irritability, and sleep problems) predicted risk of AMI.

Distress may also have far more immediate effects; specifically, it may influence acute arrhythmias. Follick and colleagues[94] showed that distress was linked to the occurrence of ventricular ectopics in post-AMI patients, whereas Reich and colleagues[95] found that, in an uncontrolled study of life-threatening arrhythmia, 23% of patients had experienced acute distress in the 24 hours prior to arrhythmia, and 15% had had 2 such episodes of distress. The distressed patients indeed had less severe structural heart disease than the nondistressed, indicating that both structural disease and distress may independently cause arrhythmias. This data is quite consistent with the acute effects of experimental stressors. Thus, "distress," can influence immediate and longer term cardiac outcomes.

Depression

There is a large literature reporting the mortality of psychiatric disorders, the data being derived mostly from hospitalized patients. In some studies, mortality is assessed by broad disease type, such as CVS disease or, less commonly, CHD. There is considerable evidence that depression causes earlier mortality from CVS disease generally[96], but in most studies, other clinical risk factors such as smoking, alcohol use, or lack of exercise (attributable in part to the depression) have not been properly taken into account[97].

More specifically, CHD has been similarly linked to preexisting depression in a range of clinical studies, both retrospective and prospective. In retrospective studies, depression was associated with atypical chest pain[98] whereas in AMI patients, some 40% reported insomnia prior to infarction and, in these, half were clinically depressed[99]. Similarly, in a small descriptive retrospective study, Greene and colleagues[100] reported that most of the subjects with sudden cardiac death had been reported as depressed.

In prospective studies, depression has both short-term and long-term effects. In the short term, both recurrent AMI and arrhythmias are reported. Ladwig and colleagues[101,102] found that persistent depression following AMI predicted recurrent AMI over 6 months, as did Frasure-Smith and colleagues[103,104], who found that depression predicted 6- and 12-month mortality in post-AMI subjects. This was unrelated to either LV function or prior history of AMI. Arrhythmias are also related to preexisting depression. Ladwig and colleagues[101] found that depression predicted significant arrhythmic events post AMI, whereas Ahern and colleagues[105] found that survival in post-AMI subjects who had either significant premature ventricular complexes or sustained V.T. was related to depression assessed at their index admission.

In longer term prospective studies, the findings

are variable. In a 35-year prospective study of normal subjects, Ford and colleagues[106] showed that depression, independent of other risk factors, increased the relative risk of CVS disease by 1.7, while for AMI, more specifically, the risk was 1.9. In a study of 4,736 hypertensive subjects followed over 5 years, Smoller[107] also found higher mortality from AMI; deaths from cancer and CVA's were also increased. However, there have been 2 prospective studies of AMI patients in which depression did not seem to predict outcome of CHD. Tennant[68] failed to find an association with recurrent AMI over 3 years, and Ruberman[60] similarly found no link to subsequent mortality over a similar period.

Anxiety

Less often studied, is the effect of anxiety on CHD. One study showed that men with panic disorder are more likely than those with less severe forms of anxiety to die suddenly from cardiac causes[108], while in a 32-year longitudinal study of 2,280 normal men[109], symptoms of anxiety predicted subsequent risk of sudden cardiac death (O.R.=5.7) and fatal CHD (O.R.=3.2). When confounding risk variables were controlled, the odds ratios were 4.5 and 1.9, respectively. Similarly, Powell and colleagues[110] have shown that "emotional arousability" (assessed during a "casual" interview) predicted sudden cardiac death over 8 years in 929 men with AMI. This effect was especially evident in younger men with high cholesterol and in high alcohol consumers. There may be a range of mechanisms to explain the acute cardiac effects of anxiety. One such mechanism may be that hyperventilation can cause coronary vasospasm and may also induce cardiac arrhythmias, especially in subjects with preexisting CHD[111].

In subjects with preexisting cardiac disease, depression, anxiety, and even more general constructs such as "distress," "burn out," and vital exhaustion have both short-term and long-term adverse cardiac effects that predispose to adverse cardiac outcomes. In normal subjects observed in prolonged prospective studies, these variables contribute to the incidence of CHD events.

Anger and hostility

Both cross-sectional and prospective studies reveal links between anger/hostility and clinical indices of CHD. In 6 cross-sectional studies, indices of anger were found to correlate with CHD risk. Hostility[112], quickness to anger, and verbal expression of anger were found more frequently in men with recent AMI than in normal controls[113], whereas in a study by Mittleman[114], preexisting anger increased the risk of AMI twofold. Meesters and Smulters[115] found that hostility had no overall correlation with AMI, but did so in younger men with first AMI. In the final study[116], AMI patients suppressed hostility more than normal controls, which perhaps reflects greater underlying anger and some compensatory effort to control it. Finally, a hostile personality was also found to correlate with clinical symptoms of peripheral vascular disease assessed correctively in 1,600 elderly community subjects[117].

There are also prospective data that confirm the retrospective findings. In one study of risk factors in 5,115 young adults, Scherwitz and colleagues[118] revealed that hostility predicted tobacco use, dietary intake of calories and alcohol, and marijuana use, whereas 4 prospective studies of CHD outcome all showed that anger or hostility predict CHD. Shekelle and colleagues[119] found, for instance, that hostility (a scale from the MMPI) predicted 10-year risk of AMI and CHD mortality in 1,900 men who had been initially free of CHD. In the MRFIT study, Dembroski and colleagues[120] found that "potential for hostility" and "antagonistic interpersonal hostility" were associated with increased evidence of CHD in a post hoc analysis of patients and matched controls. Julkunen and colleagues[121], in a 1-year follow-up of AMI patients, found that irritability, anger, and "speed and impatience" predicted subsequent AMI or mortality, whereas in a 30-year follow-up of medical students, anger was associated with an increased relative risk of AMI (3.3) and CVA (5.7), even when risk factors were controlled[122].

In studies better indicating pathogenesis, patients with carotid atherosclerosis were first found to have anger (assessed on the Cornell Medical Index) that correlated with disease severity on carotid ultrasound[123,124]. The 2-year follow-up of these subjects found that progression of carotid arteriosclerosis over 2-years was predicted by the anger-related variables "cynical distrust" and "an-

ger control"[124]. Kauhanen and colleagues[125] further showed an association between "suppression of feelings" and less severe carotid atherosclerosis at ultrasound. Thus, the evidence linking anger or hostility to CHD outcomes is increasing; both cross-sectional and prospective studies show a link to adverse cardiac events and to atherogenesis.

Conclusions

The vast majority of recently published studies reveal a strong and largely consistent body of findings implicating stress as a significant contributing factor in the onset and course of CHD. Emotions such as anxiety, depression, and anger are seen to influence outcome, especially in those with preexisting CHD. External life event stressors, both naturalistic and experimental, similarly influence CHD outcome. Furthermore, new investigative technologies now provide some understanding of the way in which these stressors may cause coronary ischemia and cardiac muscle dysfunction and thus lead to serious CHD events, including AMI, arrhythmias, and death. This body of research has implications for effectively managing stress and emotional disturbances, particularly in patients with preexisting CHD.

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Stress, Personality Interactions and Hypertension

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Abstract

Hypertension is widespread in the middle-aged populations of most Western urbanised countries and its central role as a risk factor for both cardiovascular and cerebrovascular disease is no longer in dispute. Around ninety percent of all diagnosed cases of hypertension, however, have no identified biological cause, and the term *essential hypertension* has been attached to them. A range of lifestyle factors, principal among which are dietary factors, have been implicated in the aetiology of essential hypertension. Much more controversially, however, is the view that a broad collection of psychosocial factors, popularly but inaccurately aggregated under the banner of stress, feature prominently in the causation of hypertension. This review examines the empirical evidence since 1990 which either supports or disputes the role of psychosocial factors in generating hypertension. In discrete qualitative assessments of the evidence successively addressing personality, stress and psychiatric illness, all in relation to hypertension or significant identified risk of it, the review reaches the conclusion that the role of psychosocial factors in the causation of hypertension must be seriously questioned. While some evidence is supportive, much is variable, and the overall quantitative level of support is modest at best. While methodological problems surrounding much of the existing work may well have contributed to this disappointing situation, the veracity of the hypothesis itself must also come under close scrutiny.

Introduction

For many in the population at large, hypertension is loosely but thematically synonymous with mental stress. At the very least, common perceptions of hypertension place stress prominently on the list of factors seen to cause this condition. Moreover, such views are not restricted to those entirely untutored in medicine or psychology; many practitioners in both professions will commonly invoke stress as an explanation where biological factors have failed to account for elevated blood pressure of clinical significance in a consulting individual. This is not at all surprising. The physical sensations which accompany states of emotional arousal in response to an external psychosocial stressor include an uncomfortable collection of cardiovascular symptoms including rapid heart rate and pounding of peripheral pulses, facial blushing, tightness and pressure in the chest, shortness of breath and, occasionally, fainting (Byrne, 1992). And while hypertension itself is essentially subjectively asymptomatic (Williams, 1994) this constellation of physical experiences gives face validity to the common extrapolation from stress to hypertension. Within this context, the very substantial research effort which has gone into the establishment of associations between psychosocial factors and hypertension over the past two decades is easy to understand.

Definitions, correlates and prevalence

The distinction between transiently elevated blood pressure and hypertension is crucial in considering these associations yet it is so often confused in the research literature, and in evaluating the usefulness of this research, the distinction must be kept clearly in mind. Resting blood pressure in the normal individual is influenced by a variety of both intrinsic and extrinsic factors including age, sex, race, family history of hypertension and a range of systemic illnesses (Byrne, 1992). Moreover, blood pressure is a remarkably labile physiological phenomenon; both physical states (eg pain, cold, intensive exercise) and psychological events or experiences (eg shock, threat, engaging or challenging cognitive effort) can act to markedly elevate blood pressure for the duration of the external state or event and for a brief period of recovery afterwards. But in the normal individual such elevations are relatively transitory and blood pressure will eventually revert to some baseline level which is a more or less stable characteristic of that individual.

For a minority of the population, however, resting blood pressure will exceed certain limits on a permanent basis, taking these individuals chronically into an area of the population distribution for blood pressures within which there is an increased risk of cardiovascular or cerebrovascular disease. While there is no dividing line between normal and high blood pressure (Williams, 1994) the general limits of this region of risk have been agreed on for two decades or more. Thus, Oparil

(1977) defined hypertension as ... *a casual blood pressure of 160 mmHg systolic and/or 95 mmHg diastolic or higher or a blood pressure on repeat determination of 140 mmHg systolic and/or 90 mmHg diastolic or higher* (p 404). She estimated that between 15% and 20% of the adult population in the United States satisfied these criteria. The Australian experience is not dissimilar. The National Heart Foundation of Australia (1986) data indicated 15.9% of Australian males and 11.1% of Australian females between 25 and 64 years of age to be hypertensive by these criteria. The National Institute of Occupational Health and Safety Blood Pressure Study (1987) showed that 18.3% of males and 7.3% of females of all ages had diastolic blood pressures of 90 mmHg or greater while 17.7% of males and 7.7% of females of all ages had systolic blood pressures of 140 mmHg or greater.[1]

Hypertension, so defined, may arise for two distinct reasons. The presence of a large number of medical conditions (see Williams, 1994, for a comprehensive listing) may give rise to so called secondary hypertension, however around 90% of all detected cases of hypertension are said to be *primary*, *essential* or *idiopathic* hypertension (Williams, 1994); for these there is no identifiable cause. In the absence of a clear biological aetiology, and in view of the perceived co-incidence of dysphoria and cardiovascular arousal, it has been popular to ascribe much of the causation of essential hypertension to the effects of a loose coalition of psychological factors.

Early psychological studies

Hypertension has long been considered one of the traditional psychosomatic diseases; Franz Alexander (1939) included it among the seven physical disorders which he claimed to relate specifically and directly to underlying personality traits. Alexander's psychoanalytic formulation of hypertension attributed it to a conflict between intrinsic aggression and dependence on the objects of aggression, resulting in a permanent state of biological emergency because of the subsequent need to suppress that aggression. While Alexander sought to endow his psychoanalytic approach with physiological respectability by linking it to Cannon's (1920) classical work on the flight/fight response, the essentially irreplicable basis for his claims gave them somewhat limited acceptance and endurance.

As trait theories of personality became popular, however, the possibility of associations between hypertension and various identified personality traits began to attract the attention of those seeking psychological causes for chronically elevated blood pressure. Systematic empirical studies over three decades or more reported positive associations between chronically elevated blood pressure or clinical diagnoses of hypertension and the personality traits of psychopathy (Brower, 1947), submissiveness and sensitivity (Harburg, Julius, McGinn, McLeod & Hobbler, 1964), emotional difficulties expressed at interview (Brunswick & Collette, 1977) and assessed by questionnaire (Pilowsky, Spalding, Shaw & Korner, 1973), emotional suppression (Cottington, Brock, House & Hawthorn, 1985; Jorgensen & Houston, 1986), Type A behaviour (Contrada, 1979; Steptoe, Melville & Ross, 1982), self-disclosure in the context of need for social approval (Cumes-Rayner & Price, 1990) and neuroticism (Sainsbury, 1960, 1964; Robinson, 1962, 1964; Steptoe, Melville & Ross, 1982; Coelho, Hughes, Fonseca & Bond, 1989).

The evidence was not all positive, however, with some equally systematic empirical studies reporting no association whatsoever between chronically elevated blood pressure or hypertension and a range of objectively identified personality traits (Davies, 1970; Kidson, 1973; Hodes & Rogers, 1976; Ambrosio, Dissegna, Zamboni, Santonastaso, Canton & Dal Palu, 1984), leading Goldstein (1981) to observe that psychological questionnaires of personality or symptomatology considered to be standard at the time these investigations were undertaken, in fact provide poor differentiation between hypertensives, normotensives, and those with only transiently elevated blood pressure. Goldstein (1981) pointed to two fundamental methodological flaws in research linking personality to enduring elevations in blood pressure. First, subject groups varied widely across studies but were frequently made up of young, normotensive volunteers, so limiting causal extrapolations to clinical hypertension. Second, measures of blood pressure were typically casual ones, so limiting inferences regarding

causal contributions of personality to clinically manifest hypertension. The broadly unsatisfactory nature of research causally linking psychological factors to hypertension was, therefore, characteristic of our state of knowledge up until the last decade or so.

The present literature search

To build on this situation, a systematic search of appropriate data-bases of published literature was undertaken. Data-bases chosen for this exercise were MEDLINE EXPRESS (R)[2] and PsycLIT[3]; in the latter case, only journal articles and not books or book chapters were searched for. Given the expected volume of contemporary material bearing on psychological factors and hypertension, and since much of the evidence relating psychological factors to hypertension prior to 1990 had already been extensively reviewed and a range of methodological flaws identified (see Johnson, Gentry & Julius, 1992, for an excellent coverage), only papers appearing since 1990 were requested. Commercially available CD-ROM versions of these two data-bases were searched using the keywords *Personality*, *Psychosocial*, *Stress*, *Anxiety*, *Depression*, *Psychiatric Illness*, *Post Traumatic Stress Disorder* and *Stress Management*, all in conjunction with *Hypertension* (joined by the conjunctive "and"). Each keyword was searched independently with hypertension. Only hypertension (or significant risk of developing it) and not blood pressure *per se* was searched for since blood pressure is frequently used as a dependent variable in laboratory studies which may have little if any relevance to the investigation of clinical hypertension. Abstracts of all records revealed were then read to assess their relevance to understanding the association between psychological factors and hypertension before reprints or copies of articles were obtained. Records were rejected if: (a) they did not report empirical data bearing directly on the relationship between the keyword and hypertension, (b) they reported material which was essentially anecdotal or speculative, or (c) they were in non-English language journals which were too obscure or parochial to be conveniently obtained. Searches yielded an average of 25% of relevant records per search, and while this was disappointing, the broad nature of data-base searches using simple conjunctions of two keywords makes the process prone to false positive errors.[4]

Personality and Hypertension

In the light of the largely inconclusive results of work attempting to relate attributes of trait personality to hypertension (Johnson, Gentry & Julius, 1992) recent studies seeking to establish the so-called hypertensive personality are not nearly so wide-spread as was the case two decades ago, and this is particularly so where multifaceted inventories of personality provide measures of the independent variables. An extensive meta-analysis of studies reporting links between various attributes of trait personality, collectively yielding 295 relevant effect sizes from 25,469 participants with essential hypertension (Jorgensen, Johnson, Kolodziej & Schreer, 1996) showed that when the moderator effects of age, gender, occupation, and awareness of hypertensive status were controlled for, most reported effects were eliminated. On this basis, the authors were led to conclude that the traditional view of personality causing essential hypertension is untenable. Nonetheless, studies investigating links between specific attributes of trait personality continue to appear in the published literature.

Neuroticism, emotionality and emotional instability

The attribute of neuroticism or emotional instability (Eysenck, 1967) figured prominently in earlier studies of personality and hypertension (Byrne, 1992) and it is not surprising, therefore, that this notion continues to be investigated in relation to hypertension. Results have not, however, been particularly supportive of an association. A study of military conscripts deemed to be at risk of hypertension was unable to confirm an expected relationship between neuroticism and either systolic or diastolic blood pressure (Kohler, Scherbaum, Richter & Bottcher, 1993) and, by implication, no relationship between neuroticism and hypertension. This study also failed, incidentally, to reveal any association between blood pressure and extraversion, though other work (Burke, Beilin, German, Grosskopf, Ritchie, Puddie & Rogers, 1992) has reported such an association. Some work has shown significant

associations between the presence of clinically identified neurotic symptoms and a clinical diagnosis of hypertension (Muller, Montoya, Schandry & Hartl, 1994; Magdon, Kawecka-Jaszcz, Klocek, Lubaszewski & Betkowska-Korpala, 1994) though these associations were manifest in moderate to severe hypertensives aware of their diagnosis and so the issue of reverse causality must seriously be considered (Jorgensen, Johnson, Kolodziej & Schreer, 1996). Indeed, Muller et al (1994) found that after successful treatment of hypertension and normalisation of blood pressure, levels of neurotic symptoms in those who were hypertensive became indistinguishable from symptom levels found in long-term normotensives.

Emotional instability, again conceptualised and measured as a personality trait, has been both positively (Spiro, Aldwin, Ward & Mroczek, 1995) and negatively (Kohler, Speier & Richter, 1994) related to incidence or risk of hypertension. Positive associations have been claimed to reflect a defeat reaction to stress (Raikkonen, Hautanen & Keltikangas-Jarvinen, 1996), whereas negative associations have been claimed to reflect affective inhibition in hypertensives (Roter & Ewart, 1992), this latter view being consistent with findings relating hypertension to the presence of alexithymia (Nordby, Ekeberg, Knardahl & Os, 1995; Todarello, Taylor, Parker & Fanelli, 1995). In the absence of uniform findings, however, there is not at this time sufficiently persuasive evidence that emotional instability, whether measured as neuroticism or otherwise, or whether manifest or suppressed, is causally related to hypertension.

Anger and hostility

Anger and hostility have a longstanding history of investigation in relation to the causation of hypertension (Johnson, Gentry & Julius, 1992) and much of the evidence of the decade before 1990 supported links between the two (Johnson & Spielberger, 1992). Suppressed anger has been particularly implicated in this respect (Chesney & Rosenman, 1985). Recent evidence too has been largely supportive of an association but conceptual advances in thinking about anger and hostility suggest that such associations are by no means simple. These advances alert us, at the very least, to the need to make distinctions between the experience of anger as an emotional state and the possession of hostility as a predisposing attribute to angry interpretations of environmental situations or events, and between experienced anger directed inwardly and experienced anger directed to those external situations or events seen as causal agents.

A set of meta-analyses of previously published data (Suls, Wan & Costa, 1995) indicated the experience of anger, as an emotional state, to be associated both with elevated blood pressure and clinically diagnosed hypertension, but the relationships were small and highly variable. While these collective effects could not be uniformly attributed to artefacts of the measurement situation (eg white coat hypertension) awareness of the clinical diagnosis of hypertension itself contributed to higher scores on anger scales. Prospective evidence on anger or hostility and clinically diagnosed hypertension is sparse. Hostility measured by questionnaire in 4,710 students during their university years related significantly to the development of hypertension between 21 and 23 years later (Siegler, Peterson, Barefoot & Williams, 1992), but while the "public health significance" of these findings was noted, absolute levels of association were very small indeed.

Reported associations between various measures of anger or hostility and resting blood pressures in unselected samples of largely normotensive individuals from the general population have both supported (Spicer & Chamberlain, 1996) and rejected (Spoth, Dush & Leonard, 1992) the hypothesised link. For the most part, however, recent supportive evidence has focussed either on associations between anger or hostility and blood pressure reactivity in response to external stressors in those with already diagnosed hypertension (Jamner, Shapiro, Hui, Oakley & Lovett, 1993) or those deemed to be at risk of hypertension by virtue of having a positive family history of hypertension (Jorgensen, Gelling & Kliner, 1992; Ewart & Kolodner, 1994; Shapiro, Goldstein & Jamner, 1995). Blood pressure reactivity in those with identified anger or hostility appears, moreover, to be potentiated by the coexistence of neuroticism (Miller, Dolgoy, Friese & Sita, 1996). Knowledge of pre-existing hypertension, however, may well confound these relation-

ships (Vitaliano, Russo, Bailey, Young & McCann, 1993) making their interpretation somewhat difficult. As with neuroticism, therefore, anger or hostility as causal contributors to hypertension are not, at this time, either unequivocally or conclusively indicated by the evidence.

Type A behaviour

Though not strictly seen as an attribute of trait personality (Byrne, 1996), the Type A behaviour pattern (TABP) has nonetheless been widely examined in the context of hypertension largely on the grounds that associations between the behaviour pattern and elevated blood pressure may mediate between the TABP and risk of coronary heart disease (Ward, 1990). An extensive review of the evidence prior to 1990 provides little support for this view (Rosenman, 1992). The situation is not appreciably altered by more recent evidence. While some work suggests that Type A men and women are at significantly higher risk for hypertension than those without the TABP (Ekeberg, Kjeldsen, Eide & Leren, 1990; Smyth & Yarandi, 1992, 1994; Lazaro, Valdes, Marcos & Guarch, 1993; Bages, Feldman & Chacon, 1995), and while modification of the TABP has resulted in blood pressure reductions in hypertensives (Deary, MacLullich & Mardon, 1991), other studies have failed to find direct associations between the TABP and hypertension (Lacour & Consoli, 1993; Frankish & Linden, 1996) or blood pressure reactivity in those with high resting blood pressures (Spoth, Dush & Leonard, 1992). Evidence linking the TABP with hypertension is, therefore, equivocal at best.

Conclusions

There is no consistent or persuasive evidence that personality, seen as a temporally enduring trait of the individual, predisposes or systematically relates to risk or clinical incidence of hypertension. While blood pressure may vary with certain measured attributes of personality under laboratory conditions, the transition from this to risk of hypertension is yet to be conclusively established, and Jorgensen et al's (1996) assessment of the evidence appears to hold.

Stress and Hypertension

Studies attempting to relate stress to hypertension have taken two broad forms, the one examining blood pressure reactivity in hypertensives (or those at some identified risk) of hypertension to external (usually laboratory imposed) stressors, and the other investigating the presence of environmental or psychosocial stressors in relation to clinically diagnosed hypertension. Given that the stressors which most individuals will typically experience are in the latter of these categories, the preponderance of the published material is, unfortunately, in the former category.

Stress and blood pressure reactivity

The rationale underlying much of this work reduces to the simple proposition that clinical hypertension is mediated through autonomic hyper-reactivity to events external to the individual (Everson, Kaplan, Goldberg & Salonen, 1996; Noll, Wenzel, Schneider, Oesch, Binggeli, Shaw, Weidmann & Luscher, 1996), whether by increasing cardiac output (al'Absi, Lovallo, McKey & Pincomb, 1994), peripheral resistance (Rockstroh, Schmeider, Schachinger & Messerli, 1992) or both. This reasoning extends to the view that since a family history of hypertension conveys an increased individual risk of developing hypertension (Byrne, 1992), autonomic reactivity will be more pronounced among those individuals with a positive than with a negative family history of hypertension.

Both diastolic and systolic blood pressures are characteristically reactive to a range of both cognitive and physical stressors in normotensive individuals under laboratory conditions (Byrne, 1992). There is some evidence, moreover, that at least systolic pressure, measured in the work situation, may show similar reactivity to transient elevations in occupational stress (del Arco-Galan, Suarez-Fernandez & Gabriel-Sanchez, 1994). An emerging literature now suggests that this same pattern is evident in those with already diagnosed hypertension or those who are at risk of developing hypertension. Elevated reactivity in both diastolic and systolic blood pressure to cognitive stressors has been reported for male obese patients with essential hypertension (Rockstroh, Schmeider, Schachinger & Messerli, 1992), bor-

derline hypertensives (de Faire, Lindvall & Nilsson, 1993; Jern, Bergbrant, Hedner & Hansson, 1995), and both medicated and unmedicated hypertensives (Grosse, Prchal, Diaz-Puertas & Coviello, 1993; Elkohen, Clerson, Mounier-Vehier, Humbert, Prost, Poncelet & Carre, 1994), all relative to reactivity in normotensive individuals under similar conditions. Blood pressure reactivity in hypertensives was, as well, seen to parallel reactivity in levels of cortisol secretion (al'Absi, Lovallo, McKey & Pincomb, 1994).

Those with a positive family history of hypertension have been reported to show more pronounced blood pressure reactivity to external stressors than those without (Widgren, Wikstrand, Berglund & Andersson, 1992; Semenchuk & Larkin, 1993; Noll, Wenzel, Schneider, Oesch, Binggeli, Shaw, Weidmann & Luscher, 1996) though in some studies this effect has been restricted to systolic blood pressure (Kawabe, Saito, Hasegawa, Nagano & Saruta, 1994; de Visser, van Hooft, van Doornen, Hofman, Orlebeke & Grobbee, 1995). Other work, while showing no absolute difference in blood pressure reactivity between individuals with and without family histories of hypertension, has reported a slower return to baseline blood pressures after stressor exposure in those with a positive family history (Gerin & Pickering, 1995).

Blood pressure reactivity to an external stressor appears to be potentiated by the presence of trait anxiety (Miller, 1992) and attenuated by pretreatment with a calcium antagonist (Schulte, Ruddel, Schmeider, Schachinger, Brautigam & Welzel, 1992), an angiotensin-converting enzyme inhibitor (Saitoh, Miyakoda, Kitamura, Kinugawa, Kotake & Mashiba, 1993) or an alpha-blocking agent (Lee, Lu & DeQuattro, 1996). Some work (Boone, Probst, Rogers & Berger, 1993) suggests that exercise prior to stress testing can attenuate blood pressure reactivity but evidence contrary to this has also been reported (Buckworth, Dishman & Cureton, 1994). Deficiencies in social support appear to potentiate blood pressure reactivity in the face of cognitive stress (Gerin, Pieper, Levy & Pickering, 1992), though from the opposite perspective, the presence of perceived high social support failed to attenuate blood pressure reactivity to an external stressor (Knox, 1993), a finding which challenges contemporary psychosocial views of stress.

While these findings may broadly be confounded, *inter alia*, by ethnic differences (Somova, 1992) and the effects of variable blood pressure baselines (Matthews, Woodall & Allen, 1993), it has been concluded both that blood pressure reactivity in the laboratory may convey information about blood pressure fluctuation among hypertensives in real-life settings (Dimsdale, Mills & Dillon, 1992; Light, Dolan, Davis & Sherwood, 1992) and that blood pressure reactivity to psychological challenge may play an aetiological role in the pathogenesis of hypertension (Silagy, McNeil, McGrath & Farish, 1992; Everson, Kaplan, Goldberg & Salonen, 1996).

This general view has not, however, been uniformly supported by the published evidence. In other studies, blood pressure reactivity to external stressors has failed to distinguish hypertensives from normotensives (Cardillo, De Felice, Campia & Folli, 1993; Lacour & Consoli, 1993; Lindqvist, Kahan, Melcher & Hjemdahl, 1993; Kohler, Scherbaum & Ritz, 1995), those with an identified risk of hypertension from those without (Ferrara, Marotta, Mainenti, Borrelli, Mancini & Soro, 1992; Vogele & Steptoe, 1992; Carroll, Smith, Sheffield, Shipley & Marmot, 1995), or those with increased from those with normal left ventricular masses (Cardillo, De Felice, Campia, Musumeci & Folli, 1995). Neither has a family history of hypertension consistently predicted elevated blood pressure reactivity relative to those with normotensive families (Miller, 1992; al'Absi, Everson & Lovallo, 1995). The causal role of blood pressure reactivity to stress in the pathogenesis of hypertension must, therefore, continue to be treated with some caution (Falkner, 1996).

Psychosocial stress and hypertension

Historically, investigations of the experience of psychosocial stress in the workplace have formed one important focus for work attempting to associate stress with hypertension (Frommer, Edye, Mandryk, Grammeno, Berry & Ferguson, 1986), and some early reports (Caplan, Cobb, French, Harrison & Pinneau, 1980) were broadly supportive of a positive association. Measures of job status have been positively associated with both

risk (Light, Brownley, Turner, Hinderliter, Girdler, Sherwood & Anderson, 1995) and prevalence of hypertension (Markovic, Matthews, Huston, Egbagbe, Ukoli & Bunker, 1995). Sustained elevations in systolic blood pressure have, as well, been associated with actual unemployment (Janlert, Asplund & Weinehall, 1992) but not with anticipated unemployment once pre-threat blood pressures were controlled for (Schnall, Landsbergis, Pieper, Schwartz, Dietz, Gerin, Schlussel, Warren & Pickering, 1992).

Contemporary research has, however, benefited from the more conceptually refined models of occupational stress put forward by Karasek (Karasek & Theorell, 1990) and Siegrist (Siegrist, 1996), where the concept of high demand in the context of low control has allowed for a more precise definition and measurement of occupational stress. Within this framework, high levels of job strain (high work effort in combination with low reward or sense of control) have been statistically associated with clinically diagnosed hypertension (Siegrist & Peter, 1996), gestational hypertension in pregnant working women (Landsbergis & Hatch, 1996) and sustained elevations in both diastolic and systolic blood pressures both in the work situation (Light, Turner & Hinderliter, 1992; Schnall, Schwartz, Landsbergis, Warren & Pickering, 1992; Theorell, Ahlberg-Hulten, Jodko, Sigala & de la Torre, 1993) and in the home environment after work (Van Egeren, 1992; Pickering, Schwartz & James, 1995). These effects seemed to be consistent over at least some socio-cultural contexts (Cesana, Ferrario, Sega, Milesi, De Vito, Mancia & Zanchetti, 1996).

Sex differences were evident, however, with men being apparently more susceptible to the hypertensive effects of job strain than women (Light, Turner & Hinderliter, 1992; Pickering, Schwartz & James, 1995). Moreover, some work has actually reported inverse relationships between job strain and hypertension in males and across cultures (Albright, Winkleby, Ragland, Fisher & Syme, 1992; Tarumi, Hagihara & Morimoto, 1993).

Extrapolation of these findings to the broader social environment has not been widespread. Socio-cultural disadvantage arising from minority ethnic status has been speculated to underlie hypertension in African Americans (Dressler, 1996) and adverse social conditions in adolescent males were shown to predict high blood pressures when these adolescents reached adulthood (Kalimo & Vuori, 1993). However, self-reported exposure to adverse life events does not appear to distinguish hypertensive from normotensive individuals (Nyklicek, Vingerhoets & Van Heck, 1996) or therapy resistant from controlled hypertensives (Isaksson, Konarski & Theorell, 1992).[5] Moreover, while some work suggests a positive association between objectively measured stressor exposure and hypertension (Nyklicek, Vingerhoets & Van Heck, 1996) other studies have reported a negative association between reported life event exposure and both systolic and diastolic blood pressures in individuals at risk of cardiovascular disease (Melamed, Kushnir, Strauss & Vigiser, 1997).

Conclusions

While a link between stress, whether artificially contrived in the laboratory or arising naturally from the psychosocial environment, and hypertension or identified risk of it, is both conceptually and biologically plausible (Byrne, 1992; Perry, Whincup & Shaper, 1994), the empirical evidence emerging from studies of both blood pressure reactivity to cognitive stressors measured under laboratory conditions, or of associations between psychosocial stressors (whether found in the occupational or broader social environments) and incidence or risk of hypertension, provides equivocal support at best for the existence of this link.

Stress Management and Hypertension

In the light of now widespread evidence that acutely stressful situations increase blood pressures in both normotensives and hypertensives under both laboratory and natural conditions (Van Egeren & Gellman, 1992), the application of stress management procedures to prevent and treat hypertension has received a good deal of recent attention (Hunyor & Henderson, 1996). While it must be recognised that acute elevations in blood pressure consequent on the experience of a stressful environmental event do not constitute grounds for the causation of hypertension, inter-

vention strategies form a powerful methodology for investigating causality (Susser, 1973) and so this avenue of research is not surprising.

Stress management strategies applied in the form of individual progressive muscle relaxation (Haaga, Davison, Williams & Dolezal, 1994), group relaxation exercises (McGrady, 1994), skin temperature biofeedback assisted relaxation (Albright, Andreassi & Brockwell, 1991; Canino, Cardona, Monsalve, Perez-Acuna, Lopez & Fragachan, 1994; McGrady, 1994; Paran, Amir & Yaniv, 1996), Type A behaviour modification (Bennett, Wallace, Carroll & Smith, 1991), cognitive therapy based on stress inoculation (Amigo, Buceta, Becona, & Bueno, 1991), transcendental meditation (Alexander, Schneider, Staggers, Sheppard, Claybourne, Rainforth, Salerno, Kondwani, Smith, Walton & Egan, 1996) and supportive educational counselling (Woolard, Beilin, Lord, Puddey, McAdam & Rouse, 1995) have all been shown to produce effective and enduring blood pressure reductions in hypertensives. Biofeedback assisted relaxation has also been found to increase the effectiveness of diuretic therapy for hypertension (Jurek, Higgins & McGrady, 1992) though some work with skin temperature biofeedback (Blanchard, Eisele, Vollmer, Payne, Gordon, Cornish & Gilmore, 1996) has suggested it to be of limited effectiveness in the treatment of hypertension, with the primary advantage being restricted to female hypertensives.

Though not strictly within the framework of stress management *per se*, programs of lifestyle management incorporating elements of stress management have also been examined in relation to hypertension control. Stress management strategies when used in conjunction with programs of aerobic exercise (Ginsberg, Viskoper, Fuchs, Drexler, Lubin, Berlin, Nitzan, Zulty, Chetrit & Bregman, 1993; Brownley, West, Hinderliter & Light, 1996) and dietary modification (Ginsberg et al., 1993; McDougall, Litzau, Haver, Saunders & Spiller, 1995) have been associated with significant blood pressure reductions in diagnosed hypertensives. None of these studies, however, allows for the partitioning of the therapeutic effects of stress management alone as opposed to some combination of stress management and exercise or dietary control, and so they are far less instructive than studies examining stress management in isolation in considering the causation of hypertension.

Of course not all studies of the application of stress management as a sole therapy in the treatment of hypertension have been supportive of its use. Examinations of the effectiveness of progressive muscle relaxation (Alexander, Schneider, Staggers, Sheppard, Claybourne, Rainforth, Salerno, Kondwani, Smith, Walton & Egan, 1996), temperature biofeedback (Wittrock, Blanchard, McCoy, McCaffrey & Khramelashvili, 1995), and unspecified stress management procedures (Johnston, Gold, Kentish, Smith, Vallance, Shah, Leach & Robinson, 1993) have all failed to confirm the clinical utility of stress management in the control of hypertension. Reviews of "false positive" outcomes broadly attribute these either to the inadequate use of control groups (Devine & Reifschneider, 1995) or to habituation of the "white coat hypertension" response in those initially unused to repeated blood pressure measurement (Johnston, 1994),[6] though those who have defended unsupportive studies of stress management strategies in the treatment of hypertension, have attributed responsibility for this both to a failure to apply these strategies with sufficient intensity (Nothwehr, Elmer & Hannan, 1994) and to a failure to target stress management strategies to the specific (postulated) autonomic antecedents of hypertension (Lehrer, Carr, Sargunaraj & Woolfolk, 1994).

Conclusions

Reviews of the overall treatment of hypertension continue to recommend both stress management (Engler & Engler, 1995) and lifestyle management (Beilin, 1994, 1996) as approaches of first choice (Rabkin, 1994), particularly when balanced against the potentially unpleasant side effects arising from pharmacological management. Evaluated objectively, however, stress management for the treatment of hypertension remains "... the promissory note [which] has failed to deliver" (Hunyor & Henderson, 1996, p 413).

Psychiatric Illness and Hypertension

Psychiatric illness is typically accompanied by altered states of autonomic arousal (Rosenhan & Seligman, 1995), and since arguments for the

psychological causation of hypertension have been based largely on this link, it is biologically plausible at least that hypertension may occur as the by-product of prolonged periods of some psychiatric illnesses where autonomic arousal is chronically elevated. Some reviews (Markowitz, Wells & Carson, 1995) suggest hypertension to be common in patients with psychiatric illness, and some go so far as to recommend consideration of psychiatric illness as a cardiovascular risk factor (Hayward, 1995). From the opposite perspective, clinical hypertension has been shown to complicate the course and outcome of some psychiatric illnesses (Baker, Kazarian & Marquez-Julio, 1995). This area is not, however, crystal clear in its interpretation. Psychiatric dysfunction has been shown to arise as a direct psychological response to the diagnosis of hypertension (Campbell, Bass, Chockalingam, LeBel & Milkovich, 1995; Gurgenian, Pogosova, Vartanian, Vatinian & Nikogosian, 1995), and initially undetected clinical conditions (however rare) such as phaeochromocytoma have been seen in some cases to underlie both psychiatric symptoms and hypertension where, prior to extensive medical investigation, the former had been assumed to have caused the latter (Lambert, 1992; Mann, 1996). Most importantly, prospective evidence over a fifty year follow-up has failed to establish psychopathology at outset as an objective predictor of hypertension at some later time (Vaillant & Gerber, 1996). Yet a good deal of research continues to be reported in this area, and particularly where anxiety or depression constitutes the focus of psychiatric symptomatology.

Anxiety and hypertension

Since anxiety above all states of psychiatric dysfunction is most strongly and consistently associated with autonomic hyper-arousal (Rosenhan & Seligman, 1995), the common perception that anxiety figures in the causation of hypertension is not surprising, and there is some historical support for this view (Byrne, 1992). In the more recent literature, hypertension has been associated with both generalised anxiety (Somova, Connolly & Diara, 1995) and panic disorder (Noyes, Woodman, Garvey, Cook, Suelzer, Clancy & Anderson, 1992), and high levels of state anxiety have been shown to predict later incidence of hypertension in individuals normotensive at intake (Jonas, Franks & Ingram, 1997), though one study has restricted this prediction to middle-aged men and not women (Markovitz, Matthews, Kannel, Cobb & D'Agostino, 1993). Moreover, a primary anxiolytic agent (etizolam) has been shown to effectively treat essential hypertension (Matsuo, Watanabe, Ishiguro, Arai, Sugiyama, Matsuno, Hirano & Arakawa, 1992). In an interesting if somewhat tangential sub-set of published evidence, severe and acute anxiety during the course of dental treatment has been associated with dramatic elevations of blood pressure leading to potentially fatal cardiovascular and cerebrovascular events (Matsuura, 1993; Brand, Gortzak, Palmer-Bouva, Abraham & Abraham-Inpijn, 1995; Massalha, Valdman, Farkash, Merkin & Herishanu, 1996).

The broadly postulated association between anxiety and hypertension has not, however, been universally supported. In other studies, hypertension has been found to be unrelated to symptoms of anxiety (Jones-Webb, Jacobs, Flack & Liu, 1996), generalised anxiety disorder (Fark, 1993), subjective ratings of anxiety during a painful medical procedure (France, Adler, France & Ditto, 1994), or psychometrically derived assessments of state anxiety (Jamner, Shapiro, Hui, Oakley & Lovett, 1993). In this regard, the more cautious interpretation of the balance of evidence is that anxiety may be associated with transiently elevated blood pressure, and may be co-morbid with, but not necessarily causal or predictive of hypertension.

Depression and hypertension

Clinical depression (or at least some categories of major depressive disorder) has also been consistently associated with altered states of autonomic arousal (Byrne, 1992). Depression too, has therefore been widely examined as a possible and indeed a likely factor in the causation of hypertension. Again, there is some historical support for this view (Byrne, 1992). Risk of hypertension in adolescents has been associated with trait depression as evident from responses to psychometric scales of trait affect (Ewart & Kolodner, 1994) and hypertensive subjects with a positive family history of hypertension report higher levels of depressive symptoms than either

those without a family history of hypertension or those who are normotensive (Thyrum, Blumenthal, Madden & Siegel, 1995).

Hypertension has been found to co-exist with clinical depression in the large majority of a sample of elderly patients (Ko, 1994) and elevated scores on a scale of depression obtained from a large cohort of individuals normotensive at intake predicted the incidence of hypertension between seven and sixteen years later (Jonas, Franks & Ingram, 1997). Somewhat more indirectly, shy men appear to have a greater prevalence of hypertension, and since shyness has been identified as a component of depression, hypertension has been causally related to depression through the mediator of shyness (Bell, Martino, Meredith, Schwartz, Siani & Morrow, 1993). Even more indirectly still, the presence of depression has been related to the incidence of stroke in the elderly (Fujikawa, Yamawaki & Touhouda, 1994; Wassertheil-Smoller, Applegate, Berge, Chang, Davis, Grimm, Kostis, Pressel & Schron, 1996), though while it has been suggested that this association is achieved by a link between depression and hypertension, it is equally possible that the experience of depression itself is secondary either to recognition of the existence of hypertension or to the neuropsychological effects of the stroke. Finally, a biological link between depression and hypertension has been posited on the basis that both manifest an exaggerated calcium response to serotonin challenge (Konopka, Cooper & Clayton, 1996) though this hardly amounts to a causal influence of the former on the latter.

Again however, not all recent evidence has positively associated depression either with the causation of hypertension or as a clinical phenomenon co-existent with it.[7] Baseline depression levels in a large, prospective population study were not found to predict hypertension fifteen years later (Vogt, Pope, Mullooly & Hollis, 1994) and prevalence of depressive symptomatology was not related to prevalence of hypertension in a large population sample of elderly people (Ihara, 1993). Scores on a scale of depression were not associated with actual blood pressures either in a large sample of normotensives (Jones-Webb, Jacobs, Flack & Lui, 1996) or in a smaller sample of diagnosed mild hypertensives (Jamner, Shapiro, Hui, Oakley & Lovett, 1993), and in fact an inverse relationship between depressive symptoms and diastolic blood pressure has been reported for a large sample of older men (Barrett-Connor & Palinkas, 1994). Indeed, a poor prognosis for depression was associated with the absence of hypertension in a small sample of elderly patients with major depression (Kivela, 1995). The evidence linking depression with hypertension is not, therefore, either consistently supportive or necessarily direct, and as with anxiety, a cautious approach to its interpretation is strongly recommended.

Conclusions

The presence of both anxiety and depression, whether as diagnosed clinical entities or as transient states of affective distress, have plausible links to hypertension through mechanisms of elevated autonomic arousal. Evidence from well conducted studies support these links, but neither as abundantly nor as universally as the theory underlying them would suggest. Positive evidence must be balanced against evidence which indicates either no association or, in a small number of studies, a negative association between anxiety or depression and hypertension or enduringly elevated blood pressures. There is, moreover, some suggestion that the proposed link is an epi-phenomenon arising from the pre-existence and influence of some third and unrecognised factor (phaeochromocytoma has been given as an example). In this light, both anxiety and depression must be viewed cautiously in relation to the causation of hypertension.

Synthesis

The contemporary evidence dealing with psychosocial factors as possible causal contributors to hypertension is large in volume but it is not all supportive. While not all of the evidence, supportive or otherwise, is strictly epidemiological in nature, Hill (1965) recommended a list of now classic criteria against which to judge broadly epidemiological evidence in order to infer the causal influence of a set of risk factors (in this case, psychological factors) on a disease endpoint (in this case, hypertension). It may therefore be informative to relate the evidence just reviewed to these criteria, if we are to advance the argument

for a psychological causation of hypertension further than a qualitative and largely subjective exercise. Hill's (1965) criteria were:

(1) Strength of association — for the most part, associations between psychological factors and hypertension, even when they statistically supported a link, were modest in size and often disappeared when such factors as age and awareness of hypertensive status were controlled for, suggesting that this criterion was not well satisfied;
(2) Consistency of association — studies supporting an association between psychological factors and hypertension were well balanced by studies of equal methodological merit which failed to support an association, placing some strain on the satisfaction of this criterion as well;
(3) Specificity of association — there is nothing in the supportive studies just reviewed which associate the "contributing" psychological factors specifically to hypertension, and indeed much of what appears could equally have applied to cardio-vascular disease more broadly defined, and so specificity is not satisfied;
(4) Temporality of association (measures of the independent variable should pre-date those of the dependent variable) — most of the work associating psychological factors with hypertension has been retrospective in design and so temporality of association has only rarely been satisfied;
(5) Gradient of effect — most psychological factors hypothesised to relate to hypertension could be quantified according to an interval scale and so a gradient of effect on hypertension could in principle be established, but little if any research to date has actually attempted or achieved this;
(6) Biological plausibility and coherence — in so far as the link between psychological factors and hypertension is hypothesised to operate through mechanisms of autonomic arousal, and since the psycho-biology of these mechanisms is well understood, the link does have biological plausibility;
(7) Experiment — much of the evidence associating psychological factors with hypertension has been derived from studies of cross-sectional survey design, and while evidence deriving from studies of stress management and hypertension are loosely experimental in design, this criterion is only marginally satisfied; and
(8) Analogy — a good deal of the work claiming to support an association between psychological factors and hypertension has actually focussed on blood pressure reactivity as the primary dependent variable, and while this technically satisfies the criterion of analogy, it does not contribute strongly to causal inference.

The recent evidence on psychological factors and hypertension, judged against Hill's (1965) criteria, does not present an overwhelming case for a psychological contribution to the causation of hypertension. This being so, the veracity of the hypothesis must be called into question; it may simply be that, biological or conceptual plausibility aside, the hypothesis is simply wrong. In studies attempting to relate psychological factors to illness, however, issues of research methodology are often implicated in the commission of Type II errors. In specific relation to the studies reviewed above, two broad methodological issues bear on this.

First, most of the recent evidence (and in fact the earlier evidence too) derives from cross-sectional studies, and while this is a convenient methodology, it is far less powerful than prospective evidence (Sackett, Haynes & Tugwell, 1991). And second, issues to do with the measurement of both independent and dependent variables create substantial problems for data interpretation. While psychological states such as anxiety, depression and even occupational or psychosocial stress can now be measured with relative objectivity, and psychiatric diagnoses made according to uniform and consistent criteria, there is now real doubt that such notions as trait personality, or measures of them, are valid (Mischel, 1976). More importantly, measures of hypertension used as dependent variables in many studies give cause for concern. While some studies use clinical hypertension identified at medical examination and using accepted criteria (Williams, 1994), many continue to use casual measures of blood pressure obtained in screening situations (Rose & Blackburn, 1968) and extrapolation of data obtained in this manner to diagnoses of hypertension is a tenuous exercise. Moreover, much of the work supportive of a relationship between psychological factors and hypertension has actually demonstrated relationships only between those factors and blood pressure reactivity (whether in individuals with or without positive family histories of hypertension); it is now clear that blood pressure reactivity is a very inadequate predictor of future hypertension (Rosenman, 1992).

Complete rejection of a hypothesised association for which there is both biological and conceptual plausibility, and some supportive empirical evidence, would be quite unwise. A cautious approach to the association is the next most logical step, and this caution should extend both to interpretation of the research evidence and to its application in clinical practice and decision making. The present examination of evidence attempting to link psychological factors, widely defined and chosen, with hypertension, clearly recommends this caution. Methodological refinement of research into the psychological causation of hypertension carried out in the future may well reduce the need for caution over time, but the state of the evidence right now does not allow a safe prediction as to which direction that confidence may become focussed.

Notes

1. These pressures were recorded during formal medical examination and not community screening, and so can not be considered to be casual readings.
2. National Library of Medicine
3. American Psychological Association
4. Joining the keywords "depression" with "hypertension", for example, yielded 319 records but the large majority were irrelevant to the purpose of the search since most related to depression of ST segments of the ECG and no to the clinical state of psychological depression.
5. A measured deficiency in social support networks did predict therapy resistant hypertension (Isaksson, Konarski & Theorell, 1992) though this may have been as much to do with the effect of poor social support on compliance with therapy as to do with possible autonomic consequences of poor social support *per se*.
6. Thus, observed reductions in blood pressure over the course of stress management may be more a function of habituation to measurement than to the effects of stress management itself.
7. As with anxiety, single case reports suggest that such conditions as phaeochromocytoma may produce both depression and hypertension, recommending caution in ascribing hypertension to depression until reasonable medical investigation rules out the operation of other factors (Kudoh, Kuroda, Shimamoto & Limura, 1995).

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The Epidemiology of Life Stressors: Their Impact on Mental Health and Well Being

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Adverse life experiences have an adverse effect on the mental health of individuals, though the effect is not strong. Stress is indeed bad for your brain, as Sapolsky (1996) argued recently in *Science*, proposing that sustained exposure of the brain to high levels of glucocorticoids can damage the hippocampus. There is an enormous literature on life events and health, much of it of poor quality. Only a small amount of the available information can be considered to have some scientific significance. This brief paper attempts to identify some of the most important issues: what is known about the contribution of life stress to mental disorders; and what the significance of this knowledge is for clinical practice, services and prevention. For a comprehensive overview of stress in relation to mental disorders, the chapter by Rahe (1995) in Kaplan and Sadock (1995) is a useful source. But the accompanying chapter on behaviour and immunology by Fawzy (1995) is even more useful. In his paper entitled "The epidemiology of life stress", Mervyn Susser (1981) reminded us that the stress hypothesis is a relatively recent arrival and has begun:

> "to displace the fashionable hypothesis ... which attributed a gallimaufry of obscure ills to foci of infection. Many excellent sets of teeth and many pairs of tonsils were sacrificed to that hypothesis. We can count ourselves fortunate that the stress hypothesis does not require surgical intervention".

Susser pointed to scientific deficiencies in four areas of the stress literature. The subsequent 17 years have not corrected any of these. There are problems in the following:

1. **Measurement and Instruments**. Most instruments are based on self report and are therefore open to the biases this brings. The reliability of reporting can be disturbingly variable and the validity of most instruments is suspect. Indeed this is an issue taken up by Rabkin and Struening (1976) in their influential paper in *Science*, "Life events, stress and illness". The universe of items considered may be different for different population groups. So a life event instrument may need to be tailored to the experiences that we know vary by age, gender, education and culture. Exposure to the same event may have very different significance for different people, or indeed for the same person at different points in time. And the contextual factors around events such as pregnancy or dismissal may vary greatly. The consequence is that measurement error is likely to be appreciable, even in studies of homogeneous groups such as service personnel. It becomes even more difficult to reduce measurement error when there is diversity *within* one group. For example, consider the issues to be tackled if one set out to test the hypothesis that life stress decreases with age, being less in the elderly than in young adults. The universe of life events and longstanding difficulties is not the same in the two age-groups. So the instrument to measure such exposure must allow for this. But is that possible? Here there is the problem of equivalence: the same event may have different properties in the young and in the old; and the denominator of events also changes, because some events or experiences are essentially age-related.
2. **Design**. The traditional case-control method has the serious problem of bias from post hoc reports of events by symptomatic individuals. Retrospective data are often all that is available: individuals are asked about exposures *after* these have taken place. The problem is then further compounded when a study is based on cases that have already reached health services. This is because of Berkson's bias — the life events themselves may influence whether or not a person reaches clinical services. So a spurious association could emerge between the exposure and having a particular disorder, because of selective recruitment. Clinical series are often all that is available to clinical researchers, who may not always recognise that they are not encountering the large number of people who have had the same exposures, but have not developed symptoms, or if they have, have not reached medical services. The deceptively simple but information-laden 2 X 2 table shows this so well.

Table 1. Notional: 1000 servicemen exposed to an extreme experience.

		Exposed	
		Yes	No
Onset of symptoms	Yes	a	b
	No	c	d

Question 1: is the value of "a" greater than expected?

Question 2: are "b" just as likely to reach health services as "a"?

Question 3: are "b & d" just as likely to be included in the study as "a & c"?

Case-control methods have serious limitations, so that cohort designs are a preferable approach. Their yield of information is better, but they are much more laboursome and expensive.

3. **Analysis and Hypothesis Testing**. In many studies of life stress and health, the investigators have been content with only the most basic statistical examination. Such an approach does not allow for confounding by other independent variables, particularly age, gender, education and a range of important social variables. This is a matter to which Tennant (1994) drew attention in his review of the evidence linking life stress to psychiatric disorders. Very often, too, the range of independent variables has been overly-constricted, due to the paradigm to which the investigators are ideologically committed. At the Dahlem Konferenz on the causes of depression, one participant asked Gerald Klerman why George Brown had not included family history of affective disorder in his studies of depression in London women. Klerman replied, "Because it accounts for too much of the variance".
4. **Control and Prevention of Pathology**. Susser (1981) wrote "... much current life stress research can add little to our ability to control health disorders". He acknowledged that modifying individual behaviour is not really practicable on a large scale, but the detection and control of *harmful environments* is a classical public health strategy that can be applied to the social as well as the physical or biological environment. Susser was optimistic about the possibility of changing environments for whole populations. Indeed, like Geoffrey Rose (1993), he advocated changing the paradigm from the individual to the population or ecological level. Clinicians tend to think of health and disease as these relate to the individual. But populations, too, have properties. And these properties change with changing social and biological conditions. This, after all, was what Emile Durkheim was saying a hundred years ago, in relation to suicide rates. It should be technically possible to bring about change in the response of populations to typical adverse experiences, just as we have brought about change in exercise, dietary habits and smoking. Susser issued a challenge to epidemiologists that we try to add a new set of social strategies for the control of pathology. He put it in simple terms: "Prevention and control constitute the ultimate business of health professions. They must enlist a broad range of forces before they can hope to achieve them".
5. **Stress within a Population**. Let us then consider life stress and psychiatric symptoms from the *population* view point, in contrast to the clinician's accustomed view which is to determine the relevance of certain experiences in the pathogenesis of patients' disorders. The world is arranged in such a way that clinicians are only exceptionally in professional contact with people who have had the same exposure, but have *not* become unwell.

Both life stressors and psychiatric symptoms are non-randomly distributed within the population. That is, it is possible to identify some demographic groups who have higher or lower levels of stress exposure; and higher or lower levels of psychiatric morbidity. Notice, too, that this may apply both cross-sectionally (i.e. at one point in time) and over long periods such as several decades. At the individual level, a most fertile area for research is the distinct possibility that people with high exposure to adversity keep having it. The hypothesis is that all population include a group of people who continue to experience a high load of adversity from conception onwards. Another interesting question at the population level is if the load of adversity decreases with age: there is some evidence that the elderly have fewer life events than younger adults (Henderson et al., 1981). Where this has been observed in cross-sectional data, it could be attributable to an age, a period or a cohort effect, though the first of these, an age effect, is the most likely. So much for the distribution of life events.

Next, life stressors and psychiatric morbidity co-occur closely in time more often than can be accounted for by chance. Here, it is emphasised that we are considering these phenomena from the population viewpoint. It can be proposed that there is a causal relationship, whereby adverse life events lead to the onset of psychiatric symptoms. There seems little doubt that this association does hold, though the effect is not strong. Clearly, a reverse relationship can hold, whereby symptoms can bring about life events — it is easy to think of examples. Furthermore, those in the population who have psychiatric symptoms may retrospectively report having more life events than actually they experienced, due to "effort after meaning". This phenomenon is likely to inflate

the strength of an association between adversity and symptoms. In the review by Rabkin & Struening (1976), they concluded that "life events may account at best for 9% of the variance in illness". In terms of population attributable risk, this is not a large effect, though it is far from trivial.

There is also a causal path through a third set of variables: personality traits, such as novelty-seeking, impulsiveness or egocentricity. These may increase the likelihood of meeting adversity. But they may also increase the likelihood of developing these psychiatric disorders. Likewise, there are conditions in the social environment that make it more likely that adversity will befall members of that population group. The same environmental conditions may also contribute to the onset of symptoms. Then consider the possibility of genetic factors. There may be genes that increase the likelihood of adverse exposures and, at the same time, the likelihood of developing psychiatric symptoms.

Adverse life events are only one of many exposures conferring vulnerability or resilience. For example, the work of Rutter and his group has pointed to the beneficial effects of a stable relationship for persons who are otherwise seriously disadvantaged in their earlier experiences. This leads to the interesting question: are there nice life events or exposures? And what is their effect?

Some Unknowns about the Effects of Life Stress

I should like to propose a list of areas in which it would be very helpful to have better information.

1. Specificity

1.1 Adverse life events are not risk factors for *all* psychiatric disorders. The association may be strongest for Post-Traumatic Stress Disorder, and it is also known to be present in depressive disorders and schizophrenia. What about conditions such as Alzheimer's disease?

1.2 Where a causal effect seems likely, what is the estimate of the Population Attributable Risk? That is, how strong is the effect?

1.3 It is outside the topic for this paper, but the literature on adverse life events and the onset of *physical* illnesses deserves close scrutiny. Which physical illnesses are most influenced by adversity; are there specific associations between type of life event and physical disorder?

2. Factors modifying the impact.

2.1 Do adverse experiences have a differential impact on men and on women, on different age groups, on different personality types, and in different social contexts? Indeed, we need to know rather more about the extent to which the social context can reduce or increase the morbidity that follows exposure. This is the area in which Brown and Harris (1978) excelled in their insistence on assessing the contextual factors of an event.

2.2 Next, in some social contexts, people are discouraged from developing symptoms, while in other contexts they are encouraged to do so. So here we have the important topic of illness behaviour and help-seeking, and how these may be influenced by the same life events that are putatively associated with morbidity (Mechanic, 1978, 1986). This is a matter of considerable relevance for the Repatriation Medical Authority.

2.3 There has been no satisfactory resolution about the possibility that there is a beneficial effect from social support. This is because of major problems in specifying what one wants to measure, then in being able to measure it properly. There are doubts about the validity of self-reported information. Substantial differences have been formed between perceived and actually received support. Above all, there is the problem of confounding by personality traits that make it more or less likely that a person can sustain mutually-satisfying personal relationships. So people who have little or no social support may be different in a number of other characteristics. An update of the situation has been given in a volume edited by Bruce Dohrenwend (Henderson, in press).

3. What can epidemiology tell us about sensitisation and immunisation with regard to stress exposures?

4. The recent paper by Kendler and Karkowski-Shuman (1997) in *Psychological Medicine* points to a most promising research area. Their paper was entitled "Stressful life events and genetic liability to major depression: genetic control of exposure to the environment?" The essence of their finding is that genes can probably have an effect on the risk for psychiatric illness by causing some individuals to select themselves into high risk environments. Some progress is now being made on identifying quantitative trait loci (QTLs) associated with traits such as novelty-seeking. Already, a polymorphism

of the dopamine DRD2 gene has been reported to be associated with this trait. Such work fits well with the conclusions drawn by the New Zealand group on vulnerability to life event exposure (Fergusson and Horwood, 1987). But these are not new ideas. The writer from the Orkneys, Eric Linklater (1934), in *Magnus Merryman*, has the main character say: "Perhaps nothing happens to a man except that which is intrinsically like him" (p285)

We might at the same time conclude that stress does exist, that it can sometimes have adverse consequences on mental health, and that its impact on individuals or on populations is modified by a large array of contextual, intrapersonal, experiential and biological variables.

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PART TWO

What are the potential mechanisms of the association between stressors and disease, with special emphasis on psychiatric diseases and cardiovascular diseases as defined on Day 1?

Social Constructions of Stress and Adversity: A Longitudinal Study of the Association Between Poverty, Live Events, Subjective Stress and Maternal Lifestyle

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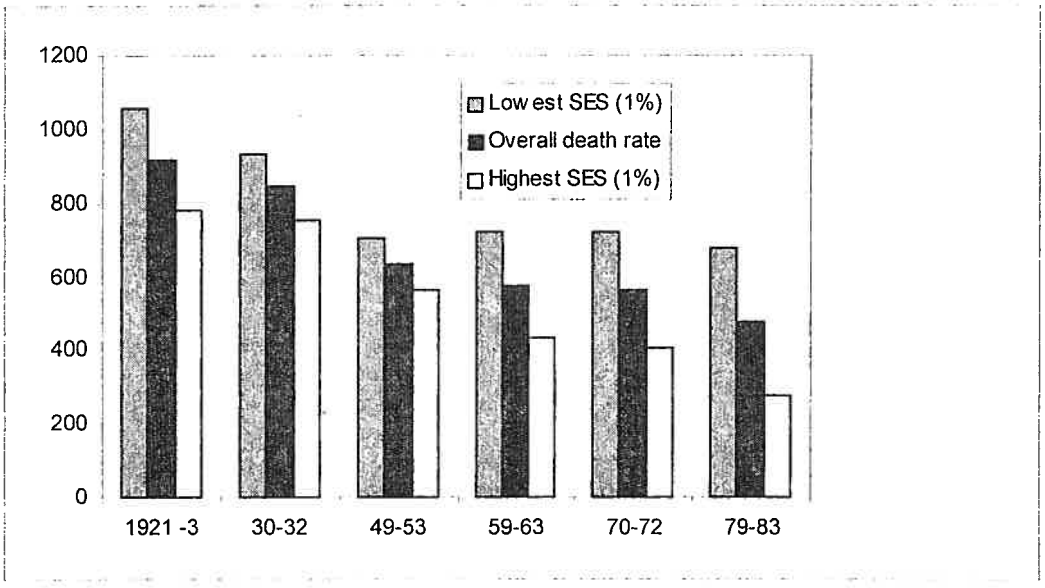
Gail M. Williams

Health and Socio-economic Adversity

Poverty and socio-economic disadvantage are arguably the major causes of disease and death in the world at the present time. Whether one compares rich and poor nations, or the rich and poor within any nation, inequalities of health are apparent. Social class or socio-economic inequalities in health are amongst the most consistently documented of all research findings, both over time and within particular countries. While data comparing class health inequalities over time and between countries need to be interpreted with caution, long-term data from England and Wales describing class inequalities in mortality are available.

In order to deal with changes in the class structure of the population over time, Pamuk (1985) has ranked the social class of a wide variety of specific occupations for which comparable data were available, over the period 1921 to 1983. Figure 1 is adapted from studies by Pamuk (1985) and Wilkinson (1989).

Indicated as separate graph lines are the time trends for the age-standardised mortality rates for the top and bottom 1 per cent of occupations, with professional/managerial occupations at the top and unskilled workers at the bottom. The average (for all occupations) age-standardised death rate is indicated by the middle bar in each year histogram. Overall death rates have clearly declined in a more or less steady trend over this period of time. (Note there was little or no change in 1970–72 over 1959–63.) The gap in the death rates between the top and bottom 1 per cent of occupations decreased in 1930–32 and again in 1945–53. The contribution of the British National Health System to this decline is, at best, a matter of speculation. However, on every occasion on which data are available since the British National Health System was introduced, the gap between the mortality rates of the top and bottom 1 per cent class groups has increased. Not only does the gap between the top and bottom class occupations appear to be increasing, but it is now substantially larger than it was in 1921–23, when these data first became available. Recent US data on educational inequalities in coronary heart disease mortality show that, over the period 1962 to 1987, the age adjusted coronary heart disease differences between educational groups increased (Tyroler *et al.*, 1993), in line with increasing economic inequalities in the United States. Moreover, as Judge and Benzeval (1993) have argued in rela-



	1921–3	30–32	49–53	59–63	70–72	79–83
Lowest SES (1%)	1057	935	708	720	724	678
Overall death rate	920	845	638	577	565	478
Highest SES (1%)	782	754	567	433	406	276

Figure 1. Age standardized mortality rates 1921–83. [Adapted from Pamuk (1985) and Wilkinson (1989)]. (Data for England and Wales ASMR. To 1951)

tion to SES inequalities in child mortality, occupational data are likely to underestimate class mortality differences as those not employed (unemployed, single parents) may have the worst health and are excluded from the above comparisons. These groups are not employed and do not receive a class score but they would usually be allocated to the lower class groups, further increasing the gap between the "top" and "bottom" of society.

Only Britain is able to provide data on long-term trends in mortality, but recent data from countries as diverse as the United States (Yeracaris and Kim, 1978), New Zealand (Pearce *et al.*, 1983), Sweden (Lundberg, 1986) and Australia (McMichael, 1985; Taylor *et al.*, 1983) all confirm the existence of class inequalities in mortality. The absence of such data for other countries reflects the lack of relevant research rather than the existence of findings which question the generality of these inequalities. Depending upon how class is defined and measured, the lowest class groups have mortality rates some 50 per cent to 100 per cent higher than the highest class groups. For example, in a recent paper which examines potential years of life lost for persons aged 5–64 by socio-economic status in Brisbane, the lowest SES group lost 53.6 years of life per 1,000 population per year compared with 35.7 years of life per 1,000 population per year in the highest SES group (Siskind, Najman and Veitch, 1992:318). Based upon these figures it appears that persons in the lowest group lose 50 per cent more years of life between the ages of 5 and 64 than do persons in the highest SES group. Another way of interpreting these differences is that persons in the lowest SES group have a shorter life expectancy as a result of their higher age standardised death rates than do people in the higher SES groups.

Extent of SES Health Inequalities

The range of class/SES inequalities in morbidity and mortality is truly remarkable. With only a few exceptions, persons in the lowest class groups manifest higher rates of morbidity and mortality from almost all causes of illness, disability and death. While research does suggest that, in a few instances, the causal process is the reverse of the one usually hypothesised (disease sometimes leads to poverty, particularly when it involves a chronic disability), the more common situation is that lower social class/poverty leads to poorer health.

The observation of substantial mortality inequalities in the young emphasises how unequal are our "life chances" right from birth. While class mortality inequalities are observed for all the main causes of death, the association is stronger for some causes than others. Thus Australian data point to pneumonia/influenza (opportunistic infections), lung cancer, diabetes and bronchitis, asthma and emphysema as categories where the lowest class group have death rates over three times those of the highest class group (Australian Institute of Health and Welfare, 1992:375). For motor vehicle accident deaths the lowest class group has three times, and for ischaemic heart disease (the cause which accounts for one-third of all deaths) two times the death rate of the highest class group.

It is clear that the impact of the class health disadvantage is pervasive, beginning in childhood and extending right through and, in many instances, past working life. Children in lower class groups not only have a higher rate of a range of diseases (Bor *et al.*, 1993) but manifest higher levels of development and vocabulary learning problems even by the age of five (Najman *et al.*, 1992). They also manifest higher rates of aggressive and delinquent behaviour (sometimes labelled "psychiatric morbidity") from a young age. This health disadvantage of lower SES/class groups continues throughout life for a wide variety of diseases. It can be seen to extend to almost every aspect of health and lifestyle.

What Indicators of Class Should be Used?

Despite their theoretical and conceptual differences, such concepts as socio-economic status and class are often used interchangeably. Concepts like socio-economic status and class need to be understood as abstractions, as ideas for organising aspects of the social world. It is not possible, for example, to "touch" or "feel" someone's socio-economic status, although one may observe and feel manifestations of it. Socio-economic status and class exist as concepts which tend to be defined differently by researchers. There remains much debate about what socio-economic status and class are (see Turrell, Western and Najman,

1994) but, whatever views are advanced, the concepts are meaningful only to the extent that they reflect some widely held beliefs and relate to a range of behavioural variations in society.

It follows then that since class exists only as an abstraction, as a concept in the mind of the researcher, it cannot be the direct or proximate cause of disease or death. If socio-economic or class differences are not the proximate causes of the health inequalities we have observed, then why is there such a consistent and clear association between SES/class and various measures of disease? Further, some might argue that it is more important to deal with the "real" causes of disease rather than with concepts developed by sociologists for "organising" social reality.

Three plausible causal sequences would suggest an association between social class, economic adversity, stress and health. Firstly, it may be that the most economically disadvantaged are the most stressed. According to this view, higher levels of stress have direct health consequences. Secondly, it may be that the most economically disadvantaged experience higher levels of stress, and that such stress has mental health consequences (e.g. anxiety/depression). Poorer physical health might follow, indirectly or directly, from diminished mental health. Thirdly, the most economically disadvantaged may manifest a less healthy lifestyle, partly in response to their economic adversity. This less healthy lifestyle may have direct health consequences (e.g. excessive cigarette and alcohol consumption). Refer to Figure 2.

Health and Stress

The study of stress has a long and detailed history. Much of this research has focussed on the health consequences of stress. There has been a widely prevalent view, over time and held by many researchers, that stress can be harmful to health and general mental and emotional well-being. Indeed, this view has been put so consistently and so widely that challenges to it are rarely expressed. This is despite the fact that stress is often defined in quite varied ways and that different disciplines have quite different approaches to the measurement of the stress they research. While there can be no doubt that some stressful experiences can have negative health consequences, it is likely that most stressful events or experiences do not have negative health consequences for the persons involved. It is also plausible that some persons may

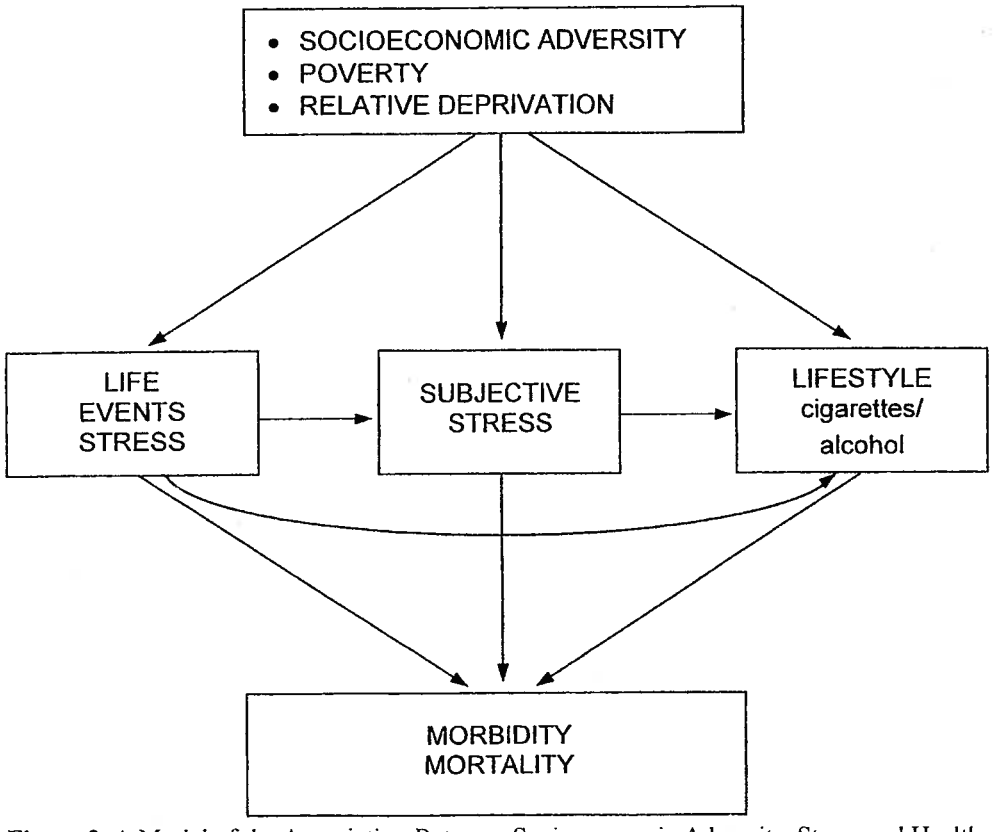


Figure 2. A Model of the Association Between Socioeconomic Adversity, Stress and Health

manifest health and well-being improvements following stressful experiences. Certainly most people who have striven to achieve in a personal or collective sense have done so despite the demands involved. Indeed most people who might be defined as high achievers have had to persevere despite the stresses involved.

A continuing problem in this context has been the definition of stress and somewhat romantic notions about the stressfulness associated with events or situations. It is, for example, sometimes suggested that contemporary societies are beset by change and therefore stressed compared with, say, the traditional hunter gatherer lifestyle. This may be true and there is certainly evidence to suggest that some occupational groups in contemporary society are characterised by rapid change, but it is not so clear that a hunter gatherer lifestyle wherein the persons involved have to search for sustenance and safety on a daily basis, constitutes a stress-free existence. Indeed, on the face of it, one might argue that there could be considerable stress associated with the uncertainty of one's capacity to obtain basic food and shelter. Alternatively, since it appears that hunter gatherers probably "worked" only a few hours a day and spent the rest of the day resting or sleeping, then they may well have had a very relaxed lifestyle.

The issue here is not whether hunter gatherers are more or less stressed than, say, persons in a contemporary post-industrial (post-modern) society but rather with the tendency *post hoc* to define events as stressful if they are related to adverse health outcomes, with the wide variety of definitions of what constitutes stress and with the difficulty of using the same term to mean very different phenomena. Broadly three types of phenomena are typically meant when the term "stress" is used.

Objective Stresses — Life Events

Firstly, there exists a wide range of objective life experiences. These experiences are objective in the sense that they are seen to have occurred, although there may be subjective elements in the meaning given to the occurrence of these experiences. Some experiences are likely to be relatively unambiguous: for example, the breakdown of a marriage, the loss of a job. There is a reasonable presumption here that the reporting of such an event is plausibly related to the occurrence of the event. Some objective events may involve a substantial subjective interpretation, for example a change in one's job situation or a change in the quality of one's relationship with one's partner. Nevertheless objective events clearly exist and they constitute one major category of stress commonly identified in the literature.

Through such instruments as the Life Events Inventory and the Social Readjustment Rating Scale, wide varieties of events have been addressed in the search for those which are stressful. Generally the life events scales have included items relating to personal relationships and events which disrupt those personal relationships: the death of a family member, breakdown of marriage and the like are typical of these events, as are loss of employment and other aspects of a person's day-to-day life. Potentially the list of stressful events is infinite and selecting particular events for inclusion or exclusion may be somewhat arbitrary. For example, it has been argued that living in a particular neighbourhood may itself have significant health consequences. It is apparent that some neighbourhoods are characterised by higher levels of threat, e.g. violence, and by poorer physical conditions. Matters of this character are rarely included in life events scales simply because they represent taken-for-granted aspects of the environment.

On the whole, relatively little has been written about the relationship between socio-economic adversity and objective life events. There is reason to expect that persons living in economically disadvantaged circumstances will be more stressed in a wide variety of ways. It is less clear that stress scales incorporate features of these different experiences. For example, to what extent does the incapacity to afford basic food, basic accommodation, clothing and the comforts of a normal existence, say a car, an annual holiday and the like, constitute stress and, more importantly, chronic persistent stress?

One view is that economically disadvantaged persons experience a wide variety of chronic stresses but the taken-for-granted nature of these stresses is such that they are not of interest or separately noted. Economically disadvantaged persons, according to this view, may not feel more stressed but from a life events perspective, may be

more persistently and chronically stressed. In any event, there is a need to distinguish those economic factors which impact on health, though possibly stress inducing, from those factors which are less clearly economically based and which may have similar effects.

Subjective Responses to Events

Here the emphasis is not on whether an event has occurred but on whether there is a perception that events have occurred and have had an impact on the respondent. Under this heading persons may be asked whether they feel stressed and have felt stressed, or whether particular types of stressful occurrences have occurred to them. On the face of it, a subjective report that one has been stressed is valid. On the other hand, such feelings may be confounded by a pre-existing emotional state or set of circumstances such that a report that a particular stressful event has occurred may be no more than a proxy report of a health or related problem. Nevertheless it is commonly the case that such subjective reports comprise a number of items and that evidence of a consistent pattern of reporting on such feelings is used to support the view that stress has been experienced.

Determining the existence of subjective stress is likely to be relatively unproblematic. There is a wide variety of instruments which measure subjective stress, though some instruments will include measures of anxiety within a stress assessment. Feeling stressed and unable to cope is something which can be easily assessed and which can be related to a variety of physiological changes and any number of potential health outcomes.

There is also the issue of why people may differ in their response to the same events: why a divorce for one person may be extraordinarily stressful while for another it is not. Issues of vulnerability, of resilience and of the extent to which there is a buffering effect are all raised in stress research, and perhaps the real point at issue is the consistent finding that only a minority of persons experiencing a particular event respond in a manner which suggests that they experience stress. Indeed in our past research we have selected what is arguably the most stressful event a human might experience, namely the death of a child, and found considerable variations between men and women and among subjects in the extent to which this event had emotional and mental health consequences.

Biological/Physiological Stress

There has been a proliferation of research in recent times relating to the biological/physiological indicators of stress. While this research is sometimes linked to objective events or subjective experiences, it often stands alone with attention being paid to particular physiological/biological responses characteristic of the experience of stress. Often such studies involve animal rather than human subjects. Studies of this type have been extensively used in an experimental context to provide a measure of the variability of responses to particular kinds of environments or experiences.

One possible problem with such biological/physiological measurements in humans is that they represent a generalised response to any of a number of environmental and emotional circumstances and while the physiological/biological parameter may be able to be measured with relative certainty, the events which contributed to that response are measured with considerably less precision.

A wide variety of hormonal/physiological reactions to stress have been noted. The consequence of these reactions can be very extensive and plausibly could be used to account for any of a wide variety of disease outcomes. This includes changes in lifestyle, for example smoking, excessive alcohol consumption and depression, all of which could be seen to be contingent on the experience of stress.

Of course any comprehensive study would trace the three categories of stress we have described. For such studies the issue of the research would be the linkage between particular objective events, subjective responses to them and the resulting physiological and health consequences.

In sum, it is clear that stress research has been under way for a considerable period of time. There has been considerable progress in the measurement of stress and the assessment of its impact on a wide variety of health outcomes. There remain however many more unanswered questions to be addressed, and it is to some of these that this paper is directed.

Firstly, there is the question of the extent to which poverty and socio-economic adversity may on the one hand cause stress and on the other have a direct impact on mental and physical health. Secondly, there is the issue of impact of different types of objective events on health outcomes: in particular the distinction between those associated with economic adversity and those related to other life changes. Thirdly, there is the question of the extent to which the health consequences of objective events may be independent of those which are subjectively reported. To what extent do objective events and subjective responses independently and/or cumulatively contribute to particular health outcomes and to what extent are they two sides of the same coin, two indicators of the same phenomenon? Fourthly, there is the concern with the causal pathway through which socio-economic adversity and stress have health consequences. Here the concern is with the extent to which socio-economic adversity, either directly or via its impact on stress or mental health, leads to health damaging changes of lifestyle. Fifthly, there is now emerging an interest in the transgenerational health consequences of stress. The question here concerns the extent to which parental stress impacts on the health of a child; the extent to which stressful experiences reported by parents may have long-term consequences, not only for the parents themselves but also for the children of those parents. Here there is a concern that stress may be not a phenomenon limited to the person experiencing the event, but may be transmitted through generations and represent, for the next generation, an accumulation of health disadvantage. For example, do smoking mothers have children with poorer health or children who are likely themselves to smoke?

To address these issues we examine the results of a large longitudinal prospective study of health and economic disadvantage. Such studies are particularly suited to the examination of stress and health as they provide the opportunity to look at events occurring prior to the health consequences which are of interest.

Methodology

Data are taken from the Mater-University of Queensland Study of Pregnancy (MUSP). Briefly, the study involves a sample of 8,556 women who presented for their obstetric care at one of two major hospitals in Brisbane. These mothers constituted, in effect, consecutive pregnancies. The hospital involved served the obstetrical needs of the south side of Brisbane.

Mothers were invited to participate in the study at their first clinic visit. Of the 8,556 women invited to participate, only 98 declined. Those women participating in the study were then followed up three to five days after the birth of the child, six months after the birth of the child and when the child was five years old. In the most recent phase, mothers and their children have been followed up when the child was 14 years of age (data not used in this report).

While the sample is predominantly mid- to lower income, it has the advantage of being large and including a diverse range of public patients. Questionnaires were administered to mothers at each follow-up. In addition, two hundred items were taken from the medical record of the pregnancy and included in the dataset. Separate assessments were undertaken of the child at the five-year follow-up. The questionnaires include some identical scales at each phase of data collection; for example the life change and subjective stress scales as well as items which differ according to the age and circumstances of the mother and child at that point in time.

Five measures of socio-economic adversity are examined including the age of the mother, family poverty, the extent to which the family have had to cut back on food because of the cost, housing problems, and the mother's marital status. While most variables are self-evident, the poverty measure warrants additional comment. Family income was assessed at three points in time: when the mother was first enrolled in the study, at six-month follow-up and at the five-year follow-up. Families who were in poverty over this whole period of time were classified as being in consistent poverty. The other groups were simply those who represented the middle income groups and then a very small proportion of families that were in the middle to higher income category. The distribution of variables relating to socio-economic adversity appears in Table 1.

At entry to the study, 16.6 per cent of mothers were classified as teenagers. It is clear that only

Table 1. Indicators of Family Socio-Economic Adversity
(Percentage of Mothers in Each Category)

	%
Age of Mother (A)	(n=8,556)
13–19 years	16.6
20–34 years	78.7
35+ years	4.7
Poverty of Family (A, E, H)	(n=5,366)
Consistent poverty	6.0
Mid-income	83.0
Higher income	10.9
Cut Back on Food Because of Cost (H)	(n=5,366)
No	76.9
Yes	23.1
Serious Problems with Housing (H)	(n=5,366
No	94.1
Yes	5.9
Marital Status of Mother (H)	(n=5,306)
Single	3.7
Living together	6.0
Married	81.7
Separated/widowed/divorced	8.6

Table 2. Percentage Reporting Experience of Special Life Events at First Clinic Visit and 3–5 Days Post-Natally

	AT FIRST CLINIC VISIT	AT 3–5 DAYS P/N
1. Someone close died/seriously ill	21.7	24.5
2. Big problem with own health	10.6	7.1
3. Serious disagreements with partner	19.8	13.0
4. Serious disagreements with others	14.8	12.9
5. Serious financial problems	23.5	19.7
6. Partner major job change	25.0	24.4
7. Major job change (own)	13.8	—
8. Serious problems housing/accommodation	12.1	10.6
9. Problem with law	4.7	4.5

Table 3. Items in Los Angeles (LA) Stress Scale

In general, I am usually tense or nervous
There is a great deal of nervous strain connected with my daily activities. I am always under pressure
At the end of the day I am completely exhausted mentally and physically
My daily activities are extremely trying and stressful

Cronbach alpha: Phase A = 0.86
Phase B = 0.88
Phase E = 0.84
Phase H = 0.85

Source: Reader *et al.* (1973).

6 per cent are classified as being in persistent/ consistent poverty, a group which was arguably consistently poor for an extended period of time. About 23 per cent of mothers reported that they had to cut back on food because of the cost and about 6 per cent of mothers reported serious problems with housing. At the five-year follow-up, almost 10 per cent of women reported that they were single or living with their partner. About 9 per cent reported that they were separated, widowed or divorced.

Life events were measured using a series of items developed specifically for this study (Table 2). They included the usual items relating to death or illness of a family member, marital disagreements, financial problems and changes in housing or problems with the law. Figures for both first clinic visit and three to five days postnatally are presented. There is a good level of consistency between both these time periods, suggesting that similar proportions of mothers experience each of these events in both questionnaires.

Job changes and financial problems were the most common experiences followed by illness and marital disagreements. Table 3 presents data for items in the subjective stress scale taken from the Los Angeles Stress Scale. The items were originally developed to assess their relevance to cardiovascular disease and they emphasise subjective feelings of tension, stress and physical and emotional exhaustion. The four items are highly intercorrelated and appear to be reliably measuring the stress experienced at each phase of the study.

Results

The analysis examines the relationship between socio-economic adversity, objective and subjective stress and maternal mental health and finally child health and well-being. The intent of the analysis is to trace the extent to which poverty and economic advantage are related to a variety of other stressful situations and consider whether poverty and socio-economic adversity may im-

Table 4. Socio-Economic Adversity and Life Events at Three Phases of Data Collection (Percentage of Each Group Reporting 4+ Life Events)

	FOUR+LIFE EVENTS (PHASE A)	FOUR+LIFE EVENTS (PHASE B)	FOUR+LIFE EVENTS (PHASE H)
Age of Mother (A)			
13–19 years	18.4	10.5	22.3
20–24 years	7.4	5.2	11.8
35+ years	6.1	3.8	8.4
	P<0.001	P<0.001	P<0.001
Poverty of Family (A, E, H)			
Consistent poverty	21.5	9.0	23.6
Mid-income	8.7	6.1	12.9
Higher income	3.7	1.9	8.1
	P<0.001	P<0.001	P<0.001
Cut Back on Food — Cost (H)			
No	6.5	4.3	9.1
Yes	16.4	10.8	25.7
	P<0.001	P<0.001	P<0.001
Serious Housing Problems (H)			
No	7.9	5.2	11.0
Yes	24.2	15.1	45.5
	P<0.001	P<0.001	P<0.001
Marital Status of Mother (H)			
Single	21.1	10.6	26.4
Living Together	19.4	12.3	34.3
Married	6.9	4.7	7.6
Sep/wid/div	15.0	10.4	44.4
	P<0.001	P<0.001	P<0.001

pact on the health of the mother and subsequently the health of the next generation, that is the children of those persons who are stressed.

Table 4 examines the association between our indicators of socio-economic adversity and the experience of life events at three points in time: at entry to the study (Phase A); three to five days after the birth of the child (Phase B); and at the five-year follow-up (Phase H).

The data are clear and surprisingly consistent and indicate that at every phase and for every indicator of socio-economic adversity, there is an association with stressful life events. The differences are strong and extraordinarily consistent, and they re-emphasise the suggestion that persons who are economically disadvantaged experience many more of a wide range of undesirable life events than do persons not so economically disadvantaged.

Table 5 examines the association between socio-economic adversity and subjective stress. Mothers who reported that they had to cut back on food, who reported that they had housing problems or who, at the five-year follow-up, described themselves as separated, widowed or divorced reported consistently higher levels of subjective stress. Curiously, the poverty variable is also consistent in indicating that neither poverty nor, in most instances, the age of the mother, is related to subjective stress. Thus, younger mothers and mothers who were consistently living in poverty report higher numbers of objectively stressful events but no increase in their feelings of being stressed. It appears to be specific events like an inability to afford basic food and housing or marital breakdown that precipitate higher levels of subjective stress.

Table 6 examines the association between socio-economic adversity and health related lifestyle. The variables chosen are variables which are of interest because they have a strong association with health outcomes. Mothers who were socio-economically disadvantaged were heavier smokers, both prior to pregnancy and at the first

Table 5. Socio-Economic Adversity and Subjective Stress at Three Phases of Data Collection
(Percentage in Each Group Reporting High Stress)

	HIGH STRESS (PHASE A)	HIGH STRESS (PHASE B)	HIGH STRESS (PHASE H)
Age of Mother (A)			
13–19 years	6.4	2.9	11.4
20–24 years	8.5	5.3	11.0
35+ years	9.9	8.3	12.3
	NS	P<0.01	NS
Poverty of Family (A, E, H)			
Consistent poverty	9.8	5.5	11.9
Mid-income	8.2	3.2	11.2
Higher income	8.0	3.9	9.6
	NS	NS	NS
Cut Back on Food — Cost (H)			
No	6.9	4.1	8.7
Yes	12.6	8.3	18.9
	P<0.001	P<0.001	P<0.001
Serious Housing Problems (H)			
No	8.0	5.0	10.5
Yes	13.8	8.0	20.6
	P<0.001	P<0.02	P<0.001
Marital Status of Mother (H)			
Single	5.7	2.7	8.8
Living Together	7.5	5.8	9.7
Married	8.1	4.7	10.8
Sep/wid/div	12.1	9.1	16.2
	P<0.01	P<0.001	P<0.01

Table 6. Socio-Economic Adversity and Health Related Lifestyle

	HEAVY SMOKER (20+ PHASE A)	HEAVY SMOKER (20+ FCV)	BINGE DRINKS OFTEN (PHASE A)
Age of Mother (A)			
13–19 years	22.3	8.0	4.3
20–24 years	17.9	7.2	2.6
35+ years	13.0	8.7	2.4
	P<0.001	P<0.001	P<0.01
Poverty of Family (A, E, H)			
Consistent poverty	25.6	10.8	7.6
Mid-income	18.0	7.5	2.7
Higher income	15.5	4.3	1.0
	P<0.001	P<0.001	P<0.001
Cut Back on Food — Cost (H)			
No	16.8	6.6	2.6
Yes	22.8	9.5	3.5
	P<0.001	P<0.001	NS
Serious Housing Problems (H)			
No	17.9	7.2	2.7
Yes	24.1	9.8	4.8
	P<0.001	P<0.01	P<0.04
Marital Status of Mother (H)			
Single	26.3	11.8	8.3
Living Together	28.8	11.6	6.0
Married	16.6	6.3	1.9
Sep/wid/div	23.2	11.9	6.7
	P<0.001	P<0.001	P<0.01

clinic visit. Furthermore, these mothers were also more likely to engage in binge drinking, that is drinking five or more glasses at a particular sitting. While small quantities of alcohol consumption are not related as clearly to adverse health outcomes, and indeed in many instances are seen to confer a cardiovascular advantage, binge drinking has a clear relationship with overall mortality and is clearly more concentrated in families living in poverty and disadvantage.

There are now data from other longitudinal studies which confirm the above finding, namely that becoming disadvantaged is a stimulus to an adverse lifestyle. Table 7 considers the association between socio-economic adversity and mental health. Mothers who were socio-economically disadvantaged have a substantially higher rate of mental health problems, and this is true irrespective of whether one considers age, poverty or other measures of socio-economic adversity or whether one considers anxiety and depression as measures of mental health.

Tables 8 and 9 have relevance to the Barker hypothesis relating to the foetal basis of adult health problems. It examines the possibility of the transgenerational transmission of maternal disadvantage and stress. While the data are somewhat less consistent than in previous tables, there is a tendency for mothers who are economically disadvantaged to have children who are in the bottom decile of weight for gestation at birth or who have the lowest height for their age at the five-year follow-up (they are more likely to have stunted growth). Children of disadvantaged mothers are small for gestation at birth and by five years are shorter than comparable children who do not come from socio-economically disadvantaged.

Finally, in Table 9 we examine the relationship between maternal economic adversity and child mental health at the five-year follow-up. Again the data are clearly consistent and indicate that, for most measures of socio-economic disadvantage, children of disadvantaged mothers have

Table 7. Socio-Economic Adversity and Maternal Mental Health

	PERCENT ANXIOUS (PHASE H)	PERCENT DEPRESSED (PHASE H)
Age of Mother (A)		
13–19 years	23.6	10.1
20–24 years	15.3	6.0
35+ years	13.8	5.9
	P<0.001	P<0.001
Poverty of Family (A, E, H)		
Consistent poverty	29.4	15.2
Mid-income	16.2	6.4
Higher income	9.4	2.1
	P<0.001	P<0.001
Cut Back on Food — Cost (H)		
No	12.1	4.1
Yes	29.9	14.3
	P<0.001	P<0.001
Serious Housing Problems (H)		
No	15.0	5.4
Yes	35.6	23.3
	P<0.001	P<0.001
Marital Status of Mother (H)		
Single	22.1	11.3
Living Together	21.3	7.8
Married	14.3	4.9
Sep/wid/div	28.8	18.2
	P<0.001	P<0.001

poorer mental health than children of advantaged mothers. To the extent that a number of adult health problems can be seen to have their origins in childhood, then it is apparent that mothers living in socio-economic adversity have children whose development suggests that they will have poorer subsequent physical and emotional health as adults.

Discussion

Previous literature has pointed to the impact of stress in a variety of areas to do with health and mental and emotional well-being. Stress is a term which has been defined in a wide variety of ways and taken to mean a wide variety of different things. If we accept a definition of stress as an event or experience which poses challenge or threat to the individual, then we can identify both objective and subjective stresses. In this instance we have distinguished between those objective stresses which are primarily socio-economic in their impact and those stresses which represent change but which have a less explicit socio-economic content. It must be emphasised that this distinction is somewhat arbitrary since economic changes will impact on other aspects of life, for example the mother's marital circumstances, and that they also reflect job-related changes which, while not primarily economic, may have significant economic consequences.

In this paper we have focussed on the impact of socio-economic adversity on objective and subjectively measured stress, on maternal mental health and lifestyle and on the generational transmission of disadvantage as well as the extent to which economic and other stresses which bear on the mother have very early consequences for the physical and mental health of the child.

The data are extraordinarily consistent in confirming that socio-economic adversity is associated with a high rate of many adverse life event experiences, with higher rates of subjectively perceived stress and with a lifestyle which exposes the economically disadvantaged to higher rates of

Table 8. Socio-Economic Adversity and Child's Physical Characteristics

	PERCENT OF CHILDREN IN BOTTOM DECILE WT/GEST AT BIRTH	PERCENT OF CHILDREN IN BOTTOM DECILE OF HEIGHT/AGE AT 5-YEAR FOLLOW-UP
Age of Mother (A)		
13–19 years	9.9	10.9
20–24 years	8.6	10.5
35+ years	5.7	3.0
	P<0.01	P<0.01
Poverty of Family (A, E, H)		
Consistent poverty	12.4	11.8
Mid-income	8.4	10.5
Higher income	8.7	6.9
	P<0.02	P<0.14 (Trend = 0.02)
Cut Back on Food — Cost (H)		
No	8.6	9.7
Yes	8.7	11.6
	NS	P<0.03
Serious Housing Problems (H)		
No	8.6	10.2
Yes	10.0	10.2
	NS	NS
Marital Status of Mother (H)		
Single	15.5	10.4
Living Together	9.7	7.6
Married	8.0	10.4
Sep/wid/div	10.8	9.6
	P<0.01	NS

heart and other diseases. Of course it is important to consider our findings in the context of other studies which show that smokers are more likely also to have a poor diet, low levels of physical activity and probably many other unhealthful characteristics. Socio-economic disadvantage and stress compromise cardiovascular health in numerous ways and it is inaccurate to focus on one of these as a cause when the factors are so consistently correlated.

Further, maternal stressful experiences or events clearly impact on the physical and mental health of the child. Children of mothers who are more economically disadvantaged or of mothers who are experiencing more change or who report that they feel stressed tend to be children who are more emotionally distressed. The primary thrust of this research has been the extent to which a diversity of stresses apparently experienced by the mother have a cumulative impact on the physical and mental health of the child.

Two issues remain to be discussed. The first concerns possible threats to the validity of the interpretation of these results; the second to a consideration of pathways through which socio-economic adversity impacts on health.

There are two primary threats to the validity of the interpretation of the data presented in this report. Firstly, there is the possibility of reporting /observation bias. Mothers living in adversity may not be more stressed; rather their adversity leads them to be more sensitive to stresses which they experience in common with their more advantaged counterparts. Similarly, the children of disadvantaged mothers may not be more disturbed than other children but rather the distress of the mother creates observation bias which leads her to imagine that the child is more dis-

Table 9. Child's Behaviour Problems by Indicators of the Mother's Socio-Economic Adversity

		RATE OF BEHAVIOUR PROBLEMS	UNADJUSTED ODDS RATIO	ADJUSTED ODDS RATIO+
Age of Mother (A)				
13–19 years	(728)	10.0	2.0	1.6
20–24 years	(4,344)	6.7	1.3	1.2
35+ years	(247)	5.3	1.0*	1.0*
			P<0.01	NS
Poverty of Family (A, E, H)				
Consistent poverty	(318)	12.6	3.6	2.6
Mid-income GP	(4,405)	7.1	1.9	1.7
Higher income GP	(576)	3.8	1.0*	1.0*
			P<0.01	P<0.01
Cut Back on Food Because of Cost (H)				
No	(4,067)	5.7	1.0*	1.0*
Yes	(1,199)	11.3	2.1	1.8
			P<0.01	P<0.01
Serious Problems with Housing (H)				
No	(4,978)	6.6	1.0*	1.0*
Yes	(308)	13.3	2.1	1.4
			P<0.01	P = 0.06
Marital Status of Mother (H)				
Single	(193)	9.3	1.6	0.9
Living Together	(317)	11.4	2.0	1.7
Married	(4,250)	6.1	1.0*	1.0*
Sep/wid/div	(445)	11.9	2.1	1.6
			P<0.01	P<0.01

+Adjusted for all other variables in the table.

*Reference category.

turbed. Richter has discussed this issue in a recent literature review (1993) and argues that there is little evidence that a mother's observations are significantly distorted by her emotional state. While this point is disputed by other authors who suggest that some distortion does occur, there is little evidence that the distortion is of a magnitude that might account for the differences we have observed (e.g. life events/smoking). It follows that the possibility of observation bias appears to be unlikely as an explanation for the differences we have observed.

A second possible threat to the validity of interpretation relates to attrition bias, that is the extent to which there has been selective loss to follow-up. While it is the case that smoking mothers, depressed mothers and stressed mothers are disproportionately lost to follow-up (over 70 per cent of the sample were successfully followed up), we have modelled a variety of scenarios to test the likely impact of attrition bias on the results. In general terms, with an attrition rate of 30 per cent and with the magnitude of associations we have observed, the impact of attrition bias is relatively minor and, in some instances, works to strengthen rather than reduce the estimates of the magnitude of association we have observed. The selective loss of distressed mothers with distressed children indeed serves to weaken rather than strengthen the associations we report.

Finally it is worth commenting on the causal pathway through which economic adversity impacts on health. It is well known that mothers in more adverse socio-economic circumstances manifest a variety of health related behaviours which are detrimental not only to their own health but to the health of the child. It must be emphasised here that the concentration on single causes and single outcomes (e.g. stress and coronary heart disease) may be misleading. Stress may have many correlated manifestations and the association between adversity and disease outcomes

can be seen for every major cause of death. Mothers in adverse socio-economic circumstances are more likely to smoke, drink alcohol to excess, have a poor diet, have little exercise and so forth. Their interpersonal relationships and interactions are likely also to be less effective. Their attention to the child in the form of monitoring the child and interacting with the child in a positive way is also likely to be diminished. While a great deal remains to be written about the extent to which distress impacts on health, it is clear that such distress is manifested in a wide variety of ways and it produces a wide diversity of health outcomes. Efforts to narrow the research question to specific forms of stress and a single outcome need to be tempered by the knowledge that, in the real world, we deal with many inter-related factors, only some of which can be adequately measured.

Despite these difficulties of analysis and interpretation, it can be concluded that people living in chronic economic adversity experience more stress, have less healthful behaviours and consequently have higher rates of disease and death.

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Stress, Immune Function and Disease

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Summary

The response to stress provokes an integrated reaction involving the immune system, the central nervous system and the endocrine system, each influencing and influenced by the array of other physiological responses to environmental change. In this context, the concept of a link between adaptation to stress and altered immune function becomes apparent. However, what may be less obvious is the fact that changes in immune status have a feedback effect on behaviour as well as nutrient intake and utilisation, such that chronic immune activation has deleterious effects on growth and development in the young and maintenance of well-being in adults. Evidence that stress impairs immune function and that bidirectional communication pathways exist between the immune and neuroendocrine systems is reviewed.

Introduction

The immune system consists of a set of specialised cells which have the capacity to recognise and respond to a foreign challenge, whether infectious or benign, by a set of effector reactions involving a myriad of humoral factors and cellular activities designed to inactivate and expel the offending material. It is now widely accepted that this response forms part of an integrated homeostatic network, influencing and influenced by other physiological responses to environmental change[1]. This network is regulated not only by the central nervous system, through direct innervation of effector sites or by neurotransmitter output, but also by soluble factors produced by both the endocrine system (hormones) and the immune system (cytokines and acute phase proteins).

Stress is an adaptive response to abnormal environmental conditions or a maladaptive response to normal conditions. It is a well-recognised phenomenon that, concomitant with a stress response, disease morbidity rises and many immune effector functions are depressed[2,3]. It has been known for many years that there is an apparent correlation between incidence of disease and the extent of chronic environmental or psychologic stress. It is only in recent times that medical research has addressed these problems to determine the extent to which stress compromises immunity and the mechanisms by which this might occur.

Exposure to environmental stressors, such as temperature extremes, overcrowding, or disturbance to established social hierarchies, increases pituitary output of adrenocorticotrophic hormone (ACTH) which activates the production from the adrenal cortex of corticosteroids which are powerfully immunosuppressive[4]. Other pituitary hormones also have immunomodulatory effects — growth hormone release has been reported to promote lymphocyte activation[5]; melanocyte stimulating hormone has anti-inflammatory effects[6]; arginine vasopressin acts synergistically with ACTH to modulate immunosuppression[7]; and prolactin is immunostimulatory and maintains immunological functions[8,9]. In addition to the cross-talk between the immune and endocrine responses, there is also a dense innervation of lymphoid compartments allowing changes in central nervous system (CNS) output following environmental change to directly impact on immune function, either by surface neurotransmitter receptors on immune cells[10,11] or even by direct synapsing between nerve terminals and immune cells[12].

However, stress can be viewed more broadly as any external factor which disturbs the internal milieu and in this context immunologic stress by chronic exposure to invading microbes or microbial antigenic debris can also produce changes associated with stress responses such as the production of inflammatory cytokines (eg. IL-1, IL-6 and TNF-) as well as an array of acute phase proteins which, in addition to amplifying the immune response, have feedback effects on the CNS and metabolic pathways causing behavioural and metabolic changes. Nutritional deficiencies may also cause stress or may alter CNS output and thereby impact on immune function.

Thus in addition to the production of a defensive response there is a considerable affector contribution by the immune system, influencing other concurrent physiological processes and the integrated network of neuroendocrine and immune responses to external challenge encompasses a complex series of host metabolic interactions (Fig.1). In this paper the concept will be developed that the immune system, in addition to a defence mechanism, is in part a sensory organ

and a regulator of metabolism, working together with the neuroendocrine responses to achieve homeostasis. Some facets of stress-immune interactions, pathways by which the responses to stressors may result in increased disease incidence and impaired growth, and potential mediators by which these effects occur will be addressed.

Stress-Immune Interactions

The anecdotal evidence linking stress with immune deficiency is supported by a limited number of epidemiologic studies. Statistical analyses have demonstrated an association between psychosocial stress and morbidity[13,14]. In humans, the incidence of the common cold is increased by cognitive, life event and environmental stress[15,16], acute or chronic family stress has been identified as a major factor associated with the acquisition of streptococcal respiratory infection[17] and unresolved role crises and social isolation in students is a predisposing factor for respiratory tract infections[14,18]. Stressful life events have been used as predictors of cervical malignancy in women[19], the incidence of ulcerative gingivitis has been linked with negative life events over the year preceding the emergence of the condition[20] and, in a cohort of army cadets, poor achievement in the face of high demands for academic success was predictive of the development of glandular fever[21].

In an attempt to provide a cause-effect link between stress and immune dysfunction a number of studies have been conducted where normal animals have been subjected to deliberate stress and immune parameters measured thereafter. Rats subjected to electric shock demonstrated suppressed lymphocyte function[22] and anaesthesia, restraint or overcrowding stress resulted in a tenfold reduction in the number of cells making antibody to an injected antigen[23]. In a rat model of adjuvantinduced arthritis, accelerated onset and increased severity of disease were associated with overcrowding stress[24] and similar findings have been reported in rats exposed to handling or to a predator[25]. Also in mice subjected to water or handling stress the subsequent growth of a transplanted tumour was enhanced relative to unstressed controls[26].

A number of studies have been undertaken to determine those components of immunity which are most affected by stressful life events. The landmark study of Bartrop and colleagues[27] reported depressed lymphocyte proliferative activities following recent bereavement. Similarly others have found in healthy human subjects that cellmediated cytotoxic activity was related to a combination of lifechange stress and psychiatric symptoms. Depressed cellular immune function has been described after accidental trauma and in a prospective study Jemmott *et al*[28] demonstrated changes in salivary antibody levels correlated with periods of high academic stress in dental students, which was predictive of upper respiratory tract infection. Similarly depressed NK cell activity and a higher incidence of seroconversion to herpes virus has been reported in medical students subjected to examination stress. In human studies the vulnerability to environmental carcinogens has been shown to increase in association with mental depression due to an impaired ability of DNA repair mechanisms[29]. These studies indicate that, in particular, the cellular components of the immune effector response are most susceptible to stress-induced immune suppression.

In addition to the substantial anecdotal support for the requirement for adequate sleep to ensure optimal immune function, there is compelling epidemiologic evidence of increased infection rates among groups experiencing disturbed sleep cycles (e.g. shift workers) and this has been correlated with depressed immune parameters[30]. In other studies Moldofsky *et al*[31] subjected human volunteers to 40 hours of sleep deprivation and recorded depressed NK cell activity and lymphocyte proliferation and Palmblad *et al*[32] recorded a significant reduction in the ability of neutrophils to ingest and dispose of microbial debris in normal human volunteers subjected to a 72 hour period of sleep deprivation. In a later study[33] the proliferative capacity of lymphocytes was reduced in volunteers subjected to a 48 hour period of sleep deprivation and the erythrocyte sedimentation rate (an indicator of pathological activation of inflammatory processes) was also found to be elevated in army officers deprived of sleep for 75 hours before being subjected to external stress, including a requirement to perform on a shooting range while subjected to authentic battle noise[34].

In our own studies we examined the role of sleep deprivation on the ability to respond to influenza infection in mice[35]. Mice were orally immunized with influenza virus and then subjected to a 7 hour period of sleep deprivation, immediately following viral challenge. Whereas normally sleeping immune mice were able to clear the virus from the respiratory tract within three days of challenge, immune mice which were sleep deprived at the time of challenge were unable to clear the virus and the extent of viral recovery was almost equivalent to that observed in unimmunized animals. These data support the concept that sleep is a behavioural state which is essential for optimal immune function.

Mechanisms of Stressinduced Immunosuppression

It is well documented that one of the physiologic adaptations to external stressors is the production by the pituitary gland of adrenocorticotrophic hormone (ACTH) which in turn stimulates the production from the adrenal glands of corticosteroids. Corticosteroids are potent immunosuppressive hormones and have been used for many years in clinical practice to inhibit the production of unwanted immune responses such as allergies, inflammation and autoimmune diseases. It is not surprising therefore that individuals subjected to both acute and chronic stress have suppressed immune responses attributable to a large extent to the overproduction of these hormones. Indeed there is a diurnal pattern of corticosteroid production with blood levels reaching a peak during the morning hours but falling during sleep. Bioperiodicity in the immune system extends beyond 24 h cycles and there is evidence for 12 hour, 7 day, 28 day (in ovulating females) and even seasonal rhythms[36]. Many cells of the immune system mirror these changes, such that immune activity peaks during sleep periods and is relatively less effective during waking times[37].

The immune system is also "hardwired" by elements of the autonomic nervous system and output via a range of adrenergic, cholinergic and peptidergic neurotransmitters has profound local effects on immune function[38]. Lymphocytes also have surface receptors for a wide range of neurotransmitters and these substances have powerful direct effects on both lymphocyte function and migration[10,11]. In addition to noradrenergic and sympathoadrenal pathways there are a wide range of neuropeptide transmitters released from the central and peripheral nervous system which have immunomodulating properties. For instance the enteric neuropeptides vasoactive intestinal peptide and substance P have profound effects locally on lymphocyte migration[39,40].

CNS-Immune Interaction is Bidirectional

Whereas hormones and neurotransmitters are the messenger molecules of the neuroendocrine system, cytokines perform the same function for the immune system. Just as the CNS, through sensory input in response to environmental change, relays information to the immune system via hormones and neurotransmitters, the immune system also has sensory receptors which detect the presence of antigens, resulting in information relay to the CNS via cytokine release. Cytokine output during an immune response not only regulates immune function but affects CNS function via stimulating endocrine output. Endotoxin challenge has been shown to stimulate growth hormone, ACTH, cortisol and prolactin secretion[41], effects which are mediated by TNF-[42], and the cytokines IL-1 and IL-2 have been shown to enhance proopiomelanocortin gene expression in the pituitary and augment ACTH and cortisol production[43].

A link between immune activation and CNS output is also supported by the observation of a change in catecholamine content of lymphoid tissues and the hypothalamus in response to antigen challenge in primed animals[44,45] and electroencephalographic studies have detected changes in firing rates of hypothalamic neurons in rats following antigenic challenge[46]. Blalock has proposed that since cytokines, peptide hormones and neurotransmitters are a set of soluble messengers common to both the immune and central nervous systems, interacting in a bidirectional fashion, the immune system may be considered as both a sensory and effector organ[47,48,49].

The effects of immune feedback produce functional changes in other physiological processes. Many cytokines produce CNS-mediated effects on behaviour — for instance IL-1 is somno-

genic[50], induces fever[51], reduces social exploration and appetite[52], and impairs spatial navigation learning[53]; IL-6 is also somnogenic[54] and induces lethargy, depression, anorexia and fever[55,56] and interferons produce fever, lethargy, anorexia, vomiting and general malaise[57]. Indeed the neurological side-effects following administration of cytokines limit their potential use for therapeutic purposes[57,58]. It is not surprising therefore that associated with immune challenge are classical symptoms of illness which form part of the essential response to achieve homeostasis, a response which has been termed 'sickness behaviour'[52].

Dietary Imbalance, Deficiency, and Immunity

There are obvious nutritional influences on immune function caused by malnutrition. Although mild malnutrition has little effect on immune competence in children[59], severe protein/calorie malnutrition causes pronounced suppression of immune activity[60,61], by activation of the pituitary adrenal axis[62], by direct effects on lymphocyte function and migration[63], and by central noradrenergic hyperactivity[64,65]. These effects are particularly pronounced at mucosal sites. Young mice fed a protein-deficient diet for only 6–8 weeks display reduced local IgA responses in lacrimal glands, leading to an absence of local antibody in tears[66], a reduced local antibody response in the intestine due to induction of abnormal suppressor T cell activity[67] and impaired differentiation of IgA B cell precursors in gut associated lymphoid tissues[68].

Obesity is a condition associated with altered nutritional, metabolic, endocrine and psychological status and has an adverse effect on immunological function. Studies with genetically obese (ob/ob) mice show reductions in various aspects of cell-mediated immunity which do not appear to be due to inherent immune cell defects but rather result from changes in the physiological milieu in which they function[69]. Less is known about immunocompetence of animals made obese through overfeeding. Dietary induced obesity usually results from the feeding of high-fat diets and the immune status of the obese subject may reflect the duration of feeding and the type of fat fed. However, obese dogs are less resistant to infection than normally fed dogs[70] and weight reduction strategies for the treatment of obesity have also been shown to produce further alterations in immune responsiveness[69].

Selective deficiencies of dietary components also have immunosuppressive effects. Vitamin A deficiency has been demonstrated to depress immune function[71,72], and Vitamin A supplementation reduces childhood mortality to infectious disease[73]. As in severe malnutrition, Vitamin A deficiency has its most pronounced effects on mucosal immunity, causing a decreased number of IgA antibody-producing cells in the gut, a selective increase in T suppressor cells and a decreased ability to control the localisation and systemic translocation of intestinal bacteria[74,75] and exacerbates the risk of HIV infection via breast milk[76].

Vitamin E deficiency causes increased inflammation following endotoxin challenge, but in dairy cows Vitamin E deficiency in association with selenium deficiency causes increased susceptibility to mastitis as a result of decreased neutrophil numbers and activity, which is reversed by Vitamin E and selenium supplementation[77]. Even in normal animals, Vitamin E administration promotes neutrophil activity[78] and when given in association with vaccination results in increased antibody responses[79,80].

Trace minerals have also been shown to be important for immune function. Copper deficiency suppresses the response to endotoxin challenge[81], zinc deficiency results in decreased metallothionein synthesis following endotoxin challenge[82], iron exacerbates the inflammatory response in arthritic patients by increasing inflammatory cytokine production[83] and chromium ameliorates the suppressive effects of stress on the immune response[84].

Dietary lipids may influence the nature of an immune response by affecting cytokine and acute phase protein production and altering membrane fluidity. For instance rats fed coconut oil have a reduced acute phase protein response to endotoxin challenge, especially with respect to eicosanoids, relative to rats fed corn oil[85] and in humans fish oil supplementation produces a similar effect[86]. Fish oils have been effectively used to limit inflammatory responses in rheumatoid arthritis[87], in burn injury[88] and toxic shock due to caecal perforation[89].

Immune Activation, Nutrient Requirements and Utilisation Partitioning

Chronic immune activation and stress can combine to alter the requirements for and utilisation of dietary nutrients[90]. Early growth failure and short stature in humans are not always due to nutritional deficiencies, as recurrent respiratory and gastrointestinal tract infections also produce these effects[91]. In a study of children in Guatemala living under conditions of poor sanitation and hygiene, 34% of subjects, although apparently healthy, had elevated white cell counts and erythrocyte sedimentation rates[92] and in limited epidemiological studies prophylactic use of antibiotics in subjects exposed to poor environments resulted in improved weight gain compared to controls with the same dietary intake[93].

Thus the effect of microbial load together with other environmental stressors such as ambient, nutritional, or psychological factors, combine to provoke an integrated homeostatic response, described by Elsasser[94] as an "endocrine-immune gradient", the sum of homeostatic responses to all environmental stressors involving the endocrine, immune and central nervous systems. Elevation in the gradient leads not only to growth retardation, but qualitative changes in nutrient partitioning. Under optimal conditions, the nutrient input into muscle development of growing animals exceeds that for fat deposition, but as energy intake increases and exceeds the requirement for protein synthesis, fat deposition increases disproportionately to lean tissue deposition[95]. However the point at which switchover from muscle to fat deposition occurs is reduced in the face of a high endocrine-immune gradient. This redistribution of resources within the body in response to changes in the gradient explain the large differences observed in traits such as fatness, feed conversion efficiency and protein accretion in animals of the same genotype maintained on a similar diet, but which have been exposed to an environment with different levels of microbial contamination[96]. Even in humans both physiological and psychological stress have been linked to fatness[97], although changes in eating patterns and nutritional intake in these subjects accounts for a significant part of the effect.

Differences in growth patterns and body composition in response to environmental stressors[98] and differences in disease susceptibility between individuals[99] may well be explained on the basis of genetically determined variation in the integrated homeostatic response, reflected in the relative slope of the endocrine-immune gradients.

Intervention Strategies to Ameliorate Stress-Immune Interaction Effects

An understanding of the neuroendocrine and immune responses to environmental stressors suggests a number of opportunities for intervention. An ability to identify diet-dependent from diet-independent effects on growth will enable new nutritional strategies to be introduced[100] such as increasing dietary energy density to reduce the metabolic effects of immunologic stress[101]. Therapeutic hormonal manipulation is now common in humans to manage maladaptive endocrine responses to environmental change, but a novel alternative approach has been developed in animals using vaccination techniques to achieve the same result. If appropriate vaccine formulations are used it is possible to achieve sufficient levels of anti-hormone antibodies, or antibodies to hormone receptors which block hormone action, to intercept signal transduction via the pituitary-adrenal axis. Immunisation against ACTH in a number of farm animal species has not only resulted in improved weight gain, and feed conversion efficiency, but improved carcass quality by reducing fat deposition[102]. It is also possible to manipulate cytokine profiles to optimise immune responses. The use of anti-cytokine antibodies or gene therapy approaches for controlling *in vivo* cytokine production are now common laboratory procedures[103] and their routine therapeutic application is an imminent possibility for managing clinical disease.

The effect on growth and development of poor sanitation in developing countries, and the cost to effective immunity of exposure to the chronic, and often inescapable, emotional and physical stresses of modern developed societies, may need to be counterbalanced by these strategies.

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This implies, that any model of post traumatic psychopathology needs to take into account the way in which attempts to come to terms with the traumatic memories and their frequent reliving may play a critical role in the emergence of long term symptomatic distress. This implies that the aetiology of post traumatic stress disorder needs to be understood from a phasic perspective. The period lasting weeks, perhaps months, in the immediate aftermath of the trauma may be critical in determining the longer term trajectory of an individual's symptoms.

The Longitudinal Course as a Process

Thus the longitudinal course of PTSD needs to be understood as a process which has a series of stages. First, while exposure to many traumatic events is often random, for example people cannot predict when an earthquake is going to occur, there are other traumas, such as being the victim of assault or accidents (Breslau et al, 1995) that is in part determined by the individual. The way a person behaves during a disaster may have an important impact on their survival. Their prior experience of traumas and training will play a role in determining their ability to maximise their chance of survival. Equally, the immediate emotional reaction at the time of the trauma will influence the capacity to respond to the threat in an adaptive way. For example, a dissociative response or a panic reaction is likely to put the individual at particular risk. Someone's state of mind in the midst of the traumatic experience will also have a profound impact on the way the memory of the trauma is layed down and subsequently processed.

PTSD emerges out of the pattern of the acute distress caused by the event . To be distressed is a normal reaction to the horror, helplessness and fear which are the critical elements of a traumatic experience. The typical pattern for even the most catastrophic experiences is restitution and not the development of PTSD. Of the minority who go on to develop a PTSD, the symptoms will resolve in approximately two thirds (Kessler et al, 1995). Therefore chronic PTSD which remains many years after the triggering event may have some different determinants from PTSD which people suffer in the first 6 months after exposure to the trauma. The most chronic forms of PTSD represent the failure of healing and modulation of the acute traumatic response.

The factors which influence the transition from health to disorder and back to recovery are of critical interest in understanding the longitudinal course of PTSD. The nature of this process is central to understanding the psychopathological consequences of trauma. This process can be divided into three stages; the acute stress response, the chronic response to the traumatic event and finally the individual's adaptation to having to endure the chronic symptomatic state of PTSD. In the chronic forms of the disorder, the associated disability and handicap are more a response to the distress and disruption caused by the symptoms of the disorder than a primary reaction to the experience of the traumatic event. The ability to tolerate suffering is therefore a critical determinant of their long term adaptation.

The individual's response at each step of this process will be influenced by a complex matrix of biological, social, temperamental and experiental issues. For example, the neurobiology of an individual's stress response, the capacity for self modulation, the ability to tolerate the fear and threat which trauma brings and to cope with any losses will be some of the factors which influence the individual's ultimate outcome. There are some characteristics which increase the probability of a pathological outcome. These are vulnerability factors; they are generally neither necessary nor sufficient to explain the onset of a disorder or predict its course, but rather place the individual at risk of a negative outcome. One example of a risk factor is having a family history of psychiatric illness (Breslau et al, 1992; McFarlane, 1992).

On the other hand, there are characteristics which protect the individual or favour a path to recovery. These resiliency factors may minimise the intensity of the individual's acute distress or allow the more rapid modulation of an abnormal reaction. One example is the ability to recruit one's social network in the aftermath of a traumatic experience. Vulnerability and resiliency factors may operate at any part of the process of the stress response ie at the time of the event, in the immediate aftermath or in the longer term. A particular factor may be important at one point in the course of the disorder but not at another.

The longer a PTSD remains, the less important is the role of the traumatic exposure in explaining the underlying symptoms. Subsequent adversity, the demoralisation of chronic hyperarousal and the progressive disruption of the individual's underlying neurobiology play an increasing role in understanding the nature and course of chronic symptoms.

Acute Post Traumatic Reactions

When PTSD was first included in DSM-III, it stated that the individual had to have symptoms for at least one month before the diagnosis could be made. Also, there was no diagnostic category for an acute stress reaction other than an adjustment disorder. The relationship between acute psychological symptoms and subsequent post traumatic morbidity has been of particular interest in armed services. The significant rates of morbidity in intense combat (Solomon et al, 1996) have had an important historical impact on the conceptualisation of PTSD (McFarlane, 1996). In fact, this has led to some confusion about whether those individuals who develop PTSD respond with intense panic at the time of the incident which, particularly in the First World War, led to these people being labelled as cowards. This highlights the importance of investigating this question in a more systematic way.

The 1980s produced a significant volume of research examining the nature of acute stress reactions. Much of the work looking at PTSD during this period involved studying populations who had been involved in incidents such as disasters. These populations were generally identified in close proximity to the event and then often followed up. This led to the reformulation in DSM-IV (1994) that the experience of helplessness and powerlessness were central aspects of the acute response to the traumatic event if the individual was going to develop PTSD. This has been now incorporated in the stressor-A criteria.

This formulation was in part encouraged by the re-emergence of an interest in dissociation as one of the main components of the phenomenology of PTSD (Atchison & McFarlane, 1995). Van der Kolk (1996) particularly has highlighted how the fragmentation of the laying down of memory, and the inadequate construction of a narrative at the time of the trauma, is a critical issue in the traumatic stress response. This question has been investigated empirically by several groups of researchers who concluded that dissociation during the time of the trauma predicts PTSD (Holen, 1990; Spiegel, 1991). Other studies by Bremner et al (1995) looked at this issue in Vietnam veterans. However, these studies were concluded more than twenty years after exposure of the trauma, which raises some important questions as to whether the symptoms of the disorder may modify the retrospective recall of the nature of the traumatic experience.

Several studies (Shalev et al., 1996; Koopman et al., 1994; Weiss et al., 1995) investigated this issue in closer proximity to the event and again highlighted the importance of peri-traumatic dissociation. Shalev et al's study was particularly noteworthy because the subjects were studied within two weeks of the accident. However these findings were not supported by interviewed accident victims at the time of hospital admission (Malt et al 1989; Malt and Olafsen (1992). In fact Lundin et al (1996)found that peritraumatic dissociation protected people from the subsequent onset of psychiatric morbidity.

A study of the acute patterns of reaction within twenty four hours of subjects being admitted to hospital following motor vehicle accidents has demonstrated that the subjects who develop post traumatic stress disorder or major depression cannot be differentiated from the subjects who have no disorder according to the nature of their symptomatic reactions within 24 hours of the accident (McFarlane and Atchison,1997). This contrasts to the re-examination of this population ten days after the accident by which time, avoidance, intrusion, hyperarousal and dissociation had begun to differentiate the groups.

In contrast to the lack of prediction of the acute psychological reactions, a cortisol sample was taken from blood drawn to measure the individual's blood alcohol immediately following the accident. This sample, taken on a mean two hours after the accident, found that the PTSD group had the lowest cortisol rise and the group who went on to develop major depressive disorder had the highest cortisol rise. Thus, the acute neurobiological stress response seemed to have some predictive ability of the onset of psychiatric disorder

six months later, in contrast to the acute psychological state.

These preliminary data highlight the need to better characterise the nature of the acute stress response and its transition into the range of psychiatric disorders which emerge following traumatic exposure. The response at the time of the traumatic event may not be the critical issue, but rather, the individual's ability to modulate their acute stress response and to restore their psychological and biological homeostasis. Thus, PTSD may be a disorder of transition rather than a specific stress disorder. In other words, it is not that these people have a greater acute stress response, it is their inability to modulate this reaction which is the critical issue. The impact of family psychiatric history, prior psychiatric disorder and peritraumatic dissociation on this transitional process are of particular importance to the further understanding of the neurobiology of PTSD. Also, the preliminary finding that the subjects who went on to develop PTSD had a lower cortisol rise emphasises the need for a greater understanding about the nature of the traumatic stress response that leads to PTSD, particularly given the interest in hypocortisolaemia as a possible factor leading to decreased hippocampal volume in patients with the disorder (Bremner et al, 1995). Furthermore, these data emphasise the importance of looking at the progression and changes in PTSD with the passage of time.

Range of the Long term Effects of Trauma

As currently conceptualised, the definition of PTSD is insufficient to describe the full range of the effects of trauma, as many other disorders and symptoms emerge in the aftermath of these events. This has important theoretical implications and is often neglected in planning the treatment services for traumatised populations.

Comorbid Disorders

The current tendency to focus exclusively on the trauma may prevent the adequate assessment and treatment of disorders such as depression and substance abuse which may exist in conjunction with a PTSD or as independent disorders. Recently, the range of specific trauma related disorders has received more attention, as has the non-specific role of trauma as a trigger for a range of psychiatric disorders. There is a consistent finding across a range of traumatic events that PTSD is only one of a number of psychiatric disorders which occurs in such settings. In fact in the majority of cases, even in community samples, PTSD is usually accompanied by another disorder such as major depression, an anxiety disorder or substance abuse (Kulka et al, 1990; McFarlane and Papay, 1992).

General psychiatric patient populations with a range of disorders are a group in whom there has been surprisingly little research examining the extent to which trauma plays a role in the onset and maintenance of the patients' disorders. However there is now a series of investigations that has looked at the prevalence of child abuse in clinical samples and found prevalence rates in the order of 18–60% (Saxe et al, 1993). Davidson and Smith, (1990) and McFarlane (1994) have also found that in general patient samples, the life-time rates of PTSD are also significantly underestimated.

Multiple forms of PTSD

In understanding the longitudinal consequences of trauma, it is important that information is derived from a range of victim groups because the outcomes of different types of traumas may vary substantially. For example, clinical experience suggests that the long term consequences of child abuse are very different from the experience of a natural disaster or other circumscribed trauma in adult life (Herman, 1992). Victims of childhood abuse are more likely to have amnesias of the trauma and a range of dissociative symptoms (Saxe et al, 1993).

Blank (1993) has highlighted that the longitudinal course of PTSD has multiple variations, namely: acute, delayed, chronic, intermittent, residual, and reactivated patterns. Longitudinal studies like the NVVRS study (Kulka et al, 1990) and the Grant study suggest a need to define a posttraumatic syndrome where the full PTSD criteria are not met, as there is a significant associated social disadvantage.

Physical Health

The impact of trauma on physical health is a neglected topic. The question arises as to whether there is a specific pattern of associated physical symptoms that arise as part of the traumatic stress response. Historically, PTSD was described by a series of names which focused on the physical accompaniments such as "soldier's heart" and "railway spine". The controversy about the effects of herbicides on the physical health of Vietnam veterans similarly highlights how even in more recent times, the physical symptoms associated with PTSD can be the primary concern of traumatised populations.

Although a number of studies have noted an increased reporting of physical symptoms in persons with PTSD, the reason for this association is unclear (McFarlane et al, 1994). There are a number of possible reasons why reporting of physical symptoms in persons with PTSD might be increased. First, physical symptoms may be an integral part of the constellation of symptoms that make up PTSD. This would be similar to the specific physical symptoms related to panic disorder or generalised anxiety disorder where they were either a physical concomitant of the disorder (such as shortness of breath or palpitations in anxiety, and constipation or weight loss in depression) or via somatisation (such as pain syndromes in depression). In these disorders, these physical symptoms are often the focus of patient's distress and cause for consultation with professionals.

Second, the physical symptoms may be directly caused by the stressor responsible for the development of PTSD. In many instances, the stressors are life-threatening events such as accidents or combat which cause physical injury to many of those exposed. Benedict and Kolb (1986) describe a sample of war veterans with undiagnosed PTSD attending a pain clinic. In all these patients, pain was localised to the site of a former injury. In this situation, the development of a PTSD may influence the presentation of the symptoms rather than their onset.

Physical symptoms may be a nonspecific response to exposure to a traumatic experience independent of the development of a PTSD. Investigation of this question has important practical consequences for the assessment of patients who have been exposed to traumatic events in which they may have been injured, particularly when the symptoms become the subject of litigation because their cause is often disputed. The presence of physical symptoms in the absence of an obvious cause should raise the possibility of an undetected PTSD.

Many variables in combat veterans make extrapolation to civilian populations difficult, including bias in the initial selection for military service, the nature of the stressors of military life and combat, the nature of injuries sustained in combat and the effect of pension entitlement schemes. Escobar et al (1992) reported on the development of new physical symptoms one year after a natural disaster in Puerto Rico. Victims of the disaster were more likely to report new gastrointestinal or pseudoneurological symptoms than persons not exposed to the disaster. Although these symptoms may have been indicators of psychopathology, no correlation was made with the presence of psychiatric illness.

The Grant Study examined the impact of combat by following the health of a group of sophomores recruited at Harvard University until the age of 65 has examined the impact of combat (Lee et al, 1995). These men were selected for their physical and psychological health and high levels of achievement at university. Although 72 subjects had a high level of combat exposure, only one retrospectively satisfied the diagnostic criteria for PTSD in 1946 with another four having a PTSD like syndrome. This suggests that PTSD is the exception amongst a group of highly competent and resourceful individuals. However, combat exposure predicted early death, independent of PTSD. Fifty six percent of the men who had experienced heavy combat were dead or chronically ill by the age of 65 (Lee et al, 1995). The length of follow up in this study makes the results especially noteworthy as these long term effects of trauma may only emerge in old age when the risk of physical illness is increased.

Modified Vulnerability

Some of the concepts developed in the literature about the outcome of the treatment of depression (Kupfer, 1993) can be usefully applied to the description of the longitudinal course of PTSD. The

issue then arises as to how to distinguish between remission and recovery from a disorder. This is an important concept because recovery defines the end of an illness episode and presumes that a further episode is a recurrence of the disorder rather than relapse of the current one. In medico legal circles where the prognosis of PTSD and its long term outcome are of particular relevance, there is an assumption that once the symptoms of PTSD have resolved, the disorder does not recur. This is based on the idea that PTSD is an adaptational response to an event (Yehuda and McFarlane, 1995), beginning with an acute stress reaction which then follows a predictable course that eventually resolves without sequelae. However, emerging evidence suggests that this is not the case. In particular, Solomon et al (1987) described 35 soldiers who had several exposures to combat and multiple episodes of PTSD . There was support for both the concept of reactivation of the original PTSD in some soldiers, whereas in others, the second episode may have been substantially independent of the first.

The model of kindling in affective disorders has been developed from the clinical observation that life events play an important initiating role in the first episodes of an affective disorder, which progressively decreases as the neurobiology of the disorder becomes autonomous (Post, 1992). This model implies that there is a biological memory of the preceding episodes of the illness and the individual's current vulnerability to affective disorder is a consequence of this progressive sensitivity to affective destabilisation. The observation that the symptoms of PTSD are maintained and triggered by day to day adverse life experience suggests that a modification of the individual's stress responsiveness may be an important aspect of the dysregulation that is central to the psychobiology of PTSD (Van der Kolk 1985; McFarlane, 1989, Koopman et al, 1994). Resnick et al (1995) found altered cortisol responsiveness in women who had been raped on a second occasion. This indicates how the course of PTSD needs to take into account the similar transformations of stress responsiveness that are thought to be operating in affective disorders.

Therefore, to gain an understanding of the longitudinal course of PTSD, it is important to consider the possibility that even if the symptoms of the immediate disorder remit, permanent changes can remain manifest in the individual's vulnerability to disordered affect and arousal. The underlying neurobiology may be similar to that found in affective disorders and Van der Kolk (1985) has proposed that kindling is a useful model to explain the changes in PTSD. Yehuda & Antelman (1993) have also suggested that a model of sensitisation can explain the abnormalities of cortisol responsiveness in this disorder.

A Psychobiological Perspective

The normalisation an individual's arousal once an acute traumatic reaction has been triggered is a critical process in the long term adaptation to an event. The modulation of acute arousal is modified by a range of biological and psychological factors. In the initial days after a traumatic event, distressing and intrusive recollections of the traumatic experience are universal and indicate an ongoing process of normal reappraisal of the experience. In this process, various representations of the trauma are entertained and an attempt is made to integrate these with existing psychological schemata. This replaying of memories allows the development of novel meaning constructs which are not part of the individual's inner world. The phenomena which differentiate the victims who develop PTSD are the emergence of an enduring exaggerated startle response, hypervigilance, increased irritability, sleep disturbance and disturbed memory and concentration (Weisæth, 1989; McFarlane, 1992).

Armory & LeDoux (1997) and Cahill (1997) provide valuable insights into the role of the amygdala, hippocampus and prefrontal cortex in the formation of these memories and role of hyperarousal in determining the intensity of these memories. Cahill et al (1996) have shown that the intensity of activation of the right amygdala plays a central role in the recall of emotionally arousing experiences. Both norepinephrine and cortisol have an inverted U shaped relationship with the augmentation of memory. The constant replaying of these memories appears to play a role in the potentiation of the individual's posttraumatic distress (McFarlane, 1992; Creamer et al, 1992; Yehuda et al, 1995) This provides the basis for a neural network model for the neurobiological

changes which are central to PTSD (Galletly et al,1996).

The experience of the traumatised individual in the immediate aftermath of the event is critical. Often, the reality of many aspects of a trauma only becomes apparent after a few days. For example, the significance of physical injuries may take some time to become apparent and the extent of both the destruction of property and the number of deaths may only become clear at the end of extensive rescue and containment efforts. The ultimate meaning of the experience will be constructed from its impact on a variety of domains. These perceptions are influenced by previous life experiences, habitual coping skills and general arousability (Freedy et al, 1992). The ability to mobilise appropriate relationships and support is another critical issue at this stage of the process of adaptation.

The progression from distress to disorder

The progression from a state of distress to more severe symptoms is influenced by the severity of the distress caused by the flashbacks, the exposure to triggers (Pynoos et al, 1997) and other adversities which befall the individual. These lead to the progressive sensitisation of the individual's reactivity . There appears to be an initial period of cognitive appraisal of the traumatic experience and the associated self regulation, during which time the traumatized individual processes and reworks the experience, elicits social support and tries to integrate the horror of the experience and the losses suffered. The relationship between intrusive cognitions and arousal is less apparent in the immediate aftermath of the trauma (Shalev, 1992), and avoidance symptoms only emerge over time (Solomon, Weisenberg, Schwarzwald & Mikulincer, 1987). Over a period of several weeks the typical symptom constellation of PTSD begins to congeal.

At this early stage, the intensity of intrusions is probably not a good measure of their psychopathological significance. It is unclear at which stage traumatic memories develop the typically fixed and irreconcilable quality with the associated sense of retraumatization often experienced in PTSD. The inflexible quality of these traumatic memories represents a failure to resolve the issue of meaning (van der Kolk, 1996). A corollary of this question is the nature of the process which leads to the onset of the avoidance phenomena. One view is that they represent a defence which modulates the emotions associated with the intense traumatic cognitions and thus are an integral part of the immediate trauma response (Janet, 1889; Lindemann, 1944; Horowitz 1986). Shalev (1992) suggested that avoidance only emerged after the individual was unable to work through these phenomena. These findings are in part supported by the work of Solomon et al (1987) and McFarlane (1992) who have suggested that intrusions are common to many who have experienced traumatic events and not specific to PTSD and that avoidance is a phenomenon that emerges during the months after the trauma and is characteristic of having developed the disorder, rather than of having been exposed to a potentially traumatic stressor.

There are very few prospective accounts of any systematic examination of the survivors in the immediate aftermath which have examined the relationship between immediate reactions and subsequent emergence of PTSD. Such studies are likely to provide critical evidence about the range of acute stress responses and their relationship with PTSD and the other psychiatric disorders which emerge in the setting of trauma. A systematic study of train drivers involved in railway accidents (Malt et al, 1993) found that while more than half reported moderate to high levels of intrusive memories in the immediate aftermath, less than one third of drivers reported symptoms of acute psychophysiological arousal. Avoidance was uncommon. The correlation between the various measures progressively increased at one month and one year, suggesting that the relationship between these phenomena changes with the passage of time.

The suggestion that the initial levels of intrusion and avoidance do not predict the onset of PTSD points to the role of some other process such as the destabilisation of an individual's normal pattern of arousal, which will have a feedback effect on the processing of thoughts and feelings (Shalev, 1992). Thus the tendency to focus on a cognitive processing model which underpins the current conceptualisation of PTSD may have

hampered the investigation of what differentiates adaptive and maladaptive responses to trauma.

Implications for neurobiology

This summary of the longitudinal course of post traumatic stress disorder highlights the complexity of the matrix onto which any neurobiological studies are superimposed. Firstly, the differential course of post traumatic stress disorder in different subjects suggests that there may be a range of different modifying factors which could be reflected in the individual's neurobiological profile. Secondly, the differential course of the intrusive, avoidant and hyper-arousal sub-categories of symptoms suggests that there may in fact not be a unifying neurobiology of this disorder, but rather the neurobiology should be investigated in relation to each of these symptom sub-categories. The importance of considering this issue is further highlighted by the frequency of comorbidity with other psychiatric disorders. Whatever neurobiological abnormalities are thought to underpin PTSD must also be congruent with the existing neurobiological theories, particularly of disorders such as major depression and panic.

The difference in the characterisation between the extremely chronic forms of PTSD after World War I and the more recent formulations that have emerged since the flourishing of research since 1980, suggest that it is important not to lose sight of the negative symptoms of this disorder. The neurobiology of the withdrawal and the intolerance of environmental stimuli is an issue which is very poorly addressed by treatment and has had little specific investigation of its neurobiology. Such research may also make an important contribution to the understanding of these phenomena and illnesses such as schizophrenia, given the many clinical commonalities and the recent documentation of post traumatic phenomena in over 50% of people who have had an acute psychotic episode (Shaw et al., in press).

Finally, a great deal of attention has been paid to the role of memory in post traumatic stress disorder. Given the observation that the intrusive phenomena are relatively non-specific, and also become less dominant in the phenomenology of the disorder with the passage of time, suggests that this emphasis should not be exclusive of a consideration of the other dimensions of the disorder. As will be discussed, it is possible (McFarlane et al., 1993 ? reference for the ERP data?) have suggested that in the chronic disorder the intrusive memories may be a secondary consequence of the disturbance of selective attention and working memory in the disorder, rather than solely a primary imprinting of the traumatic memories and the underlying biological concomitance. This suggests that one of the challenges of understanding the neurobiology of PTSD is to grapple with these counter-intuitive relationships.

Neural Networks and PTSD

The complexity of the biological matrix underpinning post traumatic stress disorder and its trajectory in time suggests the need to have some theoretical model to underpin these apparently contradictory observations. There needs to be a constant interplay between the development of theory and research findings as an on-going process. One possible paradigm which may help integrate these divergent observations are neural network models. They provide a way of conceptualising the transition of the phenomenological and neurobiological changes in this disorder across time. In particular, they address one of the critical questions.

This leads into one of the fundamental questions about PTSD, namely, how the acute response to what is often a single stressor of brief duration merges into the constellation of PTSD symptoms. A neural network model provides one hypothesis for the process by which the intrusive and distressing recollections following a trauma could potentially drive the biological and psychological dimensions that give rise to the disorder. This hypothesis is derived from the knowledge of how complex associated networks can be trained and modified, and as a result, how the brain processes, utilises, and is modified by information (Cohen & Servan-Schreiber, 1992) and is an adaptation of neural network models which have been usefully applied to other psychiatric disorders such as schizophrenia, obsessive compulsive disorder and dissociative disorders. This is based on the proposition that intrusive thoughts occurring immediately following a traumatic event may modify neural networks in the brain through a

series of predictable biological events and mechanisms, and lead to the more complex biobehavioral syndrome of PTSD. Thus, it is proposed that an individual's cognitive and affective adaptability is actually impaired by the dominance of his/her own internal memories. This model further proposes that the process of symptom exacerbation reflects the behaviour of modified neural networks as consequence of "pruning" and "top down activation". This, in turn, interferes with the development of more flexible meaning networks to explain and integrate the trauma, and leads to other syndromal features of the disorder.

The question arises as to what might be the mechanisms which modulate these neural networks. The catecholamines are possible candidates. They may both set the gain of the cortical association networks and thereby facilitate then processing of the traumatic stimuli but also be secondarily regulated by the affective valance of the memory via the amygdala and their conceptual representations in the cortex. The central noradrenaline system is one of the few systems in which the afferents have widely dispersed projections. Therefore, it stands in contrast to other neurotransmitter systems which are more localized and which generally carry quite specific information to circumscribed regions. The function of the noradrenergic system is that it sets the "signal-to-noise" ratio of the brain (Harley, 1987). Thus, this system carries relatively non-specific information to many areas, and in this capacity can serve to influence and integrate the activity other neurotransmitters and brain regions in a coordinated way. If this noradrenergic system is functionally altered, this will have consequences for the responsiveness and coordination of the brain. The neuroanatomical origin of the noradrenergic system is the locus coreuleus, a nucleus thought to be important in modulating cortical information processing. The evidence for this function comes from neuroanatomical

Abnormalities of this system are central to most biological theories of PTSD although there is ongoing debate about their exact nature and consequences. Further in primates, in particular, the noradrenergic terminal domains exhibit regional and laminar enervation patterns (Clark et al, 1987). This distribution indicates that although locus coreuleus afferent provide non-specific information to the cortex, their terminal fields are pattern-specific; that is, they modulate cortical information processing. An examination of these targets show that they coincide with many of the regions, forming the widely-distributed cortical networks described by Goldman-Rakic (1990). This is a more complex process suggested by Kolb (1987) who suggested that these systems escape from higher controls leading to the alarm reactions typical of PTSD. Similarly, it indicates that the animal model of inescapable electric shock is a paradigm which does not take into account the dynamic process involved in the early integration of traumatic memories. The activation of the dopamine and noradrenergic systems may both be a consequence of the intense arousal and fear experienced during the traumatic event but also the secondary process of reworking the trauma related memories. This secondary process may be more vulnerable to destabilisation in humans than the initial reaction during the traumatic event.

The event related potential studies of PTSD (McFarlane et al, 1993) which demonstrated problems in differentiating target from distractor stimuli in association with a decreased P300 are similar to the abnormalities which are found when the locus coreuleus is ablated in monkeys. This suggests that a functional underactivity of the noradrenergic system may underly the disorder.

Conclusion

The emergence of findings from longitudinal studies have increasingly indicated that the nature of post traumatic stress disorder at different points in its life history needs to be distinguished. It has become apparent in the last few years that the syndrome of PTSD is far more complex than a simple extension of the normative stress response. PTSD only develops in a proportion of individuals who are exposed to traumatic events; the acute stress response symptoms, typically abate in most individuals within weeks following the traumatic event. In some individuals, PTSD symptoms emerge months or even years following exposure to traumatic events, often as another life experience resonates with the prior trauma. In others, there is a life long pattern of oscillation between active post traumatic stress disorder and remitted symptoms. This suggests that post traumatic

stress disorder involves a complex set of antecedents as well as a cascade of biobehavioural changes. For these reasons, a realistic model for the development of PTSD must take into account the modification of a range of biological systems. These modifications may or may not become fully manifest over time and may in turn be affected by multiple variables.

This has major implications for treatment. It is possible that treatment interventions that are effective at one point in the history of the condition may have little effect in the more chronic forms. As the disorder progresses, the pattern of numbing and interpersonal withdrawal comes to increasingly dominate the individual's mental state. Current treatments appear to be relatively ineffective at managing this aspect of the phenomenology. In addition, there is a considerable need to understand the way in which the social context and explanations for traumatic experiences have on the course of the disorder. The question arises as to what other psychiatric manifestations become the focus of attention in settings where the diagnosis is less accepted.

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Stress, Stressors and Cardiovascular Disease

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Summary

The central theme presented is that chronic stress responses contribute to the development of cardiovascular disease, and that acute stress responses can act as a trigger for the clinical presentation of underlying, previously silent cardiovascular disease. The principal mediating mechanism is activation of the sympathetic nervous system. In essential hypertension, stress responses involving the sympathetic nerves of the kidneys in particular are a potential mechanism for producing persistent elevation of blood pressure. There is evidence of a contribution of stress to the development of coronary atherosclerosis, and to the triggering of clinical complications, such as fatal arrhythmias and myocardial infarction in the presence of underlying coronary artery disease. Panic attacks are uncommonly complicated by cardiac events such as coronary spasm and myocardial infarction, and represents an explicit demonstration of the stress-heart link.

Human cardiovascular stress reactions: it is neural rather than adrenal cortical responses which are of prime importance.

The sympathetic nervous system occupies a position of central importance in the neural control of a range of body functions. Aspects of cardiovascular, renal, gastrointestinal, metabolic and reproductive functions are regulated through this branch of the autonomic nervous system. Sympathetic nerves also constitute the major effector arm for the mammalian response to stress, sympathetic nervous outflows being activated by a variety of behavioural and physical stressors. In this regard, recent research indicates that the previous orientation, championed by Selye[1], of the adrenal cortex and cortisol as the cornerstone of human stress responses is misplaced, particularly in the context of the cardiovascular system (Table 1). Neural stress responses are clearly of greater importance[2]. Until rather recently, knowledge of human sympathetic nervous responses to stressors was sketchy, due largely to the rudimentary nature of the tests of sympathetic nervous function available to investigative clinical medicine. There has been something of a revolution in the methodology for clinical sympathetic nervous testing of late, deriving in large measure from research on the sympathetic control of the cardiovascular system, which has lead to a new understanding in the field of human stress physiology. Let us commence with a brief overview of this new methodology.

Table 1. Cardiovascular Diseases and Stress

Essential Hypertension
Coronary Artery Disease
Panic Disorder
Stroke
Cardiac Failure

Chronic stress responses contribute to the development of cardiovascular disease, and acute responses can act as a trigger for the clinical presentation of underlying, previously silent cardiovascular disease. In essential hypertension, stress responses involving the sympathetic nerves of the kidneys in particular are a potential mechanism for producing persistent elevation of blood pressure. There is evidence of a contribution of stress to the development of coronary atherosclerosis, and to the triggering of clinical complications, such as fatal arrhythmias and myocardial infarction in the presence of underlying coronary artery disease. Panic attacks are uncommonly complicated by cardiac events such as coronary spasm and myocardial infarction, and represents an explicit demonstration of the stress-heart link. The contribution of stress to strokes is less well studied than for comparable events in the heart; similar processes might be operating. Sympathetic nervous overactivity is present in even mild heart failure, and mental stress is a demonstrable trigger for the development of ventricular arrhythmias.

Testing of human sympathetic nervous system function

The two methods for studying human sympathetic nervous system function having greatest analytical power are an electrophysiological technique quantifying nerve discharge rates (clinical microneurography) and a radiotracer method for measuring the rate of release of the major sympathetic neurotransmitter, norad-

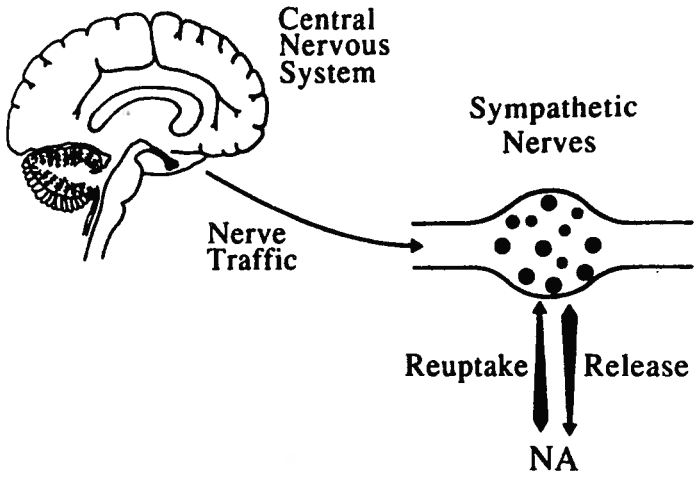

Figure 1. Clinical testing of sympathetic nervous function is best performed by recording of multiunit postganglionic efferent nerve traffic (clinical microneurography) and release of noradrenaline (NA) from sympathetic nerves to plasma (noradrenaline "spillover").

renaline, to plasma (measurement of noradrenaline "spillover") (Fig. 1).

Clinical microneurography

Hagbarth and Vallbo[3] developed clinical methods for studying nerve firing rates in subcutaneous sympathetic nerves distributed to skeletal muscle blood vessels and skin. The technique involves the insertion of fine tungsten electrodes through the skin, with positioning of the electrode tip in sympathetic fibres of, most commonly, the common peroneal or median nerves. Multifibre recordings of "bursts" of nerve activity, synchronous with the heart beat, are generated. Sympathetic activation is marked by an increase in burst number and burst amplitude.

Noradrenaline spillover rate measurements

Biochemical methods for studying human sympathetic nervous function, in the form of measurement of urinary catecholamine excretion, have been available for more than 40 years[4]. The application of isotope dilution methodology, to measure rates of noradrenaline spillover to plasma[5,6], was a useful innovation, and has replaced urinary measurements which are now obsolete. With microneurographic methods for studying sympathetic nerve firing rates, the nerves to skeletal muscle and skin only can be studied. An important limitation in stress research is the inaccessibility to testing of the sympathetic nerves of internal organs. Noradrenaline spillover measurements overcome this difficulty. Techniques measuring organ-specific noradrenaline provide a way of studying regional sympathetic nervous function in humans. The relationship which in general holds between the sympathetic nerve firing rate of an organ and the rate of spillover of noradrenaline into its venous effluent provides the experimental justification for using measures of regional noradrenaline release as a clinical index of sympathetic nervous tone in individual organs[7].

During constant rate infusion of radiolabelled noradrenaline, the regional rate of spillover of noradrenaline to plasma can be determined by isotope dilution[6,7]:

$$\text{Regional noradrenaline spillover} = [(C_V - C_A) + C_A.E].PF$$

where C_V and C_A are the plasma concentration of noradrenaline in regional venous and arterial plasma, E is the fractional extraction of tritiated noradrenaline and PF is the organ plasma flow.

The patterning of sympathetic nervous responses to stressors

The application of this methodology in quantifying sympathetic nervous system activity in stress research to-date has almost entirely been confined to a cardiovascular context. The sympathetic nerves of the heart have served as an appropriate focus[8], given the importance placed on the "stress-heart" connection in both medical folklore and clinical cardiology.

We have extensively studied the sympathetic nervous response to laboratory mental stress, typically using cognitive challenge (difficult mental arithmetic) as the stressor[8,9], and monitoring of sympathetic nerve firing and regional noradrenaline release from individual organs, including the heart. A *pronounced and preferential activation of the cardiac sympathetic outflow* is seen (Fig. 2)[8,9]. Skeletal muscle sympathetic nerve

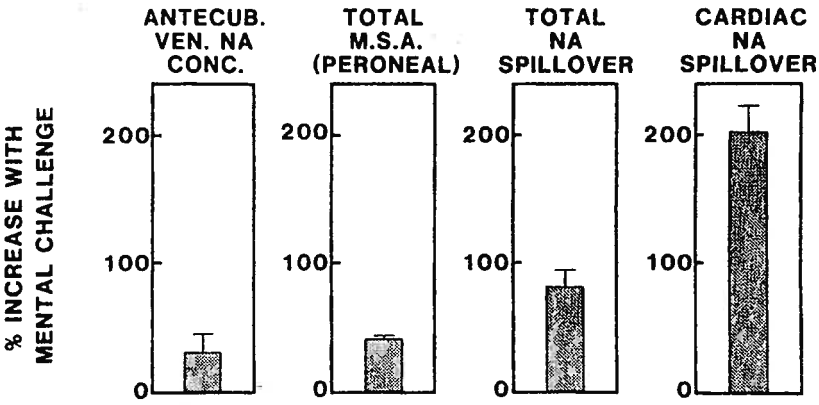

Figure 2. Patterning of the sympathetic nervous response to laboratory mental stress (difficult mental arithmetic). Muscle sympathetic nerve activity (M.S.A.), measured as the product of burst number and burst amplitude, increased only marginally with the stressor. Noradrenaline (NA) response was least in the forearm (antecubital venous sampling), in keeping with the small recorded response in sympathetic nerve firing in the limbs. Response was intermediate with total NA spillover derived from arterial sampling, which gives an averaged measure of whole body noradrenaline release, and greatest in the heart, indicating preferential activation of the cardiac sympathetic outflow.

firing and antecubital venous plasma noradrenaline concentration is little changed.

The pattern of sympathetic activation observed with laboratory mental stress, a preferential activation of the sympathetic nerves of the heart, may possibly be of importance in the pathogenesis of cardiac arrhythmias and myocardial ischaemia in patients with coronary artery disease. Both medical folklore and experimental evidence from laboratory animals[10] implicate stress in the development of disordered cardiac rhythm and sudden death. Cardiac sympathetic activation is one probable mechanism through which an acutely stressful life event can precipitate a life-threatening arrhythmia.

Essential Hypertension

Evidence drawn from a number of sources provides compelling evidence that overactivity of the sympathetic nervous system is present in a proportion of patients with essential hypertension, principally younger ones with hypertension in its earlier, developmental phase[11,12]. This sympathetic stimulation involves the neural outflows to the kidneys, heart and skeletal muscle, and is present primarily in young patients. As discussed below, this increased renal and cardiac sympathetic firing provides a plausible mechanism for the development of hypertension. Do these neural changes in patients with essential hypertension represent a stress response, and is their blood pressure elevation a consequence of stress?

Stress responses in patients with essential hypertension

One concept of hypertension pathogenesis attributes a central importance to the effects of repeated neurally mediated pressor episodes occurring during the course of daily life. The developmental stage of human hypertension, in this view, is characterized by greater than normal pressor responses to stressors, which in time lead to arteriolar hypertrophy, increased peripheral vascular resistance and fixed elevation of arterial pressure. The hypothesis has been supported by some clinical studies demonstrating greater than normal blood pressure rises in human hypertension with experimental stresses in the laboratory, and by clinical description of "labile" hypertension, with widely fluctuating blood pressure, in some patients with borderline or mild established hypertension who are thought to be in the early developmental phase of their disease.

Labile hypertension, however, does not exist. It is a misnomer applied to patients with borderline blood pressure elevations whose blood pressure, while showing the usual degree of blood pressure variability in the clinic, creates an illusion of greater fluctuation or lability than normal by oscillating around the cut off point for the diagnosis of established hypertension[13]. While the earlier suggestion was that spontaneous variability of arterial pressure was greater in borderline hypertension, 24-hour ambulant blood pressure monitoring in borderline[14] and mild established essential hypertension[15] has disclosed unremarkable pressure traces, with blood pressure fluctuation no greater than in healthy subjects.

Uncertainty remains as to whether there are greater neural and pressor responses to some standardized cardiovascular stimuli in the laboratory in patients with borderline and mild hypertension. Quite clearly there is no *generalized* noradrenergic overresponsiveness to *all* sympathetic nervous stressors in essential hypertension. Despite earlier studies suggesting the existence of

increased stress reactivity, recent large-scale studies[16–18], one of which was drawn from an epidemiological base[17], find no evidence of blood pressure and sympathetic neural hyperreactivity in borderline hypertension, or in normotensive family members of hypertensive patients. This does not exclude the possibility that essential hypertension might result from neural responses to high levels of chronic environmental stress; what has been tested in the laboratory is responsiveness to *standardized* stressors.

Hypertension as a psychosomatic disorder?

The idea that essential hypertension may arise through psychosomatic mechanisms is an old one. Even before the standard methods of indirect blood pressure measurement were available, Geisbock (in 1905) wrote, concerning his male patients with polycythaemia and hypertension (systolic pressure having been measured with a finger plethysmograph): "one finds an unusual frequency of those who as directors of big enterprises had a great deal of responsibility and demanding jobs, and who, after a long period of mental overwork, became nervous"[19].

The lay public needs no convincing that psychological factors cause high blood pressure. Despite such ready acceptance, proof that essential hypertension is a psychosomatic disorder has remained elusive. Clinical, epidemiological and laboratory research, however, does provide increasingly strong support for the notion that behavioural and psychological factors are of importance in pathogenesis[20–22]. Of particular importance in this regard are epidemiologically based observations made on human populations who demonstrate blood pressure elevation soon after migration[23], and long term follow up studies of human populations, such as cloistered nuns, living in secluded and unchanging environments, in whom blood pressure does not show the expected rise with age[24]. Henry and Grim[25] and Harburg et al[21] have linked the increased prevalence of hypertension in black Americans to high levels of psychosocial stress.

Research on the possible psychosomatic origins of essential hypertension, in addition to focussing on the external stress as the stimulus, has assessed the personality characteristics of hypertensive patients which determine responsiveness to these external influences. As a group, hypertensive patients consistently exhibit suppression of hostility, a behavioural pattern, that is particularly associated with activation of the sympathetic nervous system[20–22]. Alexander[26] first drew attention to this: "Our society requires that the individual should have complete control over all his hostile impulses. While everyone is subjected to this restriction some people are more inhibited in their faculty to express aggressive and self assertive tendencies ... consequently they live in a chronically inhibited hostile state". Links have been made between measured levels of suppressed aggression in hypertensive patients and the pathophysiology of their hypertension. Young hypertensive patients with suppression of hostility tend to have sympathetic nervous system activation, neural stimulation of renin release from the kidneys and high renin hypertension[20,22].

In short, although the concept that in some patients essential hypertension may arise by psychosomatic mechanisms is not entirely proven, there is a wealth of supporting experimental and clinical evidence. Long term neural effects of stress on renal function could possibly be the principal blood pressure elevating mechanism[27,28].

Coronary heart disease

Many, although not all of the causes of coronary atherosclerosis are well understood. At a community wide level, the importance of high blood pressure, tobacco smoking and abnormal blood lipids (including high cholesterol) as causal factors are not disputed by cardiologists. The precise cause of existing coronary artery disease in an individual patient, however, is alway somewhat unclear. The relevant issues are whether mental stress, in one of its several forms:

1. Can cause or aggravate atherosclerosis.
2. Can trigger a heart attack in the presence of existing atherosclerosis.

Whether chronic, ongoing stress leads to the development of coronary artery atherosclerosis remains a disputed issue, although recent research strongly supports this proposition. More certain is the importance of short term mental stress as a trigger for the development of abnormal heart

rhythm and sudden death in patients with existing coronary atherosclerosis.

Relation of Stress to the Development of Atherosclerosis

There are numerous epidemiological population studies, of which some involve the workplace[28–32], indicating that psychological abnormalities, particularly anxiety and chronic stress, can contribute to atherosclerosis development. In the work place, loss of control over the job (insufficient self regulation of workload, of deadlines and of the planning and direction of the work) has been consistently demonstrated to be linked to risk of developing atherosclerosis[29–32]. The mechanisms by which stress might contribute to atherogenesis are uncertain. Catecholamine effects on lipolysis in adipose tissue and hepatic synthesis of lipids[33], and neural vasoconstriction, reducing clearing of blood lipids[34] are possibilities.

The Stimulant Nerves Of The Heart Are Preferentially Activated By Mental Stress

With even relatively mild experimental mental stress, such as that induced in the research laboratory by performing difficult mental arithmetic, the stimulant (sympathetic) nerves of the heart are markedly activated (Fig. 2)[8,9]. This effect of mental stress on the nerves of the heart is greater in older people aged over 60 years[8]. In laboratory animals with experimental narrowing of the coronary arteries, an increase in the activity of the sympathetic nerves of the heart has been shown to be capable of causing electrical instability in the heart, and triggering heart rhythm disturbances and cardiac arrest[10].

A Direct Relation Of Mental Stress To Sudden Death Has Been Demonstrated in Certain Circumstances

Long QT interval syndrome is a rare inherited heart condition in which there is electrical instability of the heart muscle. Mental stress is one proven immediate cause of cardiac arrest in sufferers[35]. In heart failure there is a high level of stimulation of the cardiac sympathetic nerves, which has been directly linked to the development of ventricular arrhythmias and sudden death[36]. Even in mild heart failure the cardiac sympathetic outflow is markedly activated[37]. Laboratory mental stress has been demonstrated to augment this even further[38], and sudden death in patients with mild heart failure has been linked to emotional precipitants[39,40].

Some research linking mental stress to sudden death is disputed because of disagreement over what constitutes a stress, and whether stress can be accurately measured. Recent research showing that rates of cardiac arrest in people with underlying coronary disease were markedly increased immediately after an earthquake (in LA, 1994) (Fig. 3)[41] is free of this criticism, as no finessing is needed in the psychological measurement of stress. An earthquake is, no doubt, stressful for all. It should be emphasized, however, that the

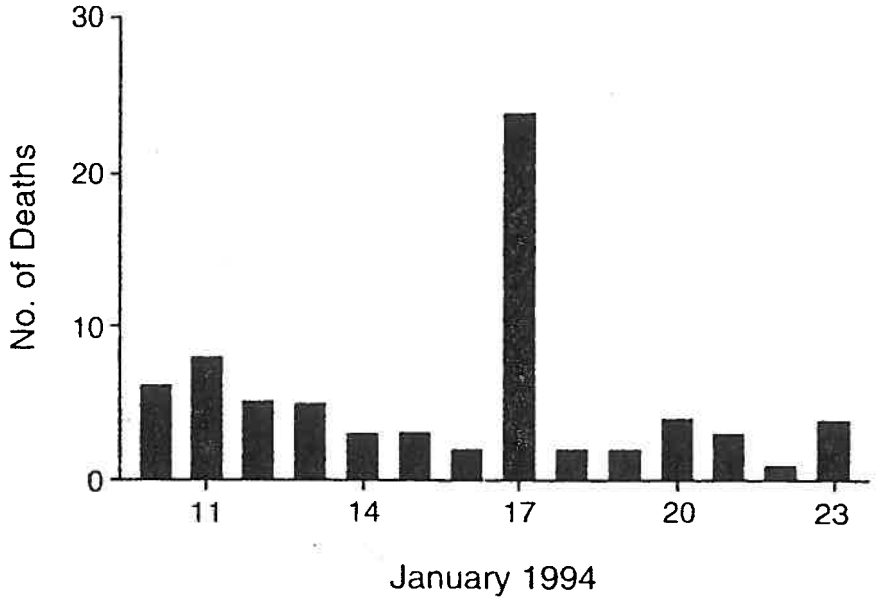

Figure 3. Daily numbers of sudden deaths related to atherosclerotic cardiovascular disease from January 10 to 23, 1994, investigated by the Los Angeles County coroner's office. On the day of the Northridge earthquake, a major quake affecting the Los Angeles area, there were a substantially greater number of cases of sudden death than in the period immediately prior to or after the earthquake. Reproduced from[41] with the permission of the author and publisher.

majority of people with coronary artery disease who were in Los Angeles on the day of the earthquake did not suffer a cardiac arrest. The risk of sudden death is small, even if the stress is major, in a single instance of stress in those predisposed by having underlying coronary artery disease. In those with healthy hearts the risk must be materially less again than this.

Mental Stress Can Lead To reversible reduction in Blood Supply To The Heart

Clinical anginal commonly has an emotional precipitant. Mental stress studied experimentally in the laboratory, in patients with existing coronary artery disease, has been unequivocally shown to be capable of causing anginal pain and inadequate blood supply to the heart in a substantial proportion of cases (Fig. 4)[42]. Severe acute anxiety, such as is encountered in panic attacks, can rarely cause coronary artery spasm even in the absence of underlying atherosclerosis[43].

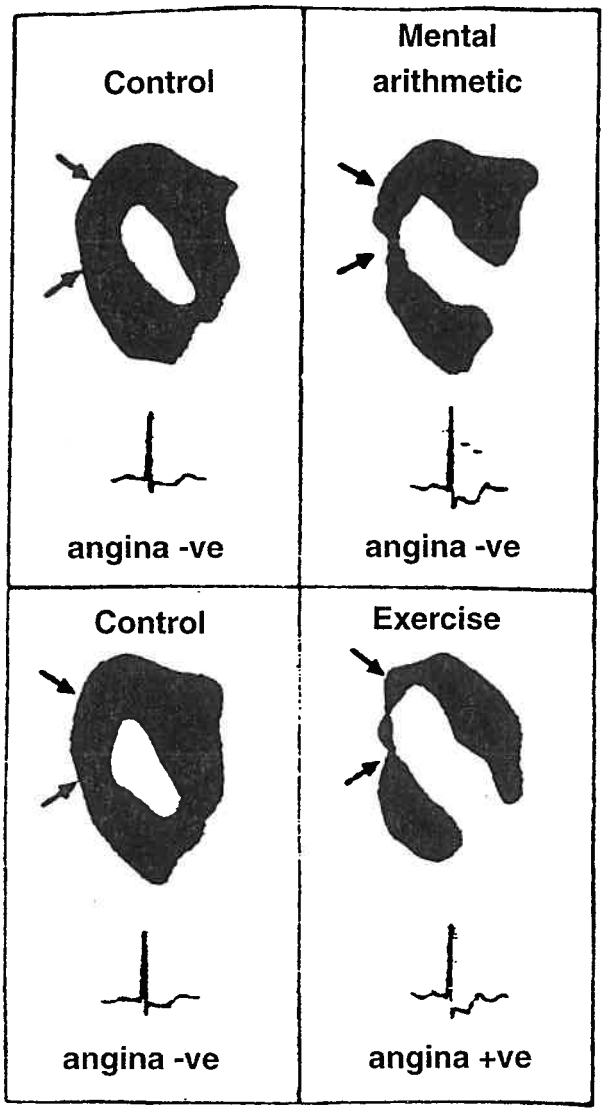

Figure 4. Changes in regional myocardial uptake of rubidium-82, in relation to the presence of absence of angina, before and after mental arithmetic or exercise. Reduced uptake is indicative of ischaemia. In the patient shown, mental arithmetic caused silent myocardial ischaemia. Exercise caused ischaemia, in a similar distribution, but accompanied by chest pain. Reproduced from[42] with permission of the authors and publisher.

Stress and Anxiety as a Precipitating Cause for Myocardial Infarction

Myocardial infarction, from critical reduction in blood supply, typically results from one of several possible causes narrowing or totally occluding one or more coronary arteries. These causes are *arterial thrombosis*, when a clot forms in the artery in situ and, less commonly, *arterial spasm*, when a reversible constriction of the artery wall reduces or arrests blood flow. The underlying causes of arterial thrombosis usually involve atherosclerosis damaging an arterial wall at the site of a thrombosis, and the adherence of blood platelets to the damaged arterial wall to initiate the clotting process. Coronary artery spasm typically also occurs at the site of arterial wall damage from atherosclerosis. Myocardial infarction from arterial spasm is less common than from thrombosis.

There are well documented mechanisms by which immediate antecedent stress can cause myocardial infarction in the presence of existing coronary atherosclerosis. The capacity of mental stress and stress hormones to increase blood platelet adhesiveness, in a way which predisposes to clotting, is established beyond dispute. Short term mental stress also has effects on the circulation, with increases in blood pressure and heart contractility, which predispose to both fissuring of atherosclerotic plaques and dislodgement of adherent arterial clot[44]. Stress responses preferentially involve the sympathetic nerves of the heart[8,9], can reduce blood flow in heart muscle[45], predisposing to myocardial infarction[43].

Panic Disorder

Panic disorder is characterized by unpredictable and overwhelming feelings of fear accompanied by various symptoms of sympathetic nervous system arousal e.g. sweating, palpitations, diarrhoea and tremor[45]. Often chest pain is present and is so similar to angina that a typical panic disorder case

history contains several emergency room visits leading to detailed cardiac workup, the result of which is typically normal.

Although panic disorder is distressing and disabling, until recently it has not been thought to constitute a risk to life. Recent well conducted, prospective epidemiological studies however, indicate that there is substantially increased risk of death in patients with panic disorder (3–6 fold increase)[46, 47]. The mechanism of cardiac risk in panic disorder is not known, but is thought to possibly involve the activation of the sympathetic nerves of the heart, predisposing to ventricular arrythmias and coronary artery spasm. Increased secretion of adrenaline from the adrenal medulla, and activation of the sympathetic nervous system is evident during panic attacks (Fig. 5). Panic disorder sufferers continuously release adrenaline as a cotransmitter from the sympathetic nerves of the heart, apparently due to loading of the nerves by uptake of the hormone from plasma, during surges of adrenaline secretion from the adrenal medulla[48].

A recent clinical report[43] demonstrates the importance of coronary artery spasm as a pathophysiological mechanism. Three panic disorder sufferers were described who developed ischaemic ECG changes during episodes of chest pain, and of these two went on to subsequent myocardial infarction. This may not have been so remarkable except for the fact that two patients were women at very low cardiac risk based on the absence of classical risk factors, and in all three patients coronary angiography disclosed no evident atherosclerosis. Coronary spasm, demonstrated in one patient, was considered to be the most likely cause of the chest pain in each case.

Although cardiac risk in panic disorder patients overall is no doubt low, it is not negligible in those with typical anginal pain during panic attacks. Understanding the process by which coronary spasm occurs in panic disorder patients should facilitate its therapeutic prevention. These patients sit at the crossroads of cardiology and neuropsychiatry, and provide an explicit demonstration of the relation of stress to heart disease.

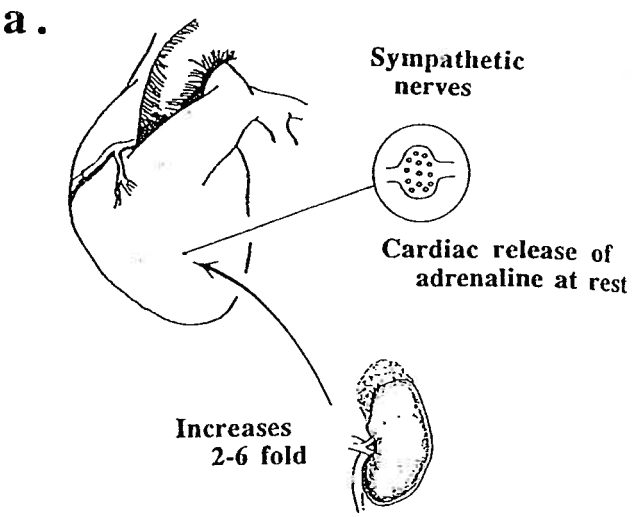

Figure 5. Adrenaline release and muscle sympathetic nerve activity (MSNA) in panic disorder. During a panic attack adrenaline secretion from the adrenal medulla increases 2-6 fold (top panel). Panic disorder sufferers release adrenaline as a cotransmitter from the sympathetic nerves of the heart at rest; the nerves are loaded with adrenaline by uptake from plasma during adrenaline surges accompanying panic attacks. During a panic attack in an individual patient (lower panel) there was a large increase in the amplitude of the recorded multiunit sympathetic nerve bursts.

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Stress and Hypertension

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Summary

Current evidence relating psychological stress and blood pressure is reviewed and a conceptual model linking psychological stress, stress perception and physiological susceptibility to hypertension is presented. While a number of studies have shown an association between stress and hypertension, others have not. In some studies there is an increased prevalence of hypertension where there is a lack of congruence between the psychological character of the individual and the social setting although this concept is not uniformly supported by the literature. Recent work suggests that coping mechanisms modify the influence of stress, especially with regard to the use of adverse lifestyle behaviours (for example, alcohol excess, poor diet and lack of exercise) and that these are may be important. The existence of a hypertensive prone personality (suppression of hostility) has been difficult to demonstrate reproducibly. Similarly, the idea that some people have excess blood pressure responses to stressful stimuli ("hyper-reactivity") has not been able to be corroborated in large scale studies. There is evidence for excess sympathetic nerve activity in the early stages of hypertension (borderline hypertension) of some subjects, especially those under 40 years of age, but its relationship to stress or to the common form of essential hypertension is uncertain. The possibility that stress mediates hypertension by influencing other physiological mechanisms, such as endothelial function or vasoconstrictor or growth hormone levels, needs further appraisal.

The question arises as to whether psychological stress resulting from membership of the Armed Forces during wartime or peacetime is sufficient to lead to the development of hypertension. It seems unlikely that the presence of such stimuli would be unique to the Services. Furthermore it might be expected that stress arising from particular occupational duties within different branches of the Services will impact in different ways. During peacetime, traumatic stress disorder is likely to provide the closest model for the consequences of Armed Forces stress. Factors that might be of importance to all Service personnel include coping mechanisms and lifestyle behaviour. In order to minimise the effects of stress, attention to work practices, appropriate treatment of traumatic stress disorder and education regarding coping mechanisms and lifestyle behaviours, should all be addressed in addition to general preventive general health measures. In this population group, opportunities for further research include examination of the interrelationship between work and home stress, assessment of differences in stress outcomes between men and women and the impact of improved work practices. The identification of subjects at risk of developing hypertension and other health problems as a result of exposure to adverse stress conditions should have a high priority.

Introduction

It is a common community perception that stress causes, or at least contributes to, high blood pressure (or "hypertension") as well as other cardiovascular conditions. Transient elevation of blood pressure associated with anxiety or a visit to a health professional and which can be recorded during 24 hour ambulatory blood pressure monitoring, is testament not only to the variability of blood pressure but to the variety of environmental, physiological and psychological stimuli which can change the blood

pressure level. However whether the repetition of such stimuli, each producing a transient elevation of blood pressure, ultimately leads to persistent hypertension with pathological changes in the small arteries characteristic of essential hypertension, is not known. This paper will review current evidence linking psychological and other environmental stresses to persistent elevation of blood pressure. The possibility that specific interventions might limit the adverse effects of psychological stress will also be addressed.

Patterns of Stress

There is an infinite variety of psychological stress patterns. Nevertheless, several environmental situations can be identified which seem to have an association with the development of hypertension. Although blood pressure increases in most populations with age, social isolation is an important modifying factor as demonstrated by the thirty year observational study of Italian nuns liv-

ing in a secluded order[1]. Blood pressure remained stable during the observation period in the nuns. Lay women from the same region showed the expected rise in blood pressure with age. After thirty years there was an average difference between the two groups of 30/15 mmHg. This was not explained by a change in body weight, diet or by child bearing history. The authors concluded that a difference in psychosocial stress was the main underlying factor. Similarly, a study in men confined to prison who lived for several months in a dormitory had higher blood pressures than those who lived in single occupancy cells[2]. In rats, with spontaneous hypertension, those reared in social isolation had a lower blood pressure than the animals reared in colonies[3].

The idea that persistent activation of the defence reaction, a fundamental response associated with autonomic arousal, was put forward by Brod et al[4] as a contributing cause of hypertension. Julius et al (1992) suggested that a permanent defence reaction pattern could lead to essential hypertension. This hypothesis was pursued in mice by Henry and colleagues[5]. They found that animals when housed in population cages developed a social hierarchy. Animals who are subdominant and attempt to achieve control have the highest blood pressures. A study of socioecological stress in Detroit[6,7] showed that highest blood pressures occurred in black males under the age of 40 living in high stress neighbourhoods (according to socioeconomic status and instability variables).

Post traumatic stress disorder is a well recognised syndrome of hyperarousal and sleep disorder following significant unexpected trauma. A variety of additional clinical features have been reported including depression, anxiety, seizures and hypertension. It occurs not only in troops related to combat but also in the general population following natural disasters. Studies linking post traumatic stress with hypertension[8] have been usually limited by lack of appropriate controls or failure to take into account confounding factors such as background lifestyle behaviours.

More complex models of stress patterns have been developed for understanding interactions between factors contributing to occupational stress. In the model of Karasek et al[9], two orthogonal components, psychological demands and decision latitude ("job control") were combined to determine the effects of jobs with high strain (high demands, low control) on the development of coronary artery disease and hypertension[10]. Other models (see Pickering[11]) have similarly identified two-dimensional component models which show links between stress and hypertension. Each of these models suggests that there is an element of discord between the individual and the social setting. There is a personal struggle between aspirations and control or resources. In most of these studies the possibility has been ignored that confounding factors, such as lifestyle, may be contributing to the conclusions. It is of interest that in a further report by Schnall et al[12] alcohol intake was highest in subjects in high strain jobs. Furthermore, job strain had a greater effect in younger subjects. However, in contrast to the study of Waldron et al[13], which showed a relation between the market economy, increased economic competition and decreased family ties, the effects were independent of salt intake and obesity (in men).

Perception of Stress

A hypertensive personality pattern with features of suppressed hostility and restrained aggression was first suggested by Alexander[14]. A number of studies have examined the relationship between various personality patterns and hypertension but the results are inconsistent. Type A behaviour, generally regarded as being at least partly a personality variable, has been related to coronary artery disease and is more prevalent in hypertensives in some studies[15]. It is possible that some subjects may learn a hypertensive personality pattern. The likelihood of this concept has generally been disregarded.

The ability to utilise coping mechanisms may be an important factor in determining the relation of stress to physiological effects such as increased blood pressure. Coping mechanisms are difficult to define and to quantify. Lindquist et al[16] developed an occupational stress indicator[17] which comprised 28 coping strategies each on a 6 point scale ("never used by me" to "very extensively used by me"). A higher score indicated more adaptive coping. Furthermore, the authors explored the extent to which people pursued various

lifestyle strategies as a means of coping so that relationships between coping strategy and lifestyle could be examined. Coping was a significant determinant of diastolic blood pressure. Particular types of coping strategies, eg excessive alcohol consumption and avoidance or denial of stressful work situations, produced adverse lifestyle behaviours. Coping mechanisms clearly have the ability to be learnt so that both genetic makeup and nurture contribute to coping skills. The study also suggested that women appear to adopt different coping strategies, possibly determined by their sex role.

Physiological Mediators of Stress

Activation of the sympathetic nervous system and the hypothalamic-pituitary-adrenal (HPA) axis are the common responses to stress[18]. Activation releases catecholamines from sympathetic nerves and the adrenal medulla and leads to the secretion of corticotrophin from the pituitary. Corticotrophin in turn stimulates the release of cortisol from the adrenal cortex. Changes in the cardiovascular system include elevation in blood pressure and increase in heart rate. In normal circumstances the response is transient and physiological variables return to baseline values as the stress subsides. With repeated episodes of stress there is usually adaptation of the response. In some subjects, eg those undergoing repeated public speaking challenges, cortisol secretion remained elevated[19]. In other subjects there appeared to be an inability to shut off the physiological response after the stress was terminated, as in the report of blood pressure failing to return to normal after an arithmetic test[20], and in primates, with hypertension accelerating atherosclerosis[21].

There is some evidence in animals for a failure to turn off the physiological responses to stress with increasing age but limited evidence in humans[22]. Another speculation is that such response systems "wear out" or become exhausted (see McEwen (18). In some cases the sympathetic nervous system or H-P-A axis response to stress may be inadequate without the usual autoregulation and the activity of other systems increases. For example if cortisol secretion does not increase in response to stress, secretion of inflammatory cytokines (which are inhibited by cortisol) increases[23].

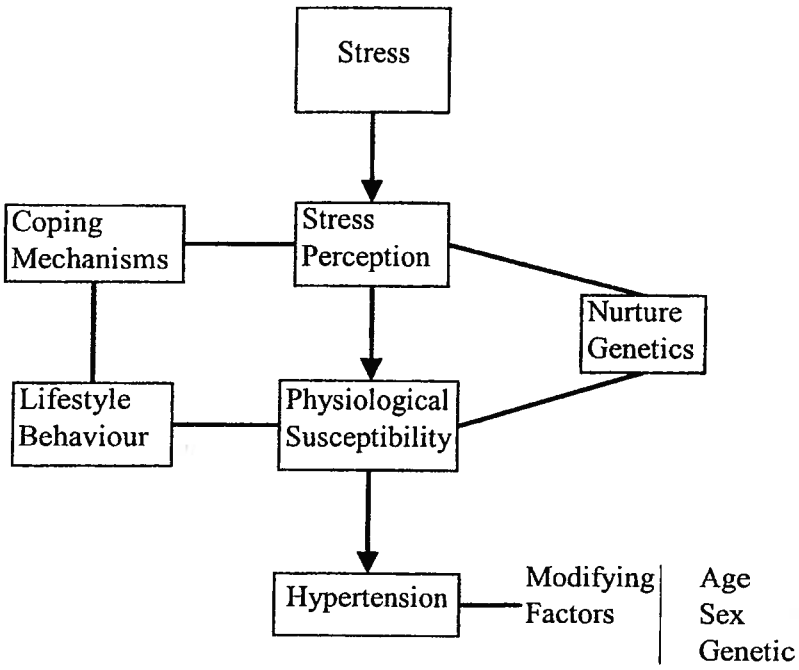
Acute stress also causes lymphocytes and macrophages to be redistributed throughout the body and to marginate on blood vessel walls as well as in certain body compartments. Acute stress enhances the traffic of lymphocytes and macrophages to the site of the acute challenge. The immune-enhancing effects of acute stress depend on adrenal secretion and last for 3 to 5 days[24] but whether such mechanisms play any role in the development of hypertension is not known. The possibility that stress activates other physiological control systems, such as endothelial function, thrombogenic susceptibility or growth inducing hormones, and whether any such changes might be related to long term changes in blood pressure regulation, has not been investigated at this stage.

In some subjects exaggerated blood pressure responses to various psychological or physical stimuli can be demonstrated[25]. It has been suggested that such increased reactivity may be a predictor of future hypertension. However recent large scale studies do not support evidence of blood pressure hyperreactivity in borderline hypertension or in normotensive family members of hypertensive patients[26].

Is there an association between stress and end organ pathology characteristic of hypertension which might be mediated by activation of the sympathetic nervous system or the H-P-A axis? Recently there have been several reports[27–29] that stress and/or sympathetic tone in the human heart is an important determinant of left ventricular mass but the findings have been questioned[30]. Whether stress can produce cardiovascular hypertrophy is yet to be demonstrated.

Conceptual Model

A conceptual model of the principal components which might be contributing to produce hypertension is shown in the Figure. The model allows the possibility of hypotheses relating to cause or importance to be tested. Using a similar model, Lindquist et al[16] and Beilin[31] have shown recently that coping mechanisms resulting in adverse lifestyle behaviours were important in the development of hypertension.



Conceptual Model of Relationship Between Stress and Blood Pressure.

after Beilin (1997), Pickering (1994)

Relation to the Services

The components of the model which might be influenced by employment with or voluntary recruitment to the Armed Forces include the nature of the stress, the use of coping mechanisms designed to neutralise stress peculiar to war and the type of lifestyle behaviours encouraged . Traumatic stress is likely to be important during wartime. More traditional stresses will have an impact in subjects undertaking employment in the Armed Forces during peacetime. Lifestyle behaviour will be influenced especially in relation to social pressures of cigarette smoking and alcohol intake. It is likely that work within particular areas of the Armed Forces will have different pressures, e.g. work as a fighter pilot compared to a naval orderly or an administrative clerk.

How to Limit Effects of Stress

At present it is not possible to identify even a single psychological stress factor which predisposes subjects to hypertension. It is important to recognise that certain environmental factors, such as excess alcohol, physical inactivity and poor eating habits have been shown to contribute to hypertension. Moreover, improvement in these adverse behaviours reduces the level of hypertension. The emphasis should be on best preventive practice and good general health advice. The results of research into traumatic stress disorder could be utilised in subjects on active service. The literature identifies several areas where help could be provided, such as an improvement in job design to limit stress, removal of incongruities in work practice so that individuals are better matched to their jobs, education regarding diet and attention to the development of appropriate stress coping strategies. Individuals with high cardiovascular risk could be stratified, e.g. by family history, and monitored appropriately.

Research

There are many possibilities for research in this area. The Armed Forces provide opportunities for assessing the interrelationships between work and home stress and investigation of the differences in stress management between males and females, particularly for those in peacetime forces. Interventions could be tested, especially in the field of coping mechanisms. There may be improved ways of identifying people at high risk by study of outcomes in those undertaking certain job activities or in individuals with particular psychological backgrounds or lifestyle behaviours.

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Adaptation to Severe Life Stressors: Health Outcomes

Case Study: Recently Widowed Older Men

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Abstract

This paper addresses the issue of potential explanatory mechanisms for the observed association between stressors and health outcomes using as a model one particular group of subjects: recently widowed older men.

We chose to study a group of community-residing recently widowed older men because death of spouse is a common, severe, adverse life event. In addition, death of spouse is almost always independent of the actions of the surviving spouse. Furthermore, older widowers experience excess "all causes" mortality in comparison with matched married men.

We were interested in several related questions: (1) Do recently widowed older men report more psychological distress than matched married men? (2) Are recently widowed older men more likely than matched married men to meet diagnostic criteria for psychiatric disorder? (3) Do recently widowed older men report more potentially hazardous health-related behaviours than matched married men? (4) What is the relationship between psychological distress, psychiatric disorder and prejudicial health-related behaviours?

The answers to our four questions may be summarised as follows: Recently widowed older men reported more psychological distress than matched married men throughout the first 13 months following the death of their spouse. The nature of this distress was predominantly anxiety-related although depressive symptoms were also reported. Recently widowed older men were more likely than matched married men to meet diagnostic criteria for psychiatric disorder. They experienced a significant excess of Major Depressive Disorder. However, the vast majority of these disorders resolved without specific treatment over the first 13 months following the death of their spouse. Recently widowed older men reported a higher rate of several potentially hazardous health-related behaviours. Specifically, they reported significantly higher rates of alcohol consumption and cigarette smoking. Amongst recently widowed older men there was a strong positive association between self-reported psychological distress and formally diagnosed psychiatric disorder. However, there was no significant association between either psychological distress or psychiatric disorder and potentially hazardous health-related behaviours.

We concluded that prejudicial health-related behaviours in recently widowed older men were not related to the manifest psychological distress they were experiencing. One or more alternative explanations was required. We hypothesised that loss of spousal care and control may be sufficient to permit recently widowed older men to adopt prejudicial health-related behaviours that they would not be able to adopt if their wives were still alive. Alternatively, direct psychophysiological mechanisms may mediate between either psychological distress or loss of spousal care and control, and death of the widower.

Background

Bereavement as a model for the impact of stressful life events

Conjugal bereavement has fascinated clinicians and theoreticians for decades and has served as a valuable model for examining the impact of stressful life events in humans (Freedman and Blumenfield, 1986; Stroebe and Stroebe, 1987). There are several reasons for this. Death of spouse occurs commonly and it is a discrete event which can usually be accurately timed. While it is often experienced as a severe adverse life event (Holmes and Rahe, 1967), it is not usually associated with physical trauma to the surviving spouse. In addition, unlike many other adverse life events, death of spouse is usually considered to be independent of the actions of the bereaved themselves (Brown and Harris, 1978). Furthermore, death of spouse is reflected in national census and health records and large data collections are available for analysis (Stroebe and Stroebe, 1987).

Older men as research subjects

With demographic trends in many developed nations indicating a substantial ageing of the population (Myers, 1994), clinical attention has been increasingly directed towards the problems of older people. As Stroebe *et al.* (1993) have emphasised, there exists evidence of substantial individual and cultural heterogeneity in response to bereavement. Whilst the empirical literature suggests that elderly women report more bereave-

ment-related emotional distress than men, there is evidence that widowers may be at higher risk than widows for physical ill health and premature death during bereavement (Jacobs and Ostfeld, 1977).

Evidence for excess mortality following bereavement

There is substantial evidence, both from purpose-designed epidemiological studies and from secondary analyses of official data collections, that the state of widowhood is associated with excess mortality in older men (for example, Helsing and Szklo, 1981; Mellstrom *et al.*, 1982; Ben-Shlomo *et al.*, 1993; Schaefer *et al.*, 1995). This excess mortality has been demonstrated both for "all causes" and for the specific cause of suicide (Durkheim, 1952; MacMahon and Pugh, 1965; Kreitman, 1988; Li, 1995). The limited Australian data also support this view, although the grouping of divorced and widowed persons for reporting purposes obscures the true magnitude of the effect among widowers (Mathers, 1994). In addition, the available evidence provides little support for the contention that the observed excess mortality can be attributed to statistical bias (Stroebe *et al.*, 1993), selection effects (Gove, 1973; Helsing and Szklo, 1981; Helsing *et al.*, 1981), assortative mating (Helsing and Szklo, 1981) or shared unfavourable environment (Schaefer *et al.*, 1995).

Is bereavement or widowhood associated with excess mortality?

An important subsidiary question raised by this literature is whether it is the state of widowhood *per se*, or whether it is the state of conjugal bereavement (or, in other words, the *transition* to widowhood), or both, which are associated with excess mortality. In relation to this issue, Susser (1981) has referred to the transition to widowhood as "bereavement as agent" and to the state of widowhood as "the bereaved situation as environment". The difference between these two conditions is essentially the difference between a relatively stable psychological and sociodemographic state (established widowhood) and an unstable and evolving, biological, psychological, and social state (conjugal bereavement). Until the work of Helsing and Szklo (1981), the preponderance of the empirical literature supported the interpretation that it was the impact of bereavement, rather than the state of widowhood, which was associated with excess mortality. The main evidence for this interpretation was the observed clustering of excess deaths in the months immediately following the death of spouse (see for example, Young *et al.*, 1963; MacMahon and Pugh, 1965; Parkes *et al.*, 1969; Bowling and Benjamin, 1985; Kaprio *et al.*, 1987). However, the excess mortality reported by Helsing and Szklo (1981) and by Ben-Shlomo *et al.* (1993) did not cluster around the immediate aftermath of the death of spouse, suggesting that factors associated with widowhood rather than factors associated with recent conjugal bereavement may be aetiologically important. Helsing *et al.* (1981) also reported that living alone was associated with excess mortality, further supporting the hypothesis that it is the state of widowhood rather than the immediate impact of bereavement which is associated with excess mortality. Providing some support for both hypotheses, Schaefer *et al.* (1995) have reported that excess mortality persisted for at least five years after the death of spouse although it was greatest during the first two years post-bereavement. Thus, it is possible that the excess mortality of widowers represents the combined effects of recent conjugal bereavement and ongoing widowhood.

If the state of widowhood is the key independent variable, then altered health-related behaviour (for example, hazardous alcohol consumption and failure to report new symptoms to a physician) may account for excess mortality among the widowed. On the other hand, if recent conjugal bereavement is the key independent variable, then psychobiological hypotheses linking psychological distress to biological changes in the body (for examples, altered circulating catecholamines and adverse cardiac effects) may be more likely.

Brisbane Widowers Study

We sought to address some of these questions in a controlled longitudinal study of recently widowed older men living in Brisbane. We used a double cohort design to investigate whether the relatively standardised stress of conjugal bereavement was associated with psychological distress, psychiatric disorder and prejudicial health-related behav-

iour. We were particularly interested in whether psychological distress or psychiatric disorder predicted prejudicial health-related behaviour.

Methods

Subjects

Subject recruitment has been described in detail elsewhere (Byrne & Raphael, 1994; 1997). Briefly, we enrolled 57 recently widowed community-residing older men (mean age 75 years) who were identified through the death registration documentation of their wives. In addition, we enrolled 57 community-residing married men (mean age 75 years) who were identified through the electoral roll. The married men, all of whom were residing in their own homes with their wives, were individually matched with the widowers for age, occupational prestige and locality of residence.

Widowers were interviewed on three occasions: at six weeks post-bereavement (T1), at six months post-bereavement (T2), and at 13 months post-bereavement (T3). Married men were interviewed at similar intervals.

Measures

We assessed the following: bereavement phenomena, psychological distress, psychiatric diagnosis, self-reported physical health, health-related behaviour and health-services utilisation. Among widowers, bereavement phenomena were assessed using the Bereavement Phenomenology Questionnaire. All other measures were administered to both widowers and married men. Psychological distress was measured on four established self-report scales: the General Health Questionnaire (GHQ); the state half of the Spielberger State/Trait Anxiety Inventory (STAI); the Zung Self-rating Depression Scale (SDS); and the revised UCLA Loneliness Scale (ULS). Psychiatric diagnoses were made using the Composite International Diagnostic Interview (CIDI). The CIDI also included questions about general physical health. Health-related behaviour and health services utilisation were measured using questions from the Health Interview Survey (ABS) and the National Risk Factor Prevalence Study (NHF). To establish the validity of self-reported alcohol consumption, fasting blood samples were taken at T1 and T3 for estimation of serum liver enzyme levels (ALT, AST, GGT).

Data Analysis

Categorical and ordinal data were analysed using Spearman's rho (r_s) and the chi-square (χ^2) test. Repeated measures categorical data were analysed using the Mantel-Haenszel chi-square ($MH\chi^2$) test. Non-parametric multivariate data were analysed using logistic regression.

Dimensional data were checked for normality and analysed using Pearson's r, analysis of variance (ANOVA), and linear regression. Standard multivariate assumptions were tested before applying repeated measures multivariate analysis of variance (MANOVA) to repeated measures dimensional data. Residual diagnostics were checked.

Analyses were run on SPSS-PC and S-PLUS.

Findings

Bereavement-specific phenomena

These findings have been detailed elsewhere (Byrne & Raphael, 1994). In summary, widowers reported substantial levels of bereavement-specific (grief) phenomena, many of which persisted to 13 months post-bereavement (T3). Widowers who reported that the death of their wife had been unexpected, reported more severe grief. Education was found to be protective in that better educated widowers reported lower levels of grief symptoms.

Psychological distress

Using the four measures of psychological distress (GHQ; SDS; STAI; ULS) as outcome variables and bereavement status (bereavement vs. married) as the between-subjects factor, repeated measures MANOVA indicated a strong main effect for bereavement status ($F(4,99) = 4.19$, $p = 0.004$). As expected, widowers reported higher overall levels of psychological symptoms than married men. Univariate F tests indicated that the main effect for bereavement status was due chiefly to the measure of state anxiety (STAI), ($F(1,102) = 13.61$, $p < 0.001$) (Byrne & Raphael, 1997).

Psychiatric diagnosis

At T1 seven widowers (12.3%; 95% CI: 3.7 — 20.8%) and no married men were found to be CIDI/DSM-III-R cases of current Major Depressive Disorder. The 95% confidence interval for the difference between these proportions was 1.7 — 10.5% with a z score of 2.645 (p = 0.0083). At T1, widowers were significantly more likely than married men to report depressed mood, appetite or weight change, sleep disturbance, fatigue, worthlessness or guilt, poor concentration, and thoughts of death and suicide. At T3 one widower (1.9%; 95% CI: -2.0 — 5.8%) and no married men were found to be CIDI/DSM-III-R cases of current Major Depressive Disorder. At T3, widowers were significantly more likely than married men to report thoughts of death and suicide (Byrne et al. — submitted for publication).

At T1, eight widowers (14.04%; 95% CI: 5.1 — 23.0%) and two married men (3.5%; 95% CI: -1.3 — 8.3%) were found to be cases of DSM-III-R current Generalised Anxiety Disorder. The 95% confidence interval for the difference between these proportions is -0.001 — 10.6% with a z score of 1.90 (p = 0.057). At T3, two widowers (3.85%; 95% CI: -1.2 — 8.4%) and no married men were found to be cases of DSM-III-R current Generalised Anxiety Disorder. The 95% confidence interval for the difference between these proportions is -1.73 — 5.46% with a z score of 1.41 (p = 0.16) (Byrne et al. — submitted for publication).

At T1, three widowers (5.3%; 95% CI: -0.6 — 11.1%) and two married men (3.5%; 95% CI: -1.3 — 8.3%) satisfied non-hierarchical DSM-III-R criteria for current phobic disorders. All three widowers satisfied diagnostic criteria for Agoraphobia without panic attacks. One married man satisfied diagnostic criteria for Agoraphobia without panic attacks and one married man satisfied diagnostic criteria for Social Phobia (Byrne et al. — submitted for publication).

Self-reported physical health

Widowers and married men reported similar levels of general physical health, history of physical illness or injury over the previous 12 months, and worry about physical health over the previous month.

Health-related behaviour

In comparison with married men, widowers reported both greater frequency of alcohol consumption ($MH\chi^2 = 4.64$, df = 1, p = 0.031) and greater quantity of alcohol consumption ($MH\chi^2 = 7.16$, df = 1, p = 0.0075). Among widowers there were highly significant correlations between both reported quantity and reported frequency of alcohol consumption, and the serum concentrations of the liver enzymes gamma glutamyl transferase (GGT), alanine amino transferase (ALT) and aspartate amino transferase (AST) at both T1 and T3 (Byrne et al. — submitted for publication).

Significantly more widowers than married men reported smoking at each time point (T1, 17.5% vs 7.0%; T2, 20.0% vs 8.8%; T3, 17.3% vs 10.9%; $MH\chi^2$ with continuity correction for the 2x2x3 array = 4.13, df = 1, p = 0.042) (Byrne et al. — submitted for publication).

More widowers than married men reported taking medication for sleeping although, after correction for multiple comparisons, this failed to reach statistical significance.

Widowers and married men reported similar levels of physical exercise.

Health services utilisation

Widowers reported longer hospital admissions than married men and were significantly more likely to report consultations with registered nurses ($MH\chi^2 = 16.31$, df = 1, p = 0.0001).

Bivariate relationships

Self-ratings of current physical health at T1 predicted reported physical illness or injury over the following year. Widowers who satisfied diagnostic criteria for a psychiatric disorder at T1 were more likely to report being worried about their physical health at T1 and T3, although this effect failed to achieve conventional levels of statistical significance. Bereavement-specific phenomena and non-bereavement-specific psychological symptoms were not significantly related to health-related behaviour, self-reported physical health or health services utilisation.

Discussion

Implications of the Findings

Although recently widowed older men reported

substantial levels of psychological distress and two potentially important prejudicial health-related behaviours, these sets of variables were not significantly correlated. Thus, a causal relationship between the two is quite unlikely and one or more alternative intervening variables must be operating.

Death of spouse may lead to potentially adverse health-related behaviours among older widowers by pathways unrelated to emotional distress. More specifically, widowers' behaviour may change as a result of loss of spousal care and control (see, for example, Gove, 1973; Umberson, 1987). If this is true, several further questions arise. Do significant changes commonly occur in the individual's social environment following other significant stressors? Certainly this is likely to be true when traumatic events affect multiple members of one family or small social group as commonly occurs in disasters and civil wars. However, it may also be true when the traumatic event leads to profound disfigurement, disablement or personality change in the victim. One or more of these changes may lead to substantial psychological distress in close family members, friends and colleagues. These changes may also lead to secondary changes in the individual's social environment.

Alternatively, either emotional distress (bereavement-specific phenomena or non-bereavement-specific psychological symptoms, or both), or loss of conjugal care and control, or both, may be related to excess mortality by more direct psychophysiological means. Whilst the nature of such psychophysiological mechanisms which might lead to excess mortality is obscure, there have been preliminary observations on potential biological pathways. Lown (1987) has reviewed the evidence linking recall of emotionally charged experiences and sudden cardiac death and has noted that sympathetic neural activity may precipitate ventricular arrhythmias. Heightened emotional distress may be associated with increased heart rate, increased cardiac stroke volume, increased blood pressure and alterations in clotting factors. Jacobs (1987) has noted that the available evidence supports the conclusion that bereavement is associated with a measurable endocrine response although he cautions that "a state of high physiological arousal is not found in everyone who is bereaved" (Jacobs, 1987; p150). Other evidence suggests that changes may be found in the immune response among recently widowed persons (Bartrop *et al.*, 1977; Irwin and Weiner, 1987) although the clinical significance of these findings is uncertain. At present it is difficult to predict the clinical implications of these putative direct psychophysiological mechanisms.

Potential limitations of the findings

Should we view these findings as applying only to a relatively small group of recently widowed older men, or should we view the findings as having broader implications? In other words, are these findings likely to be quite specific to the relatively commonplace stressor of conjugal bereavement or are they likely to be indicative of a more general process?

It is difficult to answer these questions with confidence although it is important to appreciate the potential limitations of our findings. We studied recently widowed older men. We did not study women or younger men. We did not study older men who had been divorced or separated nor older men who had been widowed for more than 13 months.

Conclusions

We found recent conjugal bereavement among older Brisbane men to be a suitable model for studying the interactions between a stressful life event and health-related outcomes. However, our relatively straightforward hypothesis that psychological distress would be causally related to prejudicial health-related behaviour was rejected. The alternative hypotheses of loss of spousal care and control over health-related behaviour, and direct psychophysiological mechanisms leading to death were canvassed. Further research could readily employ a similar model.

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PART THREE

Supplementary Papers Tabled at the Conference

Australian Military Involvement: Psychiatric Casualties

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> "The key to the understanding of the psychiatric problem is the simple fact that the danger of being killed or maimed imposes a strain so great that it causes men to break down ... There is no such thing as "getting used to combat" ... Each moment of combat involves a strain so great that men will break down in direct relation to the intensity and duration of their exposure. Thus psychiatric casualties are as inevitable as gunshot wounds and shrapnel in warfare."
>
> (Appel and Beebe, 1946, p 1474)

1. Overview: Psychiatry and the military

Pre Twentieth Century

Accounts referrable to cases of post traumatic neuroses in military personnel extend from sources of classical literature such as Homer's "The Odyssey" and the Shakespearian character of the soldier Hotspur in the play Henry IV (Trimble, 1985). Early European military records describe a condition of "nostalgia" linking psychological debilitation with combat conditions (Rosen, 1975). Nostalgia, being a "general sense of weariness, inability to concentrate and generally perform ... tasks" (Jones, 1986; p181) was recognized in seventeenth century Swiss mercenary soldiers and was considered a cause of French military ineffectiveness in the Napoleonic Wars (Jones, 1985).

The diagnosis again appeared during the American Civil War, when psychological reaction to the stress of combat lead to significant manpower loss in both Union and Confederate forces. The Surgeon General of the Union Army reported over 5000 cases of nostalgia during the first year of the Civil War and during its course six per 1000 men were discharged with a diagnosis of insanity. There was little sympathy or provision for the care of such men after discharge and while they were of concern to the military in terms of troop strength, much of the general population considered them a risk to public safety (Gabriel, 1986).

Another condition, this of psychosomatic origin was described by Da Costa (1871) during the Civil War as "Irritable Heart" (Trimble, 1985). Troops presenting with symptoms of chest pain, palpitations and dizziness in the absence of organic disease received this diagnosis. This condition has been referred to variously as effort syndrome, soldier's heart, neurocirculatory asthenia and Disordered Action of the Heart (DAH). This was a source of significant casualties in some theatres of the First World War and in subsequent Disability Pension records. Changing battle and environmental conditions, physical requirements and individual and group expectations of acceptable behaviour modes impacted on the physical expression of psychological disturbance, and by World War II DAH appears to have had been supplanted by dyspepsia and other gastrointestinal symptoms as the primary acute psychosomatic complaint in most theatres of war amongst American and Australian troops (Jones, 1985).

During the Russo–Japanese War (1904–1905) psychiatrists rather than physicians were for the first time available to assess troops. The major diagnostic category of psychiatric reaction among these casualties was that of neurasthenia, and was very close in symptomatology to that which was earlier called nostalgia, and which was often attributed to organic changes within the central nervous system. The acute facilities for the management of such war casualties were undeveloped and the military utilized the services of the Red Cross in this conflict for both treatment and dispersal of men discharged with psychiatric dysfunction. There were few available services for the chronically mentally ill who were not in need of restraint.

While Australian troops were involved in the Sudan, Boer and Maori Wars and the Boxer Rebellion, no specific mention is made regarding the occurrence or presentation of neuropsychiatric illness in these men. Indeed, history is almost silent as to the resultant disabilities of any variety which were associated with Australian military involvement from that period (Skerman, 1961).

Conflict within the Twentieth Century

The development of the theory and practice of psychiatry has been intertwined with military conflict in this century, and has impacted on the nomenclature of the stress related disorders. Early in the twentieth century psychiatry as a discipline was divided between support of organic and psychoanalytical theories of causation for psychological dysfunction. In the period prior to the commencement of the First World War, the pre-

dominant form of psychiatric care in Australia, and to a lesser degree in the United Kingdom and Europe, was involuntary institutional care for the "insane", in lunatic asylums (Garton, 1988). Only a small proportion of practitioners interested in the works of Sigmund Freud, Janet and Jung were examining the theories of neuroses outside the traditional organic theories of disease causation (Garton, 1988). At this time many of the psychiatric disorders were considered as problems in behaviour or conduct rather than illness and were often dealt with accordingly by stern measures. This was even more prominent within the military arena (Butler, 1943).

This theoretical debate regarding disease causation remained unresolved at the commencement of World War I. The events of this war provided the debate with stark perspective and created the need to organize the treatment of traumatic neurosis on an unprecedented scale, in the theatres of war, and later on repatriation to Australia (Garton, 1988). Service organizations and then popular opinion at "home" exerting pressure to humanize the care of those returned soldiers with mental disorders (Butler, 1943).

World War I

From the earliest days of World War I, record was made of "strange new diseases apparently having their origin in the stress and special horror of modern warfare" (Bailey, Williams and Komora, 1929, p 1). Early observations suggested an increased incidence during periods of heavy bombardment and many men were reported as having had symptoms including "staring eyes, violent tremors, a look of terror and blue cold extremities. Some were deaf, and some were dumb and others were blind or paralysed." (Bailey, Williams and Komora, 1929, p 2). Anecdotal accounts including those of the poet Robert Graves (1929), even more than the clinical reports (Mott, 1916) delineate chronic symptoms of irritability, insomnia, nightmares, depression and anxiety indicative of states of hyperarousal, avoidant behaviour and the re-experiencing of traumatic events.

The terms shell shock and shell concussion were coined to describe such conditions. These terms carried an assumption that they were organic in nature arising from damage to the nervous system caused by the intensity of explosives.

Recognition later in the war that such diagnostic labelling impacted acutely upon the military need for combat troops and on both patient and physician expectations of management and recovery, gave rise to the general term 'not yet diagnosed (nervous)' — NYD(N), (an analogous term existed for the fear of experiencing an enemy attack with mustard or other noxious gas 'not yet diagnosed (gas)' — NYD(G)). This was considered important as it gave casualties no help "in formulating their disorder into something which was generally recognized as incapacitating and requiring hospital treatment, thus honourably releasing them from combat duty. This left casualties open to the suggestion that they were only tired and a little nervous and with a short rest would be fit for duty" (Jones and Hales, 1987, p 527). It also administratively and effectively removed the availability of a wound stripe and thus the ability to "escape with honour" from the front, for cases of pure shell shock, which formerly had been available (Butler, 1943).

World War II and Korea

The terminology used to describe man's response to combat varied during World War II and the Korean war. During the early phases of World War II the traumatic psychiatric reactions were designated as psychoneurosis, anxiety state and anxiety reaction, psychoneurosis mixed and conversion hysteria (Glass & Mullens, 1972). The nomenclature used to describe dysfunction was "fixed" rather than indicative of a possibly transient disorder. There was at this stage amongst the American forces, a focus on psychoanalytical therapy based at distant points from military action. They suffered significant loss of troop strength from neuropsychiatric casualty and discharge and the impact of this and a comparison with the British and Australian forces is considered further.

In 1943 the United States Army introduced the term combat exhaustion for acute breakdown caused by battle stress in men with or without neurotic predisposition (Bartemeier et al, 1946), as "exhaustion was certainly understandable to any soldier who had seen combat, and therefore, the diagnosis did not carry the social stigma that any diagnosis beginning with the term (psycho) carried" (Kubala and Warnick, 1979, p 2–2). The

alteration in terminology had the same connotations as the "Not Yet Determined" neuropsychiatric casualties of the First World War, the implication being that the disorder was to be short lived and that men would return to their unit when rested. Accompanying the change in nomenclature acute treatment closer to combat areas was undertaken utilizing the rediscovered principles of proximity, expectancy and immediacy described following World War One (Salmon, 1919).

Specialist psychiatric advisors and clinicians were available in increased numbers within the military forces in World War II. A number of such clinicians including the Australian A.J.M. Sinclair (1944) and Americans Grinker and Spiegel(1943, 1945) have provided insight into World War II military psychiatry and traumatic neuroses. Their meticulous descriptive studies of selected patients were often undertaken under arduous conditions. These case descriptions serve to highlight the association of symptoms with the trauma of combat and provide further evidence of PTSD in men with states of fear and hyperarousal who repeatedly suffered the terror of re-experiencing traumatic events. Case records of neuropsychiatric casualties also document the alteration of symptoms across wars with conversion hysteria common in troops of World War I while frank fear and anxiety reactions were more prominent in World War II and later conflicts. Weisæth and Eitinger (1993) suggest the varied symptom expression has been contributed to by the level of education, understanding of stressors and the acceptance of stress reactions by the military organization and by general society.

At the end of World War II, the U.S. Surgeon General released a revised nomenclature system for psychological effects seen in the military arena. The central feature was the addition of two new diagnostic categories: transient personality reactions and immaturity reactions. The first included "all emotional reaction to acute and special stress under "combat exhaustion", or "acute situational maladjustments". While neurotic-type reactions to routine military stress were classified within the second category (Gabriel, 1986, p 48). These diagnoses focussed on the temporary nature of conditions and the character predisposition of some troops.

During the Korean War, Australian and American forces used the term combat exhaustion to differentiate the psychological from the physical effects of stress and this was later referred to as combat fatigue to better suggest a temporary and reversible condition. Other terms used during this period by United States military forces included operational fatigue and combat reaction, however, such casualties were referred to as psychiatric or neuropsychiatric casualties rather than continuing the connotations of physical disorder. Veterans with psychiatric disability as a result of combat were classified predominantly as having traumatic war neurosis, combat neurosis or gross stress reaction. The lack of unifying clinical or diagnostic framework for the consideration of these and similar conditions did not assist popular or professional understanding of these disorders.

DMS-1

The first general formalized criteria for the diagnosis of trauma-based disorders appeared with the publication of the standardized diagnostic psychiatric textbook, the Diagnostic and Statistical Manual (DSM — 1) from the American Psychiatric Association (APA) in 1952. The experience of clinicians in World War II and in the Korean war was utilized to develop its diagnostic nomenclature (Gabriel, 1986). Acute reactions to stress were recognized in the term gross stress reaction and longer lasting reactions were also described. These disorders were considered as transient situational personality disorders and traumatic "neuroses". The chronic disorders were framed within the then popular Freudian construct of unresolved conflict or experience in early life rather than actual traumatic exposures. However, the description did serve to focus interest on the subject and to acknowledge the psychological sequelae of trauma rather than considering symptoms as either organic disease or conduct disorders, as had largely been the case in earlier years. A category called gross stress reaction with similar definition was present in the International Classification of Diseases (ICD) and by the 1960s the diagnosis had achieved research support and international recognition (Archibald et al, 1962). Kolb (1968) considered the definition of gross stress reaction unsatisfactory as the accumulation of evidence from studies on war veterans and concentration

camp survivors supported inclusion of chronic as well as acute psychiatric disruption under this mantle.

The Vietnam War

Australian and American forces involved in the Vietnam War continued to employ terms for acute psychological dysfunction which carried an expectation of recovery and which acknowledged that the conditions were normal reactions to abnormal situations such as combat fatigue (Bloch, 1969; Bourne, 1970). It was recognized that troop service and involvement in this conflict was different to that of earlier wars. Some authors referred to the World Wars as "high intensity" while the Korean and Vietnam wars were categorized as "low intensity". Rather than episodes of intense and prolonged combat stress, "the stress came in short bursts interspersed by periods of rest, boredom and the build up of fear prior to going on another patrol" (Wardlaw, 1988, p 8).

Many clinicians and administrators did not recognize the classic combat fatigue in such a different combat situation. Boman (1982) describes a diagnostic dichotomy between these psychiatric casualties experiencing extremes of battle stress and a quick response to therapy who were classified as having combat fatigue and those exposed to lesser stress, who may have had a lesser response to therapy and who were considered to have an inherent predisposition and character or conduct disorder. The impact of such judgemental categorizations is interesting as the incidence of reported traumatic combat reactions during the Vietnam War appears to have been affected by the psychiatric opinion and nomenclature of the era, as well as the actual combat conditions.

DMS-II

In 1968 the second edition of the American Psychiatric Association — Diagnostic and Statistical Manual re-examined its earlier definition of post traumatic syndromes and put forward new diagnostic labels of either "transient situational disturbance" or "adjustment reaction". The chronicity of many of the cases appears to have been given little recognition at that time. That such changes should occur during the Vietnam War serve to reinforce a clinical focus on organic predisposition rather than on traumatic or environmental factors. Certainly research into the post traumatic psychological dysfunction experienced by troops in Vietnam was initially limited and revolved about the low rates of diagnosed psychiatric casualty and the success of preventative measures for such disorders.

During the 1970s mounting public concern regarding "Post Vietnam Syndrome" was experienced and was fiercely debated in both clinical and lay spheres. While the predominant movement was in the United States, Australian concern paralleled that of the larger American group. The subsequent interest in post Vietnam psychiatric disorders has had an enormous individual, social and political impact.

DMS-III

The third edition of the DSM in 1980 recognized the existence of a definitive post-traumatic syndrome which differed from the DSM — 1 definition of gross stress reaction and from the ICD — 9 categories. While traumatic events may precipitate a range of psychological reactions and psychiatric disorders the condition Post Traumatic Stress Disorder (PTSD) was identified as a major diagnostic entity within the anxiety disorders and acute and chronic symptoms are recognized. Primary and associated symptom features were outlined in some detail (DSM -III and DSM -IIIR).

Subsequently, some debate relating to the diagnosis itself has continued, regarding issues including its existence as a separate entity rather than a subset of other major syndromes such as major depression (Goodwin and Guze, 1984). Such debate has served to fuel behavioural and assessment-based studies supportive of the distinctive symptomatology of PTSD (Wolfe and Keane; 1991). Other authors have highlighted the continuum of psychiatric symptomatology and the evidence of acute and chronic disorders through the military conflicts of this century (Trimble, 1985) to demonstrate that shell shock, combat exhaustion, combat neurosis and PTSD are different terms reflecting aspects of the same principal disorder.

Conclusion

There is little doubt that the twentieth century has seen the evolution of the entity of Post Traumatic Stress Disorder particularly in the arena of mili-

tary conflict. The current diagnostic criteria for the disorder are from the DSM — IV (1994). Though a wide range of terminology has been used to describe the acute and chronic psychopathology which develops as a reaction to the extreme stress of combat, similarities exist to support the premise that they represent different views of some similar basic disorder. Differences in expression of symptomatology may be mediated by environmental, cultural, social and personal factors including education, understanding and expectation.

Table 1. Symptom clusters seen in the World Wars and in the Vietnam War (American forces) (From Jones, 1986, p.186)

SYMPTOMS	WWI	WWII	VIETNAM
Depressed Affect	X		
Fear	X		
Noise Sensitivity	X		
Tremors	X		
Psychomotor Disturbance	X		
Conversion Reaction	X	X	
Confusion	X		
Dissociative States	X		
Anxiety		X	
Nightmares		X	
Exhaustion / Fatigue		X	
Diminished Appetite		X	
Gastro Intestinal Symptoms		X	
Headaches		X	
Constructed Affect			X
Social Estrangement			X
Discipline Problems			X
Explosive Behaviour			X
Drug Abuse			X

Jones (1985) suggests that the "high intensity" highly lethal continuous combat seen in the conventional battles of World War I were associated with physical manifestations of disease such as "classical" exhaustion. The "low intensity" conflict epitomized by intermittent military action in an inhospitable environment such as Vietnam was associated with symptoms of social and behavioural dysfunction. These symptoms represented a reaction to the stimuli of the war experience but were modified by a range of factors, expanded in the following material.

World War I (1914–1918)

Australia's Involvement in the Great War

At the commencement of World War I the population of Australia numbered four million. During the course of the War more than 10% of the wartime population, that is, 400,000 Australians, were recruited. A total of 331,781 embarked to serve as soldiers in the Australian Imperial Forces in Gallipoli, the Middle East and in Europe. This war extracted a high cost in Australian casualties with more than 60,000 deaths and 113,370 returned men classified unfit (Butler, 1943). The combat of this war was characterized by trench warfare and long sustained battles of attrition. Stressors were danger, death, fatigue, disease, artillery fire, high explosives and the threat of chemical warfare.

Introduction

An examination of the literature relating to the psychiatric casualties of this military conflict reveals a remarkable and colourful variation in the case description, nature and incidence of psychiatric illness as well as in theories of causation. Case descriptions (Mott, 1916; Eder, 1919) support the view that many post combat neuropsychiatric casualties experienced symptoms which now would be classified as consistent with acute or chronic PTSD (Trimble, 1985).

Before World War One neuropsychiatric casualties resulting from war were seen as weak and lacking in discipline. A. G. Butler (1943) records the "mental and moral" disorders of war in "The Official History of the Australian Army Medical Services 1914–1918" noting that "... psychological medicine has suffered from the curse of Babel ..." and that still in the early twentieth century it was held that "insanity (was) a disease of conduct not of intellect". From this point of view psychological dysfunction was recognized within the "conduct disorders of war" and divided into three broad groups.

1. Delinquent conduct — brought about by the wilful disregard of social rules.
2. The psychoneuroses — where the patient is to a greater or lesser extent aware of his condition.
3. The psychoses — in which the patient is not aware of his state, and in which the conduct disorder (requires) compulsory segregation.

(Adapted from Butler, 1943 pp 57–58)

There existed a significant overlap between the outlined groups, and Butler noted that "the ques-

tion whether a soldier be shot at dawn as a military criminal or discharged as a battle casualty with a wound stripe and a war pension was determined by the opinion of a medical officer as to which type of this clinical overlap the soldier's behaviour should consign him." This was indeed possible in the British forces of World War I. Of the 3,080 men of the British Forces condemned to death at court martial, 346 or 11.2% were shot for offences including desertion, cowardice, quitting post, sleeping on post and casting away arms. Certainly some proportion of these men would have suffered battle-related shock or nervous exhaustion which contributed to their "offences" Under the Australian Defence Act, the death sentence could only be passed for limited and heinous crimes, and then had to be confirmed by the Governor General. No soldier of the Australian forces was executed during the whole of World War One (Babington, 1983).

Shell Shock

World War I saw the birth of the entity termed shell shock as an explanation for the symptoms of nervous disturbance seen in men after combat. The "shell shocked" serviceman displayed one or more of the following: paralysis, pseudoconfusion blindness, hypochondriasis, phobic or anxiety symptoms, freezing, running amok, irritability, depression, somatic symptoms, restlessness, insomnia, nightmares, or repetitive battle dreams (Grinker and Spiegel, 1945; Glass, 1969). The term was used to cover a range of conditions including exhaustion, anxiety and phobic states occurring after an event. The symptom complex experienced by some holds marked similarity to the current description of PTSD. The history of this condition exemplifies the difficulties of epidemiology in the psychological sphere, as confusion in terminology and imprecise description of symptomatology provide poor case definition. This extended to the division between normal and abnormal reactions to combat stress (Butler, 1943).

Many clinicians in 1914 and 1915 recognized shell shock as a pure neurosis or rarely, psychosis (Editorial, MJA, 1919). Myers (1915) pointed to the close relationship of cases to those of hysteria and Culpin and Fearnsides (1915) refer to cases as functional and mental nervous disorders. Mott (1916) reported that "in a certain proportion ... the cumulative effects of stress of active service, combined with repeated and prolonged exposure to shell fire or high explosive projectiles, apparently had induced a neurasthenic or hysteric condition in the nervous system of a potentially sound individual". By mid 1916, the ferocity of war and the flood of casualties impacted on clinical thought and a more physical cause was often ascribed.

By June 1916 the Australian Army Medical Service was using (as was the British Expeditionary Forces) a formal classification of cases of shell shock as follows:

— Suffering from shock, shell
— Suffering from concussion, shell
— Suffering from burns

with a designation of (W) wound for cases secondary to battle and (S) sickness for cases due to accidents other than battle.

The name shell shock derived from the popular consideration that the brain was shocked by repeated exposure to high explosives and that the symptoms were evidence of neurological impairment. Possible organic causes for the behaviour were sought and theories included cerebral microvascular change, carbon monoxide poisoning or molecular change in the nervous system as possible aetiologic factors (Mott, 1919). Authors of the French school of Neurology including Roussy, Brisseau, d'Oelsnitz and Lhermitte distinguished the "etats commotionnels" or physical changes of the central nervous system, from "etats emotionnels" where emotion was the causative factor (Leri,1919).

British observations after World War I in the "Report of the War Office Committee of Enquiry into Shell Shock" (Holmes, 1922); described five primary syndromes which had been attributed to shell shock, these being fatigue, exhaustion and confusion, conversion hysteria, anxiety states and obsessional states. It was recognized that both environmental and psychogenic factors contributed to the development of the condition, these including:

— new or fresh troops
— prolonged unbroken trench warfare
— volunteers with short training periods

— occurrence after rather than during severe military operations
— frontline "technicians" including gunners, engineers and artillery and tank corps, were most at risk.

The term shell shock was used to cover a polymorphous group of symptoms and disorders encompassing some normal and some pathological reactions. The pathological reactions demonstrate a similarity to the current concept of PTSD regarding both symptomatology and disease determinants. The experience of psychological casualties occurring in an epidemic pattern and the effects of trauma as well as mass suggestion were considered by all Allied Forces. From these experiences later clinical and administrative management principles were developed. Many of these were more related to military requirements than to individual needs.

Disordered Action of the Heart

The British Expeditionary Forces evacuated 80,000 troops to England over the course of the war for the condition labelled disordered action of the heart (DAH) or effort syndrome. Men with prominent cardiac symptoms, including shortness of breath and palpitations on limited exertion in the absence of organic pathology, received this diagnosis.

DAH was the second only to shell shock as a neuropsychiatric cause of admission for members of the AIF to Expeditionary Base Hospitals on the Western Front. It is not however, prominent in the history and records of the AIF (Butler, 1943) perhaps because of a concentration of interest in the "novelty" of shell shock. Records of the Australian Army Medical Service indicate the condition featured in Gallipoli and 287 cases were evacuated during the nine months of the campaign, a rate of 13.2 per 1000 per year mean troop strength. The comparative rate of admission to Expeditionary Base Hospitals on the Western Front was 8.6 per 1000 per year for this disorder. The variation for these rates may be due to diagnostic or recording differences, or may have been contributed to by the conditions of life at Gallipoli and the role of physical privation in the troops. Colonel Purves-Stewart recording in September 1915 that "... 77% of the men in firing trenches were emaciated and anaemic ... 50% (had) tachycardia and 74% (were) short of breath ... " (Bean, Volume 1, 1936, p352). Evidence from other conflicts supports the role of environmental impact upon the expression of symptoms.

Psychiatric casualties

Overall, the results from Australian troop data demonstrate the average annual rate of admission to Expeditionary Base Hospitals for psychophysical factors was 65.78 per 1000 troop strength per year (Butler, 1943). Of medical causes for admission this was second only to primary infections and infestations.

Five percent of medical evacuations of Australian troops to the United Kingdom were on the grounds of psychophysical conditions. By 1931, over 18% of the Australian veterans of World War I with a disability pension had at least one accepted psychiatric disability. These were predominantly in the neurotic and psychoneurotic spectrum though a wide range of arbitrary diagnostic labels were utilized ("K card review", 1931 in Butler, 1943). No figures are available regarding rejected claims or those who made no claim against the government for their illness. O'Keefe (1993) found much anecdotal evidence that Australian veterans suffered chronic war related psychiatric dysfunction. This was supported by a study of reported suicides from 1914 to 1937 (McKernan, 1945), showing veterans rates were higher than non veterans of the same age, while the suicide rate increased in both groups with age. This disparity between them also rose with age and period since discharge, such that by the mid 1930s veterans over fifty years of age had up to three times the suicide rate of their age matched peers.

The low incidence of "organized mental disease" found in the official statistics is consistent with descriptive findings that the prevalence of troop psychoses was similar to that of civilian practice (Campbell, 1916; Adey, 1919).

By 1918, 850 men had been invalided to Australia on these grounds. A number of psychotic cases were recognized under Repatriation legislation and by 1924 there were 341 "mental cases under restraint", a figure which remained relatively stable over the ensuing twenty years.

The rates of casualty for neuropsychiatric dis-

ease during the war varied between the Allies. The American experience suggested a low initial casualty rate but the post war problems attributed to service were extensive. The American Expeditionary Force reported a rate of 9.5 per 1000 casualties. This remarkably low rate has been attributed to the short period of active service and attempts to eliminate potential neurotic cases prior to service overseas (Miller, 1940). However, examination of disability pension provision indicates that by 1931, 45% of pensions for disabled veterans were cases of neuropsychiatric disorder related by legislation, if not by fact, to military service (Lorenz, 1931).

The British situation was somewhat different. In March 1939 there were still 120,000 men receiving pension for primary neuropsychiatric disability (including neurasthenia, shell shock, effort syndrome, epilepsy and insanity). Neurasthenia accounted for almost 100,000 pensions and represented two percent of total troops and 15% of all pensioned disabilities (Ahrenfeldt, 1958).

Conclusion

World War I was a war of attrition and the weapons utilized, both physical and chemical, and the conditions of trench warfare extracted a high cost in mortality (one in five Australian men serving overseas did not return), and in residual disability. While the dimensions of the psychological legacy of this war may have been inexact and couched under a wide range of descriptive terms, they were significant. The stresses of war service were compounded by the immaturity of psychological medicine and administrative mismanagement. The effects of mass suggestion early in World War I may have contributed to the legitimacy of the diagnosis of shell shock. Even so, it is important not to overstate the extent of the problem in the AIF, where skin infestations were responsible for twice as many evacuations from the Western front as were acute psychological disturbances.

The prevailing theories of causation for the psychological reactions to war related to predisposition, through inborn psychological or biological inferiority, or sensitization to emotional disturbance (Campbell,1916; Roussy, 1918; Forsyth, 1915). The existence of neurotic symptoms in civilian life increased the risk of war related neuroses, though some authorities considered that obsessionals and certain types of psychopathic personality did well as soldiers (Miller, 1940).

Other theories focussed on the role of environmental factors such as the form of battle, food, and sleep and those contributing to physical and mental exhaustion, often again in "predisposed" individuals. The severe reactions to combat seen in the entity of shell shock were, for a time, postulated to be organic in nature and related to microvascular or microscopic changes within the nervous system. As the belief in theories relating to anatomical lesions declined, the consideration of primary and secondary gain from illness became prominent.

Much contemporary literature focussed on the importance of predisposition to psychological breakdown. Observations and descriptive work during and after the war suggested that contributory factors to psychological reactions were often environmental among those experiencing prolonged unbroken trench life and severe military operations, and specific groups, including frontline technicians suffering higher rates of disorder (Russel, 1919). Other factors associated with an elevated rate of acute combat reaction included men over forty (especially if married) fresh troops and or rapidly trained volunteers (Holmes, 1922).

All nations recorded chronic neuropsychiatric casualties, and of the Australian experience, Butler (1943) states, "since the war the incidence of moral and mental disorders has, in its total influence achieved almost a 3:1 predominance over all other types" (p831). Each country assimilated its own lessons of the great war and these affected the development of psychological screening and management during involvement in subsequent conflicts.

World War II, Korea and Malaya

Australia's Involvement in World War II 1939–1945

By 1939 Australia's population had grown to 7 million. Involvement in this war saw enormous community commitment and support with almost one million people in uniform, 40% of whom served overseas in the Middle East, Europe and in the Pacific. By the war's end deaths from battle and non-battle casualties numbered 45,000 Australians (Australian War Memorial Archives).

While the combat in Europe was predominantly on traditional lines much of the military action in the Pacific was jungle or guerilla warfare, with very different requirements and stresses. Involvement in Africa and the Middle East saw both traditional military confrontation and desert warfare.

World War II saw significant numbers of Australian Prisoners of War (POWs) for the first time in a military conflict. 22,000 Australians were interred in South East Asia and a further 8,000 in Europe. Of those interred in South East Asia, 8,000 died while in captivity, constituting 18% of the total Australian deaths of World War II.

Psychiatry at the Commencement of World War II

At this time civilian psychiatry in Australia had progressed from its base of institutional incarceration — in no small part due to the pressure of World War I veteran management and treatment requirements for nonpsychotic mental illness (Garton, 1988), providing sparse community psychiatric outpatient facilities. The range of psychiatric therapies had extended to psychotherapy, psychoanalysis and physical methods including prolonged narcosis, electroconvulsive therapy and insulin coma therapy (Walker, 1952; Hurst and Nettle, 1962).

The predominant theory relating to the causation of psychiatric casualties of war was still that of predisposition due to inherited traits or "bad training in early life" (Ellery, 1945, p. 62) with precipitating factors in war including adjustment problems, fear, fatigue and trauma. While it was accepted that most could succumb in the face of sufficient stress it was held that usually "those who develop anxiety neurosis are ... a lazy, idle, poor type accustomed to sliding out of difficulties" (Inspector General Medical Services Report, 1941, Appendix III, pI).

Neuropsychiatric Screening and Casualty Rates

The American Forces, as in World War I, placed considerable import upon enlistment screening to eliminate those who had a predisposition or "susceptibility" to mental breakdown and also emphasised the role of neuropsychiatry in the military arena. Much of the support for these methods stemmed from the experience of World War I, though the "lessons" were selectively applied. Glass (1966) provides an extensive review of the process. He remarks on the enthusiasm for and reliance on screening as "a logical extension of their (American Army) denial or failure to appreciate the magnitude of the psychiatric problem in war" (p. 743). While the Australian Armed Forces saw benefit in the application of some initial screening (Inspector General of Medical Services Report, 1941), the manpower and resources required were not available for more than limited psychiatric history and examination (Youngman, 1942). British Forces also applied a less rigorous screening process for entry into the Armed Forces.

Australian Forces

Australian figures indicate that of the 1,762,779 recruits examined during 1939–1945, 19,500 (1.1% of the total examined and 6% of total rejections) were rejected at enlistment to the Army for mental or nervous disorders. However, as in World War I, there was also a substantial rate of greater than 15% of rejections for reasons unstated. There were 64,471 cases hospitalized (excluding those of the 8th Australian Division), and 24,562 discharged unfit for this reason from the Australian Army during the war. Nervous and mental conditions comprised 4.2% of total hospitalizations and 27% of medical discharges during this War. (Australian War Memorial, Archives).

Comparison of screening and casualty rates

Though the screening process and rejection rates for neuropsychiatric disorders varied almost fivefold amongst the American, British and Australian Forces, the neuropsychiatric casualties represented one quarter to one third of medical discharges from each. Neuropsychiatric disorder was a problem of some magnitude for the troop strength of each army. Screening recruits by the various methods utilized was limited in effect and in ability to determine those at risk of acute reaction during active military service. All forces found that casualties were increased at times of intense combat and that overall rates paralleled those for physical casualties. The greatest predictor of psychiatric casualty in any force was the exposure to combat.

As well, there are cases not reflected in the official casualty rates of any war or forces, includ-

ing those with ill-defined physical complaints, some minor or exaggerated injuries, those who sought behavioural escape in absconding (AWOL), or through self-inflicted wounds, or self inflicted disease such as a failure to take antimalarials, and finally deaths resulting from men unable or unwilling to defend themselves due to mental incapacity.

The Australian Experience

Of published Australian descriptive studies during World War II (Love, 1942; Fitts, 1944; Youngman, 1942; Cooper and Sinclair, 1943; Sinclair, 1943, 1944), work by A.J.M. Sinclair provides an illuminating insight into Australian psychiatric casualties of the period. These comprise:

1. a descriptive study of the first 207 men admitted to war neurosis inpatient clinic in Tobruk from May to September, 1941 (Cooper and Sinclair, 1943);
2. a similar descriptive study of 310 casualties seen September 1942 to January 1943 in a Base hospital setting near Port Moresby (Sinclair 1943);
3. his experience at a convalescent depot in Palestine; and in
4. a Base Hospital in South Australia.

Together, these form the basis of observations presented in "Psychiatric Aspects of the Present War" (Sinclair, 1944) which is a descriptive survey of 1000 Australian psychiatric casualties. This body of work provides observations from varied arenas, but without the usual interobserver differences which normally accompany such disparate descriptive reports.

Anxiety and fear states predominated in the acute combat settings. Precombat psychological abnormalities were found in 20% and pre-enlistment abnormalities in 10% of the acute casualties. Rates of recovery differed between the centres. The most successful being 80% return to unit in Tobruk, compared to New Guinea where 85% returned to work (48% Class A return to unit, 36% Class B), and 15% were evacuated to Australia. In Palestine there was a 20% return to unit on discharge from the convalescent depot. In all settings longer periods of hospitalization were associated with more chronic pathology and less likelihood of return to combat. The disparity between the two acute units is unlikely to be due to differences between the troops themselves, but may be due to different combat demands, conditions and morale, though no firm conclusions may be drawn.

There were marked variations in presentation between different troops, particularly relating to cardiac symptoms and effort syndrome. The proportion of psychiatric cases with this complaint was 20% in New Guinea, 12% in Palestine, 8% in Australia and 5% in the siege of Tobruk. This may have been due to the different forms of warfare and particularly the environmental conditions and terrain experienced in New Guinea. As with the Gallipoli Campaign of World War I, the arduous conditions and often intense physical exertion required to traverse inhospitable terrain may have provided a physical, cardiac or respiratory focus for psychological symptoms.

Sinclair found the same incidence of acute illness in enlisted men and conscripts. Anxiety states were more frequent in older men, while the younger troops experienced hysteria and fear states. In all but a few men, fear reaction was secondary to heavy fighting and young fit men were more commonly in combat frontline with older men in the support arena, which may contribute to observed age differences. Two thirds of the patients from the Pacific theatre reported no direct combat exposure, highlighting the importance of accessibility to services as well as the military fitness of the casualties and the size of contributing pools of men. Others (Walker, Volume 2, 1952) found that the nervous disorders were uncommon in men during the arduous periods, including the Owen Stanley campaign, as the intercurrent problems of physical environment, temperature, disease, including dysentery, malaria and infestations intervened.

Different stimuli of combat and conditions existed in the Middle East and in New Guinea (Sinclair, 1944). New Guinea was seen as a struggle of individuals in inhospitable jungle conditions which differed from the predominant unit or classical warfare of other theatres. The varied incidence rates for effort syndrome have exemplified this and parallels those described in World War I for disordered action of the heart. The Island campaigns also saw a variant form of psychosomatic disorder referred to as "tropical fatigue" or "tropical neuraesthenia", with decreased energy and ap-

petite and which had both physical and psychological components.

Sinclair (1944) found that as well as the obvious gross phenomena of combat, a number of other factors impacted on men's psyche in the military. These included the changed society, boredom, increased physical and decreased intellectual demands and the importance of individual adaptability and morale. He noted that despite the many stresses experienced during service, "neurotic illness is found to affect less than 5% of the army population" (Sinclair, 1944, p502) though recognizing that men may escape diagnosis of neurotic symptoms through medical treatment for psychosomatic illness, or they may carry on without seeking any acute medical attention.

The longer time spent in inpatient care the more likely men were to give a history of pre-enlistment psychological problems. Ten percent of those from the Tobruk sample compared with 40% from the convalescent unit gave such a history. This may have been associated with recall bias, secondary gain, or the altered selection of patients, such that those with a previous history had a higher risk of serious psychiatric disorder. The rate of return to unit decreased with pre-enlistment history of psychiatric disorder but increase in such history with increasing length of treatment may again be a confounding factor.

An analysis of Sinclair's work suggests that combat exposure precipitated normal as well as significant psychopathological reactions amongst Australian troops. A number of conditions were described in forward and support troops. In those exposed to combat the stress related disorders predominated. Acutely these were described as fear or exhaustion states. Some cases with more persistent symptoms mirror the descriptions presently used for Post Traumatic Stress Disorder.

Lessons Regarding the Determinants of the War Neuroses

American clinicians Grinker and Spiegel (1943) recorded their experiences in a detailed descriptive study "War Neuroses in Northern Africa — The Tunisian Campaign" examining psychiatric casualties from January to May 1943 at the Psychiatric Base Hospital in Algiers. They described a range of syndromes including: free floating anxiety, somatic regression, psychosomatic visceral disturbances, conversion symptoms, depression, exhaustion states, neuroses complicating concussion, fatigue, psychoses, and finally malingering.

They and Sinclair (1944) noted that there was significant variability in the presentation of cases seen at different stages within the chain of the evaluation system. The symptomatology of men seen at Clearing Stations, Forward Evacuation Hospitals, Base Hospitals and Convalescent Depots was in no way consistent and few wider conclusions regarding disease incidence, types of syndromes and the predisposing factors and recovery rates were made. In this and later work (Grinker and Spiegel, 1945) they saw possible determinants of the disorders as including:

1. personal — constitutional background, previous nervous stability;
2. sociological — how the society at large views warfare, national morale;
3. physical — sleep, water, food, heavy battle; and
4. psychological factors.

While constitutional factors were seen as important, Grinker and Spiegel suggested that such factors had been given undue weight in the past and "the realities of war, including the nature of army 'society' and traumatic stimuli, cooperate to produce a potential war neurosis in every soldier" (Grinker and Spiegel, 1943, p131). This stance, while opposing the standard model which held the primacy of predisposition, was supported by other authors at the time including Vinson (1946).

The individual outcome of these acute psychiatric casualties of combat depended on a number of interrelated factors which appear to parallel those determinants of disease, including the person's background, ego strength, capacity for understanding, the history of previous trauma and the severity of the precipitating trauma, the level of exhaustion and amount of anxiety, repressed levels of hostility and the presenting clinical syndrome (Grinker and Spiegel, 1945). The work of these and other clinicians (Glass, 1972) focussed interest on the psychiatric casualties of war and lead to more widespread interest in the post traumatic neuroses.

Findings of Wartime Experience

While the official Australian history of psychiatric casualties in World War II is limited in its narrative form (Walker, 1952) the American Official War Histories of Neuropsychiatry in World War II (Glass and Mullens, 1972; Benusucci and Glass, 1966) detail a significant body of work examining the history and effects of neuropsychiatric casualties and demonstrate the variability of psychiatric casualty rates between units and at times of intense combat. The initial reliance on screening and the use of evacuation and distant psychotheraputic treatment facilities was found to be costly in terms of acute and chronic psychiatric casualties. The experience of psychiatry in World War II holds valid lessons for future conflict. However, as demonstrated in the evolution of the psychopathology of the Vietnam War, the initial recognition of various forms of military and combat stress and of differing forms of conflict were limited.

The "lessons" of World War II psychiatry from the American Forces (Glass, 1972) included the following:

- Battle stress is the primary element of combat psychiatric disorders
- There is a direct relationship between the intensity of stress and the number of those affected
- Support and cohesion of the soldier's primary group is a major protective influence
- Psychiatric casualties increase in the new and old of a unit and the risk of psychiatric casualty increases greatly after 80 — 100 days combat experience
- It is impossible to predict which men will succumb in a given situation
- The practice of proximity, immediacy and expectancy (Salmon, 1919) in treatment of acute casualties allowed a rapid return to duty and a decreased incidence of chronic psyciatric problems.

Military psychiatry in its preventive measures saw acute mental illness as a function of the unit environment rather than of intra-individual factors.

The Australian experience supported these findings and suggested that different forms of combat such as the jungle warfare of New Guinea, with importance of individual initiative rather than the unit strength of traditional battle, precipitated different psychiatric symptoms in different subgroups of men (Sinclair, 1943, 1944).

There was a decline in support for the primary role of predisposition in the aetiology of acute and chronic psychiatric disorders of war, though this was still a prevalent belief. Also there was an increasing interest in the role of early intervention in the management of such casualties and in the importance of troop morale and of community support both within the fighting unit and the wider social environment in prevention of disorder.

Glass (1954) summarized the experience of the World Wars: "Available epidemiological data indicated that the mental illness of troops in warfare, exclusive of psychotic disorders, is more significantly related to circumstances of the combat situation than to any personality attributes or characteristics of the individuals who are exposed to battle stress. Pertinent combat circumstances include the intensity and duration of battle which can be measured by the battle casualty rate and the days of continuous action. However, of equal importance in determining the frequency of psychiatric cases are less measurable elements of battle; to wit, the degree of support given the individual by buddies, group cohesiveness and leaders. These less tangible influences explain the marked differences that may occur in combat effectiveness and the frequency of psychiatric cases among units which are exposed to the same intensity and duration of battle."

The acute psychiatric disorders of World War II, such as combat exhaustion, were viewed as a result of the kind, amount and duration of stress, superimposed on the preexisting mental state and character structure of the man, his coping mechanisms and the morale and support of his unit. Focus on the health of the unit environment as a community was found useful for preventive practice.

This recognition of the importance of the group as well as the individual appears established, but by the time of involvement in Vietnam, though preventive psychiatry viewed the group as important, the model of illness again began to center upon the individual. Behavioural disorders were blamed for conduct more related to group dysfunction and lowed morale (Boman, 1982).

Post World War Two

Other than for POW (J) survivors (covered elsewhere) there is little material relating to the range or variability of the chronic problems of Australian neuropsychiatric casualties from the perspective of subgroups of units or even different theatres of war and little contemporary prevalence data. Early in the post war period clinicians (Vinson, 1946; Holman, 1947) documented that the symptoms related to the emotional stresses of warfare and combat did not disappear with cessation of combat. Such symptoms included periods of depression or elation, irritability, dissatisfaction, physical complaints, unreasonable attitudes, sleep difficulties and problems with work.

American followup studies (Archibald, Long and Miller, 1962; and Archibald and Tuddenham, 1965) have demonstrated the chronicity of these post combat reactions and the incidence of other psychopathology including depression and substance abuse. More recently community based studies (Norquist, et al, 1988) have found the overall prevalence of psychiatric illness to be similar in veterans of World War II and age matched community controls, though depression and substance abuse were still in evidence, and significant numbers of veterans were otherwise undiagnosed and untreated for these conditions. While such studies demonstrate that the overall rate of psychiatric disorder is now similar, such broad statements do camouflage important subgroup differences, such as between combat and noncombat troops, groups shown to be significantly different in studies of Vietnam veterans (Goldberg et al, 1990).

Provision of Repatriation Pension and Treatment

During and after this war, as with World War I a number of Australian authors, critical of the provision of Repatriation pensions for mental disorders and the "problem of the pensioner", including Bostock (1941) suggested that the country should learn from the "mistakes" of the First World War and recognize the importance of treatment, rehabilitation and retraining rather than pension, for war related psychiatric dysfunction. Others such as Thom (1943) highlighted the importance of the demobilization process and government services for compensation of disabilities and the problems of inappropriate or excessive training requirements in contributing to the burden of the war neuroses.

At the end of the World War II the existing facilities for treatment of neurosis in Australia were limited. Sinclair (1946) states that the civilian public and private departments were inadequate and that the Repatriation Department had little to offer for the early treatment, supervision, hospitalization and social readjustment of neurotics or psychotics. Psychiatric units were developed in the newly established Repatriation Hospitals (in each state capital) and use was made of convalescence centres. Treatment and active rehabilitation, occupational therapy, job retraining and placement were undertaken. Long stay facilities within the grounds of established State mental facilities were also established in some states.

It is salutory to examine pensioning for war neuroses in Australia after World War II though this is not synonymous with disease prevalence. These figures represent those who have claimed and who have had accepted by the Repatriation Department a condition as being due to, or contributed to, by war service. As was seen in the K-card review of 1931 (Butler, 1943), there was a progressive increase in disability pensions for psychiatric disorders after war service.

"The Report of the Medical Advisory Committee in Treatment of Neurosis (6/3/1946)" (Repatriation Commission Collection) gives pension statistics to 31/12/45 for neurosis, psychoneurosis and mental disorders: 12,194 men and 117 women had been accepted as having such a condition due to service; 10,662 men and 592 women had had such claims rejected; 53% of men and 16.5% of women who claimed, had a psychiatric condition accepted as due to service, the disparity being related to differences in recognition of active overseas and Australian service.

A review of the Australian Repatriation Department data for pension entitlement and treatment of psychiatric conditions was undertaken in 1961 using a 2% representative example of veterans (Hurt and Nettle, 1962). This was precipitated by mounting concern for the incidence of these disorders following World War II. Of the 235,000 Australian veterans receiving a disability pension

Table 2. Recognition of psychiatric disability as service connected 1961. United States and Australia (Appendix A, Report to the Repatriation Commission on Psychiatric Services in Australia, 1962)

Category	USA			AUSTRALIA		
	Neuroses	Psychoses	Total	Neuroses	Psychoses	Total
Compensated Veterans - psychiatric	212,329	87,192	299,521	54,360	5,625	59,985
Fully compensated	1,601	33,085	34,686	4,349	1,069	5,418
All living			22,403,000			1,033,000
All compensated veterans			1,999,531			235,000
Ratio of compensated psychiatric to all living veterans	1:105	1:257	1:75	1:19	1:184	1:17
Ratio of compensated to all compensated veterans			1:11			1:4.4
Ratio of compensated psychiatric to all compensated veterans			1:6.5			1:4

in 1961, 26% had at least one psychiatric condition recognized as due to or contributed to by war service. While this figure does not differentiate veterans from the different wars they were predominantly World War II veterans. The estimated number of living veterans at that time were 116,000 World War I veterans, 904,000 World War II veterans and 12,000 Korean veterans.

These figures indicate that Australia compared to the United States accepted as service related a higher ratio of both psychoses, with one case per 184 living veterans versus one case per 257 living veterans, and neuroses being one case per 19 living veterans versus one case per 105 living veterans. This was much different from the situation following the First World War and overall resulted in more psychiatric acceptances with 26% of veterans in receipt of a disability pension having an accepted disability of some psychiatric disorder versus 15% for the United States. These differences reflect numbers claiming the conditions, the standards of proof and legislative policy which varied between the wars as well as case definition and the actual occurrence of disorder. They indicate at least an administrative recognition of the psychiatric effects of service. Whether there exists any inherent difference in individual, combat and military characteristics is uncertain.

No material analogous to the 1962 review is available for current beneficiaries. The percentage of new claims for psychiatric illness secondary to World War II military service has represented approximately ten percent of total yearly disability claims (estimated in 1951, 1961, 1971, 1981) and has only experienced a relative decline through the 1980's, to 5% in 1991 as claims for smoking related and degenerative disorders predominate (Figures derived from the Benefits Program, DVA, 1992). Of approximately 12,000 new disability claims finalized for World war II veterans in the year June 1991–June 1992 five percent or 600 were for psychiatric disorders. The acceptance rate for such claims was 45% (1992 DVA Benefits Program figures). While many factors impact upon these figures (financial, legislative and social) the fact that acceptance rates for new claims four decades after service still approach 50% acknowledges the chronicity of many of these psychological disorders, and the cumulative impact of life events including other traumas, aging and retirement.

While significant lessons in combat psychiatry were learnt from the experiences of World War II (Glass, 1954; Glass, 1972) the costs in life, physical and mental casualty were great. All forces suffered acute casualties many of these resulting from combat or military stress. These acute casualties had varied presentation and symptom com-

plexes, the most readily recognized being combat fatigue or exhaustion but cases of anxiety neurosis, hysteria and confusional, even psychotic states were also described.

Chronic psychiatric illness, as recognized by Repatriation claims for pension and treatment, was prevalent amongst Returned Servicemen. Australian records indicate that by 1961, 6% of all living veterans or 26% of those in receipt of Disability Pensions had a psychiatric condition as an accepted disability.

The Bridge to Korea

After World War II the changing political structures and the polarization of the East and West power blocks impacted upon the Australian psyche and flavoured our involvement in later conflicts. The strengthened Pacific alliance and also the ANZUS treaty (1951) drew Australia into the Korean War as allies of the Americans against the Communist threat; as was the case of our later engagement in Vietnam. These later wars did not enjoy the enormous popular commitment of earlier conflicts such as World War II. They have, however, had significant social, cultural and political impact upon the fibre of Australia as well as the more obvious impact upon those who served in these conflicts.

Korea and Malaya

Between August 1950 and July 1953, 10,600 Australian Army and a further 4,500 Navy personnel served in Korea. Records indicate a total of 339 fatal (or MIA) and 1,216 non-fatal casualties (Australian War Memorial Archives). Australian participation in the Malayan Conflict (1948–60 and 1964–65) involved a total of some 7,000 troops and records indicate 28 deaths and 109 casualties across this period (there were 26 battle casualties and 83 non battle casualties) (Australian War Memorial Archives).

There are few Australian references to psychiatric disorders or casualties during our involvement in the Korean and Malayan conflicts. Also the "Official History of the Australian Army Medical Services in Korea" Volume II (O'Neill, 1985) notes that the RAAF files were destroyed and the RAN files were very poor, further limiting source material.

Australia's participation in the Korean conflict was significantly different from that of the earlier World Wars and has been described, with Vietnam, as "low intensity" (Gabriel, 1986; Wardlaw, 1988), because of the different nature of the campaign, the sporadic fighting and also the implementation of the policy that no soldier should be required to serve more than twelve months on active duty.

Published medical comment relating to Australia's involvement is limited to descriptive general discussions of medical care and evacuations for battle and non-battle casualties (Cantlie, 1952; Latta, 1957; Harsan, Brown and Ingham, 1953). The Official Histories provide limited comment relating to the psychological problems of war and their relationship with levels of morale. "During lulls in the fighting, psychological problems — the effects of cold weather and snow, boredom and homesickness and the feeling that the troops had been forgotten by the Australian people — increased." (O'Neill, 1985, p575). Some disorders were attributed to combat as in the winter of 1951, after heavy enemy shelling, more than 40 cases of shell shock and battle fatigue were diagnosed and treated. While in May 1953 it was noted that there was an increase in men attending sick parade and that this was due to symptoms of headache and dyspepsia of psychosomatic origins. The Divisional psychiatrist attributed the problems to inadequate physical and psychological screening of troops and men with "immature and undisciplined personalities". Obviously, this is an opinion which placed more importance on predisposition than on environmental factors associated with this conflict. It is one which was common through records of the Vietnam war.

The Americans applied the lessons learnt in World War II with preventive measures and early and proximate treatment for psychiatric casualties. Their experience in Korea saw a decline in evacuation of psychiatric casualties from 23% of all medical evacuations in World War II to 10% during the Korean war (Gabriel, 1986). This was attributed to the troop rotation policy (similar to the Australians), the forward location of mental health professionals, and where necessary the availability of air medical evacuation. The re-

ported success of these policies saw them repeated with zeal in the Vietnam war.

Conclusion

World War II was fought primarily on traditional lines, though guerilla, jungle and desert warfare were also experienced. For the first time Australia witnessed war at close hand and this engendered enormous public commitment and support.

The Australian, American and British Forces all recognized the importance of limiting neuropsychiatric casualty rates for the maintenance of troop strength, though they approached the problem in differing ways. Early in their involvement the Americans favoured intensive initial screening procedures and management of neuropsychiatric casualties by removal of troops and distant psychotheraputic treatment. The British and Australian Forces undertook less rigorous screening processes and the British, after their experience of troop losses in World War I, maintained a firm approach to casualties, attempting to minimize secondary gain by limiting attached benefits from discharge. Australian Forces saw acute management along British lines with general care at proximate Field Stations. Psychiatric consultation was usually limited to Hospital settings and used for only a subset of acute casualties. The experiences of this War demonstrated the limited value of screening as applied by the United States Forces and established the benefit of proximity, immediacy and expectancy in the management of neuropsychiatric casualties to minimize acute troop losses.

Neuropsychiatric casualty figures reflect a wide range of disorders and while analysis is limited by uncertain case definition; description and figures do support the occurrence of acute and chronic psychiatric disorders related to combat experience. The symptoms lie within the anxiety spectrum and often were acutely referred to as fear or exhaustion states. Chronic disorders recognized post-war bear symptom descriptions which demonstrate pervasive psychological and social dysfunction consistent with current concepts of Post Traumatic Stress Disorder.

Australia recognized service and combat related psychiatric disorder through its Repatriation Department Disability Pension and treatment services. The nomenclature used to refer to such disorders often an arbitrary mixture of labels related to either symptoms, specific events or to more conventional psychiatric diagnosis. The Repatriation Hospital system developed after this war provided acute psychiatric and rehabilitation facilities. Provision was also made for long term psychiatric care in units attached to analogous State institutions. By 1962, 6% of ex-servicemen had had a psychiatric disability accepted as due to service. New claims for such disability continue to occur in significant numbers.

Theories on the causation of psychiatric disorder moved from those based on organic and predisposing factors and toward recognition of the primary trauma of the conflict and combat and also the importance environmental and social support factors. The realization that troops had limited endurance to battle exposures and the importance of morale, a sense of community and preventive psychiatry were also lessons from this conflict.

Involvement in the Korean War saw the practical application of a number of these lessons. The introduction of twelve month troop rotation, preventive psychiatry measures and a focus on community and social supports, as well as acute management using the principles of proximity, immediacy and expectancy saw a decline in the American Forces evacuation of psychiatric casualties.

The Vietnam War

Australia's Involvement in Vietnam

Australia's involvement in Vietnam commenced in July 1962 with a small team of army advisers (the Australian Army Training Team Vietnam — AATTV). In 1965 the Australian military presence increased with the introduction of combat troops. By December 1972 when troops were withdrawn 50,000 Australians had served in Vietnam. Approximately 500 lost their lives on active service with 423 killed in action and 2,398 recorded battle casualties (Australian War Memorial Archives).

Introduction

The guerilla warfare of the Vietnam War differed considerably from the traditional battlefield com-

bat of the World Wars. This War saw combat with an indigenous revolutionary army in an alien country and with an alien culture, often with uncertainty even to who represented the enemy. Also social and personal features of this war such as moral doubts regarding the justifiability of the war, the relative youth of combatants, and the relative lack of commitment and antipathy of many at home all impacted upon the psychological casualties of this conflict.

Australia's continued involvement in this War was seen as politically questionable by many and engendered social unrest particularly in the later stages of the War. Several features of service itself including the rotation of troops and nature of the guerilla combat, as well as the return from an unpopular and unwinnable war have impacted upon those who served in this conflict. This section provides a discussion on the incidence of psychiatric casualties and some background on Australian and American servicemen and the disparities between the two.

Australian Psychiatric Casualties

During the ten years of our involvement 499 Australian psychiatric casualties were evacuated from Vietnam (personal communication, 1993, Brendan O'Keefe, Official Historian, Australian War Memorial, Official History Unit) an overall a rate of 10 per 1000 troop strength per year.

There are few Australian publications from the war or early post war period which deal with the psychological impact or the psychiatric disorders of this conflict, with the notable exception of Spragg (1972). This paucity of material may have been contributed to by a number of factors including

— The availability of Australian psychiatrists on rotation in Vietnam for only two of the ten years of our involvement, from 1969 (Boman, 1982).
— Military resources committed in Vietnam were numerically much less than those of the World Wars and less opportunity existed to examine returned servicemen after their tour of duty due to the troop rotation and dispersal patterns employed.
— The expectation that the implementation of preventive measures and access to fast means of evacuation would decrease the numbers evacuated, as in Korea, and
— The public perception and widespread opposition to the war may also have contributed to silence on the psychological casualties of this War (Penk and Robinowitz, 1987).

Boman (1982) examined results of data from June 1969 to December 1970 for 410 new psychiatric referrals to the Australian psychiatric services in Vietnam. He made observations for that period from which some comparisons with the American experience in Vietnam may be drawn. The Australian psychiatric casualty rate drawn from this period was 50 per 1000 per year (Boman, 1982) and appears much greater than the overall American psychiatric casualty rate (for admission for assessment) of 14 per 1000 per year (Gabriel, 1986). This may reflect more conservative management of troops in the Australian forces or different definition of disorders and practice regarding the need for initial specialist referral or medical or disciplinary measures rather than a difference in levels of psychopathology. It may also reflect a higher rate of exposure to combat or military trauma in Australian Troops (Personal communication, 1993, Dr. Brian O'Toole, Vietnam Veteran's Health Study).

In Australians, the major symptomatic complaints were related to fear, anxiety, sleep alteration and depression. The reasons for referral are illustrated in Table 3 and the recorded diagnosis for a sample of Australian troops is given at Table 4.

Eighty percent of those who presented for psychiatric assessment were in the 18–23 year age group (Boman, 1982). This reflects the youthful age range of the troops sent to Vietnam by both Australian and American Forces. Older men presented with depression rather than the fear or anxiety disorders seen in the younger group. This was consistent with findings in World War II

Table 3. Reason for Psychiatric Referral of Australian Troops in Vietnam, 1969–1970.
(Adapted from Boman, 1982)

Reason for referral	Percent
Assessment regarding effectiveness	56%
Behavioural problems	23%
Functional aspect of a physical complaint	16%
Other	11%

Table 4. The recorded psychiatric diagnoses from a sample of 410 Australian troops referred for assessment in Vietnam 1969–1970. (From Boman, 1982, p 114)

Diagnosis	Percent
Psychoneurosis	23.5%
Transient situational disorder	19.9%
Personality disorder	18.8%
Alcoholism	5.4%
Psychosomatic disease	4.9%
Functional psychosis	2.6%
Special symptoms	1.8%
Drug abuse	1.2%
Acute organic brain syndrome	0.8%
Sexual deviations	0.4%
No disease	20.7%

(Sinclair, 1943, 1944). The principal reasons for referral related to behaviour and troop effectiveness these accounting for 80% of psychiatric referral. The predominant diagnosis in this sample of Australian psychiatric casualties was that of psychoneurosis (Table 4). One fifth of the group had behavioural disturbances classified as personality disorders and a further one fifth had no diagnosable disease present. Fourteen percent of the psychiatric casualties gave a clear history of premorbid adjustment problems including previous psychiatric care (Boman, 1982).

Higher rates of casualties were described in support troops rather than field troops with rates of 86 and 38 per 1000 per year. While this would appear to be inversely related to the level of stress to which the groups were exposed, the finding is consistent with those of the American Forces (Bourne, 1970) and also earlier Australian studies (Fitts, 1942) and reflects accessibility to services as well as the presence of a range of psychopathology, rather than post traumatic pathology. The peak incidence of disorder in combat troops was at five months (Boman, 1982) while the support troops had a more even incidence over the twelve month period, the differing disorders and accessibility to services are again of importance.

Two thirds of those seen were Regular Army and one third were National Servicemen. This represents a significant weighting toward Regular Army personnel as the proportions serving in Vietnam were 52% and 48% respectively (Tennant et al, 1990). In the limited Australian literature relating to post Vietnam psychiatric disorder this weighting remains for poor psychological adjustment (Streimer et al, 1985, 1986) but not for the development of Post Traumatic Stress Disorder (Tennant et al, 1990). Boman (1982) and others (Tennant, et al, 1990) have commented on the possible causes for this association citing inherent preenlistment differences in enlistees to the armed services and lower level of education at entry to the service as contributory factors.

Eighteen percent of the men from this sample were evacuated from Vietnam to Australia and the diagnostic categories of the evacuees studied was similar to the larger sample examined above (Boman, 1982). Management of acute combat related psychiatric casualties in Vietnam differed from the Americans as several of the Australian psychiatrists serving in Vietnam were not enamoured of the "proximity, immediacy and expectancy regime" as applied by the American Forces (Spragg, 1980) and used brief supportive psychotherapy in preference to sleep induction with chlorpromazine. The Australian approach has been vindicated by later research, and it is now recognized that the use of antipsychotic medication has little if any role in the treatment in the treatment of acute or chronic stress reactions (Friedman, 1991).

Differences Between Australian and American Casualties in Vietnam

There are some significant differences between these results and those of the United States Forces. The most marked of these are the much lower incidence of the diagnosis of personality disorder, 18.8% versus 67% (Strange and Arthur, 1967) and the reliance on alcohol in Australian troops rather than hard drug use (Spragg, 1972). As well as issues of availability and accessibility of drugs and the presence of racial disharmony, early authors saw the application of the troop rotation policy as one which contributed to the Americans patterns of drug use, as a form of group definition and identification which had otherwise been removed (Bey and Zecchinelli, 1971; Renner, 1973; and Ingraham, 1974). While both forces utilized one year rotation of servicemen the

Australian combat troops were sent as part of a cohesive battalion, however, base area troops were rotated singly at times. The American soldiers were sent singly or in small numbers with much less opportunity to form bonds and a sense of community prior to entering the conflict (Spragg, 1992). The existence and acceptance of alcohol consumption as a "cultural icon" by Australians may have contributed to our own rates of alcohol excess and may have in this context been utilized in group identification, particularly in the support units where problems of morale were most in evidence (Boman, 1982).

The American Experience

The extraordinary disparity in rates of conduct disorder and disciplinary problems between Australian and American troops should be considered in the perspective of the experience of the American Forces in Vietnam. Official American presence in Vietnam extended from 1964 to 1973 and during that period approximately 2,796,000 troops saw service in Vietnam with 57,000 battle and nonbattle deaths being recorded (Gabriel, 1986).

Psychiatric services in the United States forces involved in the Vietnam War, when dealing with acute reactions to combat stress employed terms such as combat fatigue (Bloch, 1969; Bourne, 1970) and combat exhaustion. Based on experience gleaned from earlier wars, these terms carried an expectation of recovery and acknowledged that the conditions were normal reactions to abnormal situations. However the combat conditions were different from those of earlier military conflict, without the prolonged confrontation and bombardment seen in the World Wars and the classical concept of fatigue and exhaustion often did not sit well with the history and symptoms presented. The numbers diagnosed with these conditions were limited and far outweighed by diagnoses of character disorders and a range of disciplinary problems.

The terms conduct or character disorder were used for disorders including the Adult Situational Reactions described in DSM -II (APA, 1968) as "transient disorders of any severity that ... represent an acute reaction to overwhelming environmental stress" (Boman, 1982, p 119). Once such disorders fell under the rubric of conduct disorder they were labelled as administrative rather than medical problems (Strange and Arthur, 1967; Jones, 1967). Some psychiatrists devised alternate diagnostic categories which were often judgemental in nature. Strange (1969) acknowledged three groups of combat precipitated psychiatric casualties:

1. combat fatigue — seen in those with good premorbid adjustment experiencing extreme stressors, and a good response to treatment
2. pseudocombat fatigue — a similar presentation to the first group with lesser stressors and with a higher rate of premorbid maladjustment
3. combat neurosis — a term used for men with long standing neurotic conditions aggravated by combat experience.

The incidence of reported traumatic combat reactions during the Vietnam War appears to have been affected by the psychiatric opinion and nomenclature of the era, as much as the actual combat conditions. Early reports indicated that cases of combat fatigue accounted for fewer than 6% of all hospitalizations with most men subsequently returning to duty (Bloch, 1969). Only 6% of American medical evacuations from Vietnam in the 1960's were for psychiatric reasons, about one quarter of the World War II rate of 23% (Bourne,1970). The interpretation of these figures varies significantly and Bourne (1969) details the success of preventive measures and the professional approach to military psychiatry and that " our level of knowledge of combat psychology has now reached the point where with adequate vigilance psychiatric casualties need never again become a major cause of attrition in the United States military in a combat zone." (Bourne, 1969, p. 231). Glass (1969) considered that features of combat in Vietnam such as its intermittent nature, U.S. air superiority, and comfortable base camps, were relevant in minimizing psychiatric casualties. Other authors consider such factors as a reticence to diagnose psychiatric illness by clinicians (Motis, 1968) and the predominance of frontline management and return to duty (Renner,1973) as important factors in the low reported rates of psychiatric casualties.

By 1970 the psychiatric admission rate for American troops was double that of 1968, at 25.1

per 1000 per year, despite a recorded fall in those wounded in action of 60% (Neel, 1973). Much of this increase was related to the implementation of large scale drug screening and the evacuation of drug dependant soldiers as psychiatric casualties (Gabriel, 1986). The elevation of psychiatric casualty rates did not correspond to the experience of World War II where the incidence of psychiatric casualties paralleled that of physical casualty (Glass, 1966). There was a substantial elevation in conduct and discipline disorders and large numbers of administrative discharges during the years of war (Gabriel, 1986). In retrospect, Glass' (1972) suggestion to examine all sickness and nonsickness categories of military discharge before determining a true psychiatric casualty rate seems even more relevant for Vietnam than for World War II, the conflict to which he was originally referring.

There exists a similarity to certain of the diagnostic categories used in the First World War regarding conduct disorder. Conduct versus psychiatric disorder was not a novel concept in the Vietnam era. Rather it was revisiting an earlier period, and has at its base the necessities of war and the requirements of administrators and military psychiatrists to maximize unit strength.

The factors of troop rotation practices, lack of group identity, and poor morale as well as those referred to by Jones (1984) when discussing the "nostalgic casualties" of Vietnam were seen as contributing to the increased rate of psychiatric and behavioural casualties. These factors included culture shock, boredom, disorganization, poor weather, static or reversals in battle, the prolonged warfare and lack of unit friendships. Jones' nostalgic casualties included men with constricted affect, social estrangement, disciplinary problems, substance abuse, sexual problems and Post Traumatic Stress Disorder. Such casualties have been described in both the acute military milieu and in civilian spheres. While recognizing the primacy of the traumatic event, the individual factors interplay to mitigate or exacerbate its psychological effects in the military context.

The Post Vietnam Era

During the 1970s community concern regarding "Post Vietnam Syndrome" (Shatan, 1973) was experienced and was fiercely debated in both clinical and lay spheres. Shatan used the term to refer to veterans with

— guilt feelings and self punishment;
— feeling scapegoated;
— violent impulses;
— psychic numbing;
— alienation from oneself and others; and
— doubts about ability to love and trust others.

A number of the procedures based on World War II experience and introduced by the Americans to minimize acute neuropsychiatric casualty in Vietnam were suggested as contributors to longer term disturbance. The limited one year tour of duty and troop rotation practices received criticism for diminishing the sense of community support and morale amongst troops. Also, management of acute combat reaction by sedation with antipsychotic medication has been seen to limit the ability of combatants to work through their experiences to appropriate resolution (Friedman, 1991).

Widening public concern stimulated case reports and studies relating to the psychological effects of involvement in the Vietnam conflict (Egendorf et al, 1981; Fairbank, et al , 1981) and the adjustment difficulties on return home to civilian life. Such adjustment difficulties have been reported after earlier conflicts. McKernan (1945) suggested such difficulties contributed to an increased rate of suicide in returned servicemen after World War I and Grinker and Spiegel (1945) noted that the actuality of the homecoming rarely lived up to that which has been anticipated by the combatant and that this may engender feelings of disappointment and hurt. These feelings were compounded after the Vietnam conflict as men returned not as victors, as did their fathers, but often as isolated participants of an increasingly unpopular confrontation (Bourne, 1972), and to a Veterans Administration still designed to cater for the Veterans of an earlier era (Leventman, 1975).

While Strange (1974) highlighted the problems of re-entry to civilian life he suggested the primacy of this readjustment in the development of depressive syndromes postservice and postcombat, rather than effects of the conflict as had been suggested by others (Bourne, 1972; Shatan, 1973). Reintegration has been an integral issue in

the psyche of the post Vietnam era, and the importance of recognition in the form of Homecoming Parades and civil recognition of service is seen as part of this process. The primacy of the traumatic event is established in the causation of Post Traumatic Stress Disorder. However, the homecoming and reintegration process is seen as important for combatants to work through their experiences and attain a sense of closure (Egendorf, et al, 1981) and to make the transition into to post war society.

The American Centre for Disease Control's "Vietnam Experience Study" (1988), is one of several well designed American cohort studies considering the mental health problems of the American Vietnam veteran community (the NVVRS will be considered later). It was marked by a rigorous study design and subject (Vietnam theatre veterans) and control (Vietnam era veterans) selection protocol, the aim being to have two cohorts which were as comparable as possible at the time of enlistment, with sample size adequate for valid statistical manipulation (Centres for Disease Control, Vietnam Experience Study, 1989 Volume 1). The study concerned a random sample of 7924 Vietnam and 7364 non Vietnam veterans interviewed by telephone (overall response rates of 87.3% 83.8% respectively) and a random subsample of 2490 Vietnam and 1972 non Vietnam veterans for physical examination. The findings are well reported and were published in JAMA 1988 and in complete bound form by the CDC in 1989, and covered psychosocial characteristics, physical health and reproductive outcomes and child health.

Significant findings included that 15% of Vietnam veterans had experienced PTSD at some time after service. It was also designed to examine possible lasting physical health effects of military service in Vietnam and failed to demonstrate objective signs of any long term physical health effects which could be related directly to military stressors. Subjective illness was greater for Vietnam veterans but current objective differences were not significant. Vietnam veterans had a higher rate of hearing loss, higher positive haemoccult test findings, and lower sperm concentrations, though they fathered similar numbers of children. Among Vietnam veterans, each of 33 selected health outcomes showed an increasing odds ratio with an increasing level of self-reported herbicide exposure in Vietnam after adjustment for reported combat exposure (Appendix H Vol II Health Status of Vietnam Veterans, CDC, 1989). It is recognised that the Vietnam veterans' increased reporting of so many different kinds of health problems may have more than one explanation. Results in CDC VES Vol II (1989) demonstrated poor correlation between self reported and physician assessed disorders in a random sample of US Vietnam veterans, when veterans with three or more psychological symptoms were excluded, most odds ratios relating to self reported illness shifted appreciably toward unity.

The participation rate for Vietnam theatre veterans in the PTSD assessment and examination was 66%. Psychological evaluation for the PTSD component of the study was based on a self administered questionnaire MMPI and on a centrally coordinated personal interview Diagnostic Interview Schedule version 3A, and a Combat Exposure Questionnaire for each of the 2,490 male Vietnam theatre veterans who participated in the study group.

The findings indicated that their sample of Vietnam Theatre Veterans had:

— a 14.7% lifetime prevalence PTSD
— a reported incidence of one or more symptoms of PTSD at some time since Vietnam of 33%.
— a 2.2% point prevalence of symptoms consistent with PTSD in the month prior to examination.

No comparison group for analogous rates in Vietnam era veterans was undertaken. However, raw data is presented in Volume 1V of CDC Vietnam Experience Study.

The findings are supportive of earlier work (Bourne, 1969; Figley, 1978, 1985) which shows an excess of Vietnam theatre veterans (those who served in Vietnam as opposed to Vietnam era veterans who served in the American military services in the period the Vietnam War) who still experience psychological problems some 20 years after service. This cohort study found significant differences in alcohol dependence (14% versus 9%), anxiety (5% versus 3%), and depression (4% versus 2%) and a 15% lifetime history of PTSD. In spite of the increased levels of psychopathology, overall, they found that the social and economic characteristics of Vietnam theatre and Vietnam era veterans were similar.

A number of studies relating to the long term effects of post combat psychiatric conditions in World War II veterans (Archibald et al, 1962; Archibald and Tuddenham, 1965) suggest that such problems may worsen with time, and that there may be a significant lag period post service before these conditions surface. This appears to be consistent with work relating to chronic and delayed onset Post Traumatic Stress Disorder in the Vietnam veteran population.

While PTSD and other post combat disorders are the focus of this work, the overall prevalence rate of diagnosable psychiatric disorders in Vietnam era veterans was found to be similar to that of age matched nonveterans in an analysis of the Epidemiologic Catchment Area program (Norquist, et al, 1988). This finding was consistent across World War II and Korean veterans though the trend across wars was for increasing rates of psychopathology in younger veterans, particularly relating to substance abuse. As mentioned earlier the study found evidence of untreated psychiatric disorder in all groups of veterans particularly relating to substance abuse, (alcohol and/or drug) and major depression. Despite the glare of research and media attention relating to veterans, particularly of later conflicts, and the treatment facilities available to them, many still do not seek help or fall through the cracks in established therapeutic programs. This highlights the importance of epidemiological study and community prevalence data for such psychiatric conditions as Post Traumatic Stress Disorder.

The Australian Vietnam Veteran's Health Study (O'Toole et al, 1996a,b,c) provides the most substantial recent Australian contribution to the literature relating to the psychiatric sequelae of war service. This study was designed as a prospective cohort study of a random sample of 1000 male Australian Army Vietnam veterans, and used information from Army records (this data extracted for all cohort members), personal interview and questionnaires. The current morbidity data set relates to 641 respondents (67.5% of total cohort, 50 of cohort known to have died 8 in Vietnam and 42 post Vietnam) interviewed between July, 1990–February, 1993. Some concern has been voiced regarding potential for response bias in the study's results. The detailed methodology (O'Toole, 1996a) notes that several different groups were used to undertake interviews: study team principal investigators and assistants (54.8% I/V), VVCS volunteer counsellors (39.0% I/V) and Australian Army Psychology Corps (6.2% I/V); and that the interviews took from 3–9 hours (average 4 hours). The interviews covered:

- physical health (ABS 1989–1990 Australian Health Survey questionnaire),
- self-reported psychological tests and Vietnam experiences (Centre for Epidemiological Studies — Depression inventory, the Speilberger (Trait) Anxiety inventory, the 28 item GHQ, the Spanier Dyadic Adjustment scale, a seven item combat index, the Mississippi scale for combat related PTSD and the Army self-description inventory,
- assessment of combat related PTSD (AUSCID-V a standardised psychiatric diagnostic interview for Vietnam related PTSD — included establishment of A criteria and the symptom inventory of SCID NP-V)
- general psychiatric assessment (Diagnostic Interview Schedule (APA, 1987) with modules for somatisation disorder, depression and related disorders, anxiety disorders, PTSD, alcohol, drugs, gambling, and antisocial personality. Psychotic illness modules not included.)

The mail back self administered questionnaire contained attitudinal, social, parental and early life questions, legal, welfare, and current circumstances questions and questions on history of VVCS treatment.

The principal findings of this study include:

A total of 59.6% of subjects met criteria for any DIS diagnosis, (36.2% current in the last six months) and this compares to 49.1% from the NVVRS Vietnam veteran sample (17.1% current in the last 6 months).

The predominant psychiatric conditions affecting Australian Vietnam veterans were found to be alcohol abuse or dependence, PTSD, somatoform pain disorder, and social and simple phobias (T5 & T6).

The lifetime prevalence of PTSD, using the AUSCID-PTSD, was 20.9%, and was significantly related to self reported severity of combat exposure, but not records based measures of combat exposure (this is detailed at pp 42–43 in the next section).

Vietnam veterans reported greater health service use and excess health problems across most

Table 5. Lifetime prevalence estimates for the major DIS diagnostic categories from veterans' cohorts AVHS[1], CDC VES and NVVRS, and population comparisons using the American NCS and Christchurch, NZ studies. (extracted from Tables 1 & 2)

	AVHS (%)	NVVRS (%)	CDC VES (%)	NCS (%)	NZ (%)
Lifetime prevalence					
Depression	6.2	5.1	12.5	12.7	8.8
Dysthymia	9.0	4.2		4.8	3.8
Depression NOS	9.5				
Melancholia	3.5				
Panic Disorder	3.1	1.8		2.0	0.9
Generalised Anxiety	7.3	14.1	23.5	3.6	27.1
PTSD	17.1	30.9	14.7		
O-C Disorder	2.5	1.8			1.0
Organic brain disorder	1.9				
Antisocial Personality	5.7	9.5		5.8	4.2
Alcohol Abuse/ Dependence	41.1	39.2	50.6	32.6	32.0
Drug Abuse/ Dependence	2.7	5.7	14.7	14.6	7.2
Gambling disorder	4.0				0.5
Phobia	21.6				6.8
Agorophobia	5.8			3.5	3.4
Social phobia	14.4			11.1	4.3
Simple phobia	10.2			6.7	3.4
Somatoform Pain disorder	16.6				
Somatisation disorder	0.3				

[1]these figures are the results from the 641 interviewed subjects, unadjusted for the nonresponse in the 950 eligible subjects.

recent and chronic illness categories used in the Australian Health Survey questionnaire. Combat exposure, however, was significantly associated with a more limited spectrum of conditions including acute and chronic mental disorders, recent hernia, chronic ulcer, recent eczema and chronic rash deafness, chronic infective and parasitic disease, chronic back disorders and symptoms, signs and ill-defined conditions.

The Gulf war and Peacekeeping forces

This paper, because of its focus on World War I, World War II and the Vietnam War, deals predominantly with descriptions of acute and chronic reactions to combat stress including PTSD. It is recognized that acute PTSD symptoms may occur in delayed form; or further stressful events may trigger acute exacerbations in combatants who have chronic PTSD. Also at risk are smaller groups of Australian military personnel who have been involved in later conflicts including the Gulf war (fewer than 1,000 troops — most of these offshore Navy), and in stressful United Nations Peace Keeping missions. There is a necessity to be alert to the acute problems and interventions applicable to these groups (Steffen, 1992) though they are not as yet dealt with in this paper.

In recent years the major involvement of Australian troops has been in peace keeping forces in Namibia, Somalia and Cambodia. United Nations peace keeping forces which may well "make the peace as well as keep it" and may face hostile civilians and organised hostile forces.

Problems arise among peace-keeping forces which differ from combat experience, particularly the impotence to retaliate to aggression, taunting and the internalising of their own ambivalent or negative/aggressive feelings. Many troops have limited training in the peace keeping role but have had extensive combat-ready training (both attack and defence) which is much different in practice in the job of peace keeping. These troops are under threat of, or are actually exposed to, violence and certainly may witness first hand the devastation of war. The limited ability to retaliate, and their ambivalence at the role in which they find themselves, the defined tours and the varied belief in the value of their actions are important factors in dealing with the stresses of this situation. Further, the troop numbers involved from any one country are often a small component when set against the total serving troop members and those involved may feel isolated or unsupported, particularly from social and community supports at home.

Thus adequate selection and training for peace keeping duties and especially education relating to the experiences and difficulties of such work is necessary. Visible and ongoing support for peace keeping troops from their families and the wider community is also important, as is adequate debriefing and follow up of troops on their return from such duties.

Conclusion

The history of the Vietnam War presents features which differ from earlier conflicts, both in the style of military involvement and in personal and societal terms. Early in the War the American Forces described low psychiatric casualty rates. This situation was to alter significantly as war progressed. In addition, large numbers of administrative discharges for conduct and behavioural disorders were recorded. Features of the war contributing to this change included the form of guerilla combat, the foreign culture, the uncertainty regarding friend and foe and even uncertainty regarding involvement in the war itself. Practices such as troop rotation and loss of "community" also have been cited as contributing to the casualty rates.

There exist a number of significant differences between the classification and management of the psychiatric casualties from the Australian and American Forces as well as more fundamental military selection and procedural differences (Spragg, 1992). In the post war period re-entry difficulties and fears related to the possible health risks of exposure to Agent Orange have focussed sustained attention upon the Vietnam veteran group.

The problems of the war were often compounded by a perception of post war disenfranchisement and neglect which left many veterans unable to fully reintegrate into society (Figley, 1985). In Australia, the Homecoming Parades and more recently the unveiling of a Vietnam memorial in Canberra move to redress the visible form of this neglect. The development of the Vietnam veterans Counseling Service in the early 1980s providing further care and recognition for the problems of this group of veterans.

Interest in the health of veterans after service in Vietnam regarding psychiatric disorders and chemical exposure in Vietnam (The Agent Orange issue) has had enormous individual, social and political impact. Research involving the long term psychological sequelae of service in Vietnam veterans provided impetus for the official recognition of Post Traumatic Stress Disorder in 1980. While the predominant interest has been in the United States, Australian concerns paralleled that of the larger American group and the Evatt Royal Commission called for "... the mental health problems of the Vietnam veteran community in Australia" to be examined in a "scholarly fashion" (Evatt, 1985, Volume 5, p164) and described, at least in part, in the recently published Australian Vietnam Veterans Health Study.

Which features of military service contribute as 'toxic' exposures?

Drawing on literature and personal disaster research, Lars Weisæth (1991) suggests that the six most important dimensions of a war or disaster situation which are likely to predict an acute or long term psychiatric problem are physical injury, threat to life, loss of loved ones, attack on one's human integrity, horror and denial of identity. He also noted that control was a protective factor which appeared to diminish negative outcomes, as did being a member of a strong cohesive group,

having strong trust in one's leaders, strong commitment, high quality personal training, and high quality emergency services. These findings are consistent with Australian (Raphael, 1986; McFarlane, 1988) and world literature (Wilson, Harel and Kahana, 1988) on this subject. Firm conclusions relating to the relative contribution of individual factors is yet to be delineated.

Determinants in the Vietnam Veteran Population

It has been suggested that war and military combat may be distinguished from other forms of disaster by virtue of certain destructive features:

1) "the stress of war is prolonged , repeated and of high intensity.
2) war is deliberately not accidentally destructive
3) war is man made and hence should not occur ..."

and protective features including the "... fact that war is engaged in by young, healthy men, who are anticipating its consistent events and are trained for them, both individually and as a group."

(Spragg, 1992:731).

There is a base of early literature predominantly utilizing clinical cases which has attempted to examine the concept of combat related psychological disorders. These were usually uncontrolled case studies and many demonstrated a bias toward the aetiologic importance of personal and developmental premilitary factors (in accordance with the organic and Freudian theories of the day). Later work emphasized the importance of the traumatic episode, the military community and post trauma factors in the evolution of the disorder (Glass, 1972).

In the last decade, studies of Vietnam veterans have further shifted the aetiologic emphasis from predisposition, to traumatic exposure and other variables. A review of "early" literature (19691980) of the Vietnam era (Boman, 1982) delineated 22 studies where some form of study design with control of variables was attempted. Boman reports that seven found no evidence of association between the "Vietnam experience" and later emotional problems, while 15 reported such an association was present. He also notes that it "... becomes rapidly clear that their writers belonged to two vehemently opposed groups which, in their mutual vituperation, could almost be styled the psychiatric equivalents of hawks and doves." (Boman, 1982, p 121). While there has been considerable development in the study of post trauma psychopathology and PTSD it is to be remembered that features of this dichotomy still exist, both amongst researchers and within the wider community.

A number of factors relevant to the Vietnam conflict have been seen as possibly contributing to long term psychological sequelae of the era, including PTSD. Some, such as the troop rotation system, have been mentioned earlier, others include:

— "entry to and exit from the war alone
— the social change, and opposition of many Americans to involvement in the conflict, post 1968
— the nature of the war no front lines, uncertainty regarding friend and foe, continuing guerilla warfare
— the military psychiatry practiced in Vietnam with predominant requirement to preserve troop strength
— the known 'tour of duty' and brief transition back home".

(Walker and Cavenar, 1982)

The majority of controlled studies examining pre-military, military, and post military factors, in clinical and nonclinical groups of Vietnam veterans appear to support the premise that the type, severity and duration of the traumatic exposure is the most important variable (Solokoff et al, 1986, Foy et al; 1987; True, Goldberg and Eisen, 1988; Yehuda, Southwick and Giller, 1992) and is consistent with the findings of the population based CDC Vietnam Experience Study (Decoufle' et al, 1992). These results cut across study populations and measurement tools. The VA cooperative monozygotic twin study (Goldberg, et al, 1990) defined a continuum of symptoms with the highest incidence of PTSD symptoms in combat veterans from South East Asia, then noncombat Vietnam Veterans, then non war zone Vietnam era veterans. Twins exposed to intense prolonged combat in Vietnam showed a 47% lifetime prevalence of PTSD, 9.2 times the rate of their noncombatant brothers.

The results relating other potentially contributing factors have been more variable across studies, particularly those relating to premilitary,

familial (Egendorf et al, 1981 versus Penk et al, 1981), psychological (Worthington, 1977 versus Foy et al, 1984) variables, and age of entry to the service (Worthington, 1977 versus Frye and Stockton, 1982). The VA Twin study (Goldberg, et al, 1990) of 2,092 Vietnam veteran monozygotic twin pairs, found that seventeen percent of twins serving in the war zone qualified for a diagnosis of PTSD within six months, compared to five percent of their brothers who served elsewhere. The twin design, which controlled for premorbid family environment, socioeconomic status and genetic variability, demonstrated that the impact of trauma was much greater than any preexisting factor.

The National Vietnam Veteran Readjustment Study was developed to address specific issues raised in a U.S. Congressional mandate (Kulka et al, 1988) relating to the psychological sequelae of Vietnam service. The sample of Vietnam Theatre and Vietnam Era Veterans was selected to be most representative of the entire population of Vietnam veterans. The randomly selected study sample consisted of 1632 Vietnam theatre veterans, 716 Vietnam era veterans and 668 nonveterans who were studied utilizing multiple PTSD diagnostic tools. The findings of this study relating to male Vietnam theatre veterans included:

— 15.2% current prevalence of PTSD
— 30.9% lifetime prevalence of PTSD
— 11.1% current partial symptoms of PTSD
— 22.5% lifetime history of partial symptoms of PTSD

The prevalence of PTSD in the Vietnam era veterans who did not serve in Vietnam was 2.5% and was 1.2% among the nonveteran males.

A feature of the NVVRS was the preliminary validation of assessment tools utilizing a subset of 244 clinical subjects with consistent independent Structured Clinical Interview for DSMIII-R diagnosis and a five hour interview examining the following five measures for diagnostic and predictive accuracy for PTSD: Diagnostic PTSD Interview, Checklist of PTSD symptoms, Mississippi Scale for combat related PTSD, Impact of Events Scale and Form AX of the MMPI.

The Diagnostic PTSD Interview and the Mississippi Scale for combat related PTSD provided the best prediction of certified clinical diagnosis, though all measures performed reasonably well with clinical subjects. However, further validation of the tests carried out with community veteran samples demonstrated that the sensitivity of the Diagnostic PTSD Interview measure was poor in this setting (Kulka et al, 1991; p549).

The study also found that the prevalence of PTSD and other post war psychological problems was significantly higher among those with high levels of exposure to combat and other war zone stressors (in comparison to either Vietnam era veterans or Vietnam theatre veterans with low or moderate exposure to war zone stressors). A greater rate of PTSD was found among those who had more than one tour of duty, compared to those with shorter exposure. Substantial differences in current prevalence rates of PTSD were also found for minority status groups (eg Blacks and Hispanics). These variations may be contributed to by differing exposures to war zone stress and/or subsequent life stressors than non minority veterans. Penk et al (1989) examined the issue of ethnicity as a variable controlling for combat exposure and found that ethnicity contributes to PTSD in selected instances but minority group status alone did not account for observed differences.

There appears to be a continuum of stress severity response, combat bringing about the highest amount. However, the threat of physical violence is not the only important parameter in post traumatic disorders. Involvement in abusive violence (Yehuda, Southwick, and Giller, 1992), death or loss, infantry contact and forward area experience compounds this to further expand the problem (Grady, Woolfolk and Budney, 1989). Personal, social and environmental factors may also mitigate or aggravate the individual response (Figley, 1985a,b; Jones, 1986).

Australian Studies

Australian studies (Tennant et al, 1990; Streimer et al, 1985, 1986; Boman, 1985; Spragg, 1980) have been largely descriptive in nature and have been carried out predominantly on records of one random sample of 126 hospitalized Vietnam veteran psychiatric patients (Tennant et al, 1990; Streimer et al, 1985, 1986). These have suggested that poor psychosocial adjustment and psychiatric disorders in Vietnam veterans were statistically

associated with poor childhood/adolescent history, a higher rate and extent of combat exposure, and were more common in regular enlistees rather than National Servicemen (Streimer et al, 1985, 1986).

Work focussing on PTSD (Tennant et al, 1990) indicates that of the 126 inpatient Vietnam veterans studied, 19% had a primary or secondary diagnosis of PTSD. Those with PTSD gave a history of involvement in heavy combat significantly more frequently than those with other psychiatric diagnoses. There was no association between the premilitary adjustment factors studied and the development of PTSD, and no difference in the rate of diagnosis in Regular and National servicemen. Regular soldiers did have a higher incidence of personality disorder and of alcohol and drug related disorders. Post military period findings were that those with PTSD showed poorer work adjustment and twice the rate of unemployment of those with other psychiatric diagnoses. There were no significant differences in other measured areas of adjustment (marital, sexual and interpersonal). The authors do stress that the samples relate only to psychiatrically disturbed Vietnam veterans seeking treatment and that findings cannot be generalized to community veteran samples. Boman (1985) found no significant difference between the prevalence of depression, anxiety, irritability, aggressive behaviour, impulsivity and substance abuse in a comparison of hospitalized Vietnam veterans with PTSD and those Vietnam veterans hospitalized for other psychiatric disorders.

The Australian Vietnam Veteran's Health Study (O'Toole et al, 1996a,b,c) (described above) reported a total of 59.6% of subjects met criteria for any DIS diagnosis, (36.2% current in the last six months) and this compares to 49.1% from the NVVRS Vietnam veteran sample (17.1% current in the last 6 months). The psychiatric conditions affecting Australian Vietnam veterans were found to be alcohol abuse or dependence, PTSD, somatoform pain disorder, and social and simple phobias.

The relationship between combat and each of the DIS diagnoses was assessed using a records based measure (unit posting and length of posting) and a self reported combat exposure scale (see Table 6). The two measures though being moderately correlated (r=0.44) gave different results. The records-based assessment of posting to a combat unit was not related to any lifetime DIS diagnosis except obsessive compulsive disorder, nor to any current diagnosis. The self reported combat exposure scale was significantly related to all lifetime diagnoses except depression, gambling, drug abuse melancholia and somatisation disorder. The lifetime prevalence of PTSD, using the AUSCID-PTSD, was 20.9%. The OR across quartiles of self reported 21-item combat index compared to the lowest quartile were as follows: 1st quartile OR=1.00, 2nd quartile OR=3.03, 3rd quartile OR=5.36 and 4th quartile OR=9.18.

The authors noted the use of two measures of combat exposure using indirect methods from military records and from self report interview measures. The first was a scaled measure from the Army records based on the roles that individual units played, as advised to military advisers to the AVHS which independently grouped the units which had been present in Vietnam into six, depending on their role and presence on the field and thus proximity to combat:

1. High combat — Australian Army Training Team Vietnam, Special Air Service and some Signals squadrons
2. Combat — Infantry, some field engineers (mine clearance teams) some Armoured tanks, and Cavalry regiments (personnel carriers and convoy escort, 1 Field Squadron workshop
3. Protected combat — Artillery
4. Non-combat field presence — some Signals and Transport squadrons, some Service units, Aviation
5. Non-combat possible field presence — some Signals squadrons, some Head Quarters and Workshop Units
6. Non-combat non-field — Field Hospital, some Head Quarters and postal units.

The second, self-reported combat exposure was assessed at interview using a 21 item scale derived from Wilson and Krauss and focussed on the frequency of experiencing each of 21 specified events, such as direct enemy contact, and seeing Australians killed or wounded.

Conclusion

Most material concerning post combat psychological health relates to the American Vietnam veteran population. This population differs appre-

Table 6. Odds ratio for risk of each lifetime DIS diagnosis with each quartile of self reported combat index compared to the lowest quartile and P value for the t-test of association with the continuous combat score.

DIS diagnosis	1st quartile	2nd quartile	3rd quartile	4th quartile	P value
Depression	1.00	2.24	2.75	1.99	0.28
Dysthymia	1.00	0.98	1.67	2.58	0.009
Depression NOS	1.00	1.55	1.21	1.81	0.14
Melancholia	1.00	1.99	3.33	3.11	0.063
Panic Disorder	1.00	3.20	3.27	10.10	0.001
Generalised Anxiety	1.00	0.91	1.81	3.14	0.003
DIS-PTSD	1.00	2.64	4.43	7.17	<0.0005
AUSCID-PTSD	1.00	3.03	5.36	9.18	<0.0005
O-C Disorder		1.00	0.77	2.46	0.001
Antisocial Personality	1.00	0.78	1.86	4.51	<0.0005
Alcohol Abuse/ Dependence	1.00	1.07	1.56	1.86	0.002
Drug Abuse/ Dependence	1.00	2.83	1.21	1.74	0.78
Gambling disorder	1.00	0.98	2.30	1.08	0.37
Phobia	1.00	1.47	2.31	2.79	<0.0005
Agorophobia	1.00	3.25	5.58	6.51	0.002
Social phobia	1.00	1.24	1.80	2.18	0.012
Simple phobia	1.00	1.76	2.58	4.47	0.001
Somatoform Pain disorder	1.00	1.05	1.88	2.47	0.001

ciably from that of Australian veterans, given the selection process, racial differences and potential objective assessments of combat exposure. The American group has been extensively studied by a variety of researchers and this has been stimulated by political, social, and historical pressures. It is notable that the only major Australian study of this group was completed more than two decades after cessation of our involvement in the war, and almost a decade since its need was highlighted by the Evatt Royal Commission.

The AVHS highlighted several issues of interest and concern:

- the lack of comparable Australian population data relating to the prevalence of psychiatric disorders (This project is however underway)
- the disparity between some American (CDC VES and NVVRS) data and this current investigation with respect to prevalence of DIS diagnosed conditions.
- and finally, the major differences in results for association of psychiatric disorder with combat between the indirect methods of assessment of combat exposure used in this project. This raises the issues of why the records based assessment was so poorly correlated with psychopathology, and the potential need to validate the self reported data (and raises the question of the effect of recall bias especially in frequency measures between those with and without psychopathology).

The task now is to identify a descriptor system for the stressor experiences of war which are applicable in the Australian military milieu. The above may assist in the consideration of the overall experience of war and the principal psychological findings which may be drawn from the major cohort studies, particularly in relation to Vietnam veterans.

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Stress and Psoriasis

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There is a body of literature from the last fifty years which examines aspects of the stress and psoriasis conundrum. Published epidemiologic reviews relating to psoriasis currently focus predominantly on genetics and a number do not include stress as an important aetiologic agent (Nall, 1994; Naldi et al, 1994; Elder et al, 1994). However psoriasis also appears in many classifications of psychocutaneous disorders, as being primarily due to genetic and environmental factors, with a course which may be influenced by psychological stress (Ginsburg, 1995). The available literature relating to the potential association between stress and psoriasis is predominantly based on small case series and on retrospective analysis and thus has the potential for significant bias. Most studies are based on hospital inpatient or outpatient samples which may not mirror the experience of psoriatics in the community. The level and poor quality of evidence is perhaps the outstanding feature of the literature search undertaken on stress and psoriasis and while a large body of the literature was reviewed only a portion has been discussed in this paper, given the obvious interpretive limitations of case studies and opportunistic case series reports.

The definition of the exposure (stress), stressful life event, methodology and measures of outcome are variable and to date no large prospective cohort studies have been published to examine the potential association. Additionally, in considering the issue of worsening (the issue before the RMA being that of permanent aggravation) of the disorder after stressful events, can it be said that the effect is truly of permanent aggravation and also is it the event per se or is it that dealing with such events takes effort and time? If this were the case, perhaps, less time and care is allocated to the skin program, that is clinical worsening is an effect of the neglect of treatment rather than a true causal effect of the stressful event itself?

Ginsburg (1995) provides an excellent overview of the literature and the structure of the following is based on her paper. It appears that the literature may be arbitrarily divided into four groups, the first are the case reports, case series and "amplified anecdotes" most of which were published between 1940–1970.[1] Such small uncontrolled studies as those of Susskind and McGuire (1959) demonstrated a high rate of recall of upsetting events and anxiety and/or resentment before the onset (40%) or recurrence (70%) of symptoms of psoriasis in (N=20) hospitalised patients.

The second group of papers is based on patient survey data, utilising epidemiological questionnaires. Farber et al (1968)[2] and Farber and Nall (1974)[3] both described an association between recalled worry and symptoms of psoriasis. Here and in the first group, the exposure of interest is a very broad category and one which could be suggested to cover almost any sort of distress. This form of retrospective survey was used by Al'abadie et al (1994) who again described an association between a wide variety of life event stresses, ranging from family upset to "hormonal change". The authors suggest caution in interpretation given the variable belief systems of patients and the nature and recall of such 'stress' being subjective, retrospective and imprecise.

Poikolainen et al (1994) used a retrospective case-control analysis (55 psoriatics and 108 unmatched controls with other skin disorders from a dermatology outpatient department to examine several potential risk factors for psoriasis. The authors described an increase in smoking and negative life events in psoriatic patients compared to controls, however these negative events were not associated with exacerbation of disease, and they considered that the finding was most likely a consequence of the disease itself.

The third group of papers use more precise 'tools' in an attempt to gauge the stress, the exposure of interest. Seville (1977, 1978) was one of the first to use a life event methodology to describe stress in psoriasis research. He interviewed 132 psoriatics and an age and sex matched control group (infection related conditions) about major stress incidents in the month prior to disease onset. 46% of psoriatics compared to 10% controls reported recalling such a stress. The findings based on retrospective assessment and with the potential for differential recall have been criticised (Shuster, 1979)

Harrison and Moore–Fitzgerald (1994) outline an assessment made on psoriatic outpatients to a UK dermatology department. 47 chronic psoriatics and 51 control patients were interviewed and assessed by a psychologist. Psoriatics experienced no more stressful life events than controls,

however their perception of such events as stressful was greater and the authors suggested that this may be because of associated anxiety depression and lack of confidence. Additionally psoriatics assessed had reduced coping skills for dealing with everyday life events.

A number of researchers have used standardised questionnaires to assess the relationship between external events and psoriasis. Baughman and Sobel (1971) reported that psoriasis severity (not onset or relapse) varied moderately with life stress using the a five year recall of events in 252 hospitalised psoriatics. The Rahe Social Readjustment Rating Scale (SRRS) was used, and 40 common life events were weighted along with life change units to quantify disruption and need for adaptive change. Fava et al (1980) using a semistructured interview of stressful events in the preceding six months, examined retrospective life events in 60 patients, 20 psoriatics, 20 with chronic urticaria and 20 with fungal infections. At least one event was reported by 80% of the psoriatics, 90% of those with chronic urticaria and 50% of those with fungal infections. Payne et al (1985) described no association between stress and psoriasis symptoms in a controlled study of 32 psoriatics.

Gupta et al (1989) looked at 64 hospitalised psoriatics who considered themselves to react to stress and 63 who made no such associations. The authors found that the groups did not differ in major life events in the six months before admission, however the 'stress responsive' group had more psoriasis-related stress and 'hassles'. Suggesting that the reaction to events rather than events themselves are implicated in the patients' distress.

The only prospective study, Gaston et al (1987) used only five patients with scalp psoriasis, observed weekly over 20 weeks (100 observations). When results for four of the five patients were considered a positive correlation between the severity of symptoms and psychological distress (partial $r = 0.31$; $p < 0.01$) and impact of adverse life events was reported. In their discussion they note however, that no significant association was obtained when the data from one of the subjects (20% of the data) was included in analysis. Gaston et al (1991) report a similar study looking here at both aggravation of symptoms and effect of psychological interventions. The authors suggest that some patients may benefit from psychological intervention aimed at reducing stress. (It is unclear as to the contribution of the disease itself on the patients psyche and this may be contributing in some cases). The use of psychological techniques in the overall management of psoriasis is considered by a number of authors (Ginsberg, 1995; Frankel and Misch,, 1973; Hughes et al, 1981, Benoit and Harrell, 1980) however this does not aid in determining the aetiological significance of stress in causation of the disease.

The interplay of 'stress' and psoriasis is not unidirectional. Gupta and Gupta (1995) present a 15 item psoriasis life stress inventory to assess the psychosocial impact of the disease on patients. This is one of a number of such measures.[4] Ginsgurg and Link (1993) explored the concept of disease stigma in the psychosocial mellieu of the psoriatic patient using 100 adult cases with moderate to severe psoriasis, and Fried, Friedman et al (1995) and Ramsay and O'Reagan (1988) also consider the impact of psoriasis on the individual. John Updike, whose psoriasis commenced in childhood, wrote:

> Leprosy is not exactly what I have but what in the Bible is called leprosy ... was probably this thing ... I am silvery, scaly. Puddles of flakes form wherever I rest my flesh ... We lepers live a long time, and are ironically healthy in other respects. Lusty, though we are loathsome to love. Keen sighted, though we hate to look upon ourselves. The name of the disease, spiritually speaking, is Humiliation.
>
> (Updike, 1985)

Whether the term is as all encompassing as 'stress', or the event specific 'stressful life event' problems in interpretation arise. Compendious lists of events ignore the variability of such events (eg job loss through incompetence c/f a job of short duration eg seasonal worker/musician) and subjective self-rating scales may be confounded by personality type and levels of optimism/pessimism. Aspects of life events that may be further defined include those that change usual behaviour, desirability of change, the individual's control, and if the event is life threatening.

Mazzetti et al (1994) examined stressful events in the genesis of relapse in psoriasis in 80 inpatients. This group described that the preceding

stressful events where of low average intensity (2.56 in a 5 point scale from 2–6). 71% of the group were said to demonstrate symptoms of a DSM-IIIR psychiatric diagnosis (Personality disorder 35%, Mood disorders 17.5%, Anxiety disorders 12.5% and Psychotic disorders 6.25%). It was not the intensity of the event rather the perception and meaning of the event which was seen to be important. This is an extraordinary proportion of personality disorders and it may be that certain features of the patient group (eg limited coping mechanisms and need for hospitalisation) may effect the interpretation of this sample. This finding is not supported by the findings of earlier research extensively reviewed by Seville (1989) on personality and psoriasis. He noted no evidence (four papers unsupportive of such an association) of a psoriatic personality type or psychological or psychosocial predisposition to the illness. He cites four papers demonstrating an increase in neurotic psychiatric symptomatology in psoriatics.

The fourth group of papers examine the biological events that may be precipitated by stress and which could possibly contribute to psoriasis. Psychoneuroimmune and neuroendocrine pathways have been considered (Arnetz et al, 1985; Farber et al 1991, Farber and Nall, 1993, Harvima et al, 1993). Substance P and calcitonin gene related protein have been implicated in the CNS to skin pathways in this disorder (Pincelli et al, 1994; Farber et al, 1990, Farber, 1993).

Arnetz et al (1991) attempted to evaluate whether altered neuroendocrine and dermatological reactivity existed in patients with psoriasis (N=10) and atopic dermatitis (N=7) compared to healthy controls (N=10). The authors describe differences between the controls and those with specified skin conditions in response to standardised experimental stressors, the authors considered that differences in coping style mood and cognitive factors accounted for most of the variation.

Glinski et al (1994) examined beta-endorphin in sera of psoriatics (N=71), patients with other inflammatory skin diseases (N=34) and healthy subjects (N=100). The levels in psoriatics were elevated with data suggesting that beta endorphin is produced in psoriatic lesions by inflammatory cells rather than as a result of activation of the pituitary axis by chronic stress. Overall, this research still needs to clarify cause and effect and not merely an association in individuals with dermatological irritation such as psoriasis.

While the above is not an exhaustive review of all case reports and case series it would appear from the results of a range of studies that stressful life events can, in some psoriatics, be implicated in exacerbating the disorder (this may well be true for many if not most diseases). Seville (1989) noted that exacerbations of psoriasis occurred generally within two weeks and almost always within one month of the stressful event if one was so implicated. There is less literature on stress as a cause of psoriasis, and the association is certainly not clear, no prospective studies exist examining the onset of this common skin disorder and stress or stressful events. While little literature is available on the issue of DSM IV diagnosed psychiatric conditions and psoriasis, there is support in Seville (1989) and to some degree Mazetti et al (1994) for chronic anxiety disorders and depression to be implicated in the acute exacerbation of the disorder.

In summary it appears that there is support for an association between life event stress and perhaps certain psychiatric disorders and flare up of psoriatic symptoms in some psoriatic patients. Whether this is consistent with "permanent aggravation" of the condition is unclear. The limited evidence for a causal association is much less convincing though it has some support by authors such as Farber and Nall (1993) invoking the psychoneuroimmune axis theories.

Notes

1. Case reports such as Walter J (1987) *Severe stress and psoriasis.* Australas J Derm 28 pp. 135–136.
2. 2144 psoriatics surveyed, 40% recalled worsening during periods of worry, 20% reported no association.
3. 5600 psoriatics surveyed, 30% recalled worsening (new areas of psoriasis) with worry, 30% recalled no association.
4. For example Finlay and Kelly (1987) *Psoriasis — an index of disability.* Clin Exp Dermatol Vol 12 pp. 8–11.

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Stress and Cerebrovascular Accident (Cerebral ischaemia, Cerebral infarction and Cerebral haemorrhage)

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Introduction

There is a common perception that stress contributes to cardiovascular disorders such as ischaemic heart disease, hypertension and stroke. There is a large body of literature examining the role of stress in the aetiology of coronary artery disease and hypertension. This literature covers the impact of life-events, job-strain, psychiatric illnesses, social support and laboratory controlled stressors on blood pressure and heart disease. However, due to a number of methodological problems, and inability to adequately adjust for confounders there is no consensus on the role of chronic stressors in the aetiology of coronary heart disease or hypertension.

Hypertension is a well recognised risk factor for both ischaemic and haemorrhagic stroke. While the role of chronic stress in the aetiology of essential hypertension is debatable, there is consensus that acute stress can cause a temporary elevation in blood pressure. It is plausible that the temporary elevation of blood pressure from acute stress may cause rupture of cerebral blood vessels leading to haemorrhagic stroke. Studies have documented coronary artery spasm in response to acute mental stress in individuals with pre-existing coronary artery disease. No similar studies of cerebral vessels were encountered with the exception of a couple reports documenting reduced cerebral flow with hyperventilation.

Heightened sympathetic arousal is seen in combat veterans with Post Traumatic Stress Disorder (PTSD) when they are exposed to reminders of their original trauma, as shown by heart rate, blood pressure, electromyography and sweat activity.[1] Increased sympathetic outflow probably also occurs during panic attacks. Hence it would be of interest to see if these individuals are at greater risk of cerebrovascular accidents. However, positive findings would need to be interpreted cautiously because these individuals are at higher risk of substance abuse disorders[2,3] and possibly also have elevated levels of other lifestyle risk factors for stroke. The literature is practically non-existent in this area.

Psychiatric diseases, personality, emotional factors and chronic stress no doubt influence known and possible life style risk factors for stroke such as smoking, alcohol intake, diet and exercise. This makes it rather difficult to know if stress, personality and emotional factors play any role in the aetiology of stroke, independent of their influence on established behavioural risk factors.

Slowly progressive undiagnosed cerebrovascular disease preceding the onset of the cerebrovascular accident may lead to considerable difficulties in the person's life and psychiatric disease such as depression and this can be difficult to tease out as well. It is also important to disentangle effects of acute and chronic stress preceding cerebrovascular accidents.

Storey (1985) reviewing the literature on emotional aspects of cerebrovascular accident stated that there is no doubt that strokes can be precipitated by major emotional turmoil. He stated that there is however, little evidence so far that personality or emotional factors can be linked with long-term predisposition to strokes (particularly subarachnoid haemorrhages with normal angiograms) independent of other risk factors. The evidence Storey presented consisted of case-reports and case-series addressing subarachnoid haemorrhage. He did not present any convincing evidence in favour of emotional stress causing cerebral haemorrhage or cerebral ischaemia.[4]

Literature Search

A Medline OVID search was carried out for the period 1966 to October 1997. The search employed the MeSH headings, cerebral haemorrhage, subarachnoid haemorrhage, cerebral embolism and thrombosis and cerebral ischaemia. The search was limited to the subject headings epidemiology and aetiology, English language articles and human studies. Relevant articles were obtained and relevant Medical Textbooks were also consulted.[5]

Findings

Military Studies

Watanabe and Kang (1996) reported on a proportional mortality study of US Marine and Army Vietnam veterans who died during 1965 through 1988 (final sample of 62,068 veterans). There was no evidence of increased deaths from circulatory disease (which included cerebrovascular acci-

dents) in Vietnam veterans when they were compared with non-Vietnam veterans (Vietnam era veterans) or when compared with the US population. There was also no evidence of increased risk in the non-Vietnam veterans when compared to the US population.[6,7]

Thomas et al (1991) examined mortality among women Vietnam Veterans and non-Vietnam veterans and noted a significant deficit in circulatory deaths (followed-up to Dec 1987) compared to the US population. Vietnam veterans were also not at greater risk of cardiovascular deaths compared to non-Vietnam veterans.[8]

Nice et al (1996) compared long-term health outcomes in a volunteer sample consisting of 70 former naval aviator POWs (Prisoners of War, white, aged 47–69 in 1993) and a comparison group of 55 naval aviators who served in Vietnam but were not POWs, matched on race, age, marital status, education, rank, year of entry into the navy and pilot status. Subjects participated in an annual health screening program to 1993. Only those who attended the 1979 and 1993 annual examinations were included in the analysis which resulted in 51% (70/138) of POWs and 40% of controls being included in the analysis. There were no differences between POWs included in the analysis and those not included in the analysis on demographic factors or in captivity-related treatment, such as length of solitary confinement, estimated body weight loss, and visual symptoms in captivity. The only significant difference was in overall length of captivity, which was longer in the POWs included in the analysis. No association was found between POW status and ischaemic heart disease (IHD), hypertension or cerebrovascular disease.[9]

Dent et al (1989) reported on the post-war mortality of Australian WWII POW (Japan) by comparing 908 POWs with 797 non-prisoners of war who served in the South East Asia or the South West Pacific during the same period to June 1983. Cerebrovascular disease and IHD were no more common among POWs. Hypertensive disease was encountered as a cause of death in the death certificates more often among POWs (3.1% vs 1.7%).[10]

Follow-up mortality studies of US WW II (follow-up 30 years) and Korean conflict (follow-up 22 years) veterans did not show a significant increase in deaths from vascular lesions of the central nervous system (CNS). Three groups of former prisoners of war and six other groups which served as comparative groups (for prisoner of war experience) were considered. The Standardised Mortality Ratios (SMRs) for the POWs and comparison groups are presented below:[11]

Venn and Guest (1991) in a review of chronic morbidity of former POW and other Australian veterans concluded that there was no evidence of excess circulatory diseases among former POWs. Anxiety states and depression were more common in former POWs compared to relevant comparison groups.[12]

An Australian mortality study of National Service Vietnam veterans (18 949 veteran and 24 646 non-veterans) did not report excess cerebral haemorrhage, ischaemic heart disease or other diseases of the circulatory system in Vietnam veterans or non-veterans (those who served in Australia). Vietnam veterans were not at greater risk compared with non-veterans. The population examined consisted of former National service men who were alive on 1/1/1982 and were followed up until Dec 1994. Their vital status at follow-up was determined by matching against the National

	SMR
PWP (POW WW II Pacific combat)	0.63 ($p \leq 0.05$)
WP (controls from Pacific units committed to combat early in WW II)	1.02
PWE (POW WW II Mediterranean and European combat areas)	1.15
WE (control units with heavy combat exposure in Mediterranean and European combat areas)	1.12
PWK (POW Korea)	1.03
WK (control men wounded and returned to duty in Korea)	0.83

Table 1. Observed and expected deaths from Diseases of Circulatory System *(ICD Chapter VII)* among national service veterans and non-veterans, for major causes of death.

	Non-Veterans 1982-1994		Veterans 1982-1994		SMR_{VV}/SMR_{NV}
	O/E	SMR	O/E	SMR	RR (95% CI)
Ischaemic Heart Disease	75/105.2	0.71	57/82.4	0.69	0.97 (0.68-1.39)
Cerebral Haemorrhage	4/6.6	0.60	3/5.2	0.58	0.96 (0.14-5.66)
Other disease of the Circulatory System	25/41.2	0.61	17/32.0	0.53	0.88 (0.44-1.69)

Death Index, electoral roll and Medicare databases. Information on cause of death was obtained from death certificates. The data is presented in the table above:[13]

Psychiatric conditions

Psychiatric symptoms may occur following overt or subclinical stroke. Depression can commonly occur secondary to otherwise asymptomatic strokes.[14] Hence it is important to keep this in mind when conducting studies which examine the role of psychiatric disorders in the aetiology or course of cerebrovascular disease.

Vogt et al (1994) conducted a prospective study of 1659 household units with 2573 adult members of the Northwest region of Kaiser Permanente a large health care organisation in Portland. Subjects were respondents to a personal interview survey in 1970/71 and were followed up to 1985 for morbidity (first incidence of IHD, cancer, stroke, hypertension, infection) and mortality. Ninety-two percent were successfully interviewed. Baseline measures of mental health status was assessed by Langner index (22 symptoms, widely regarded as an index of psychophysiological symptomatology and general malaise), depression index (allowing a close approximation of diagnosis of depression in DSM III), Bradburn-Caplowitz Affect-Balance Scale (emotional state during previous few weeks) and Bradburn Worries Scale (worries during past few weeks).[15]

For men only, the risk of dying during the follow-up interval was lower for the least depressed compared with the most depressed tertiles [RH=0.71, CI 0.52-0.97]. However, there was no evidence of excess risk of stroke when upper and lower tertiles of the four scales were compared, after adjusting for age, sex, socioeconomic status (SES), length of health plan membership, subjective health status and smoking.[16]

Simonsick et al (1995) followed a cohort of older hypertensive adults from three sites [established populations for epidemiologic studies of the elderly (EPESE)] to see if hypertensive subjects with depressive symptoms would express poorer hypertension control and higher cardiovascular mortality. Subjects from East Boston and Iowa were from total community surveys. In New Haven subjects from public or private elderly housing were oversampled. Study population was restricted to those with hypertension [were told by a physician that they had hypertension or measured blood pressure was high (SBP≥160 mmHg or DBP≥95 mmHg), or subjects were taking antihypertensive medication]. Depression score was available in over 90% of the hypertensives in each of the three sites: East Boston — 385 males, 934 females; New Haven — 348 males, 684 females; Iowa — 330 males, 780 females. Stroke and vital status were ascertained annually for 6 years; depressive symptoms and blood pressure were measured at baseline and in Years 3 and 6.[17]

At the end of three years there was no consistent association between depressive symptoms at baseline and elevated blood pressure (taken as indication of poor control regardless of medication status). Among men, there was a significantly higher adjusted rate of self reported strokes in those with high depressive scores at baseline (compared to those with a low depressive score) in East Boston at the end of 3 (14.9 vs 4.3) and 6 years (25.3 vs 9.3) respectively, and New Haven at 6 years (18.9 vs 8.3) but not in Iowa (3 years: 5.7 vs 10.0; 6 years:12 vs 16.3). Among women

with higher depression scores a higher adjusted rate of strokes was seen at the end of 3 years in New Haven (8.5 vs 4.1) and Iowa (9.5 vs 4.5) but not East Boston (3.6 vs 3.7); at the end of 6 years significant increase in risk was seen only for New Haven (13.1 vs 7.8). These results were adjusted for age, disability, diabetes, angina, use of digitalis and history of myocardial infarction (MI) and stroke (no mention of blood pressure or body mass index — BMI).[18]

The rates of stroke were 2.3 to 2.7 times higher in several subgroups with high depressive symptomatology. Rates of cardiovascular mortality were also elevated in some of the subgroups. The authors stated that the association seen between cardiovascular deaths, stroke and depression symptoms in hypertensives could be a function of the severity of illness among depressed individuals. This study could not elucidate the chronological relationship between onset of depression and complications of hypertensive disease. The study found an inconsistent association between blood pressure control and depression.[19]

Saku et al (1995) reported on the cause specific mortality of psychiatric patients admitted to a National mental hospital in Saga, Japan (n=4980) during 1948 to 1982. The cases were followed up to August 1985 using Japanese family registers and cause of death was ascertained from death certificates. There were 1332 deaths including 429 during hospitalisation. The all cause SMRs were significantly elevated in these cases (2.88 in males and 3.10 in females). There were 110 cerebrovascular disease deaths. For the whole sample SMR for cerebrovascular disease was raised significantly only in males (Males: SMR=1.65, 95% CI 1.35–1.98; Females: SMR=1.18, 95% CI 0.82–1.658). The SMR for CVD was not significantly raised in schizophrenia cases (Males SMR=1.03, Females SMR=0.92), or depression cases (Males SMR=1.65, Females SMR=0.39). Raised cerebrovascular disease SMR was seen with alcohol/drug abuse (SMR=2.27) and organic brain syndrome (Males SMR=2.59, Females SMR=2.43).[20]

Sims (1973) followed up 166 patients treated as inpatients, day patients or outpatients at Uffculme Clinic, Birmingham in 1959 for 12 years. Diagnostic categories in these patients included "anxiety reaction", "hysteria", "obsessive compulsive reaction", "neurotic depression", and "pathological or immature personality". Information was available on 157 subjects (97%) at the end of the 12 years. There were 20 deaths during this period, three of which were suicides and 5 were classified as quasisuicides (possibly or partly attributable to psychiatric illness). Twelve died of natural causes which is twice as high as would be expected. Of these 12 natural deaths, 7 were from cardiovascular disease and 5 were from tumours. Deaths from natural causes showed an approximately normal distribution for causes of death and sex of the sample. Three died of strokes: 2 died of cerebral haemorrhages and had hypertension (aged 53y and 58y); one died of cerebral thrombosis (aged 55y). No information was provided on confounders.[21]

Gibbs (1992) reported the occurrence of cerebral ischaemia in panic disorder. Nine patients meeting the DSM-III-R criteria for panic disorder and nine healthy comparison subjects of similar age and sex were studied by transcranial Doppler ultrasonography before and during hyperventilation by using a Biosound Genesis II vascular ultrasound unit with transcranial Doppler capabilities. The basilar artery was insonated through the foramen magnum. There was no significant variation in baseline mean basilar artery flow velocity (38.4 cm/sec, SD=12.5, vs mean=40.4 cm/sec, SD=6.0) or in the baseline pulsatility index (mean=0.85, SD=0.16 vs mean=0.85, SD=0.12). The pulsatility index is equal to the peak systolic velocity minus the final diastolic velocity divided by the mean velocity. Generally an increase in the pulsatility index is an indication of increased vascular resistance distal to the segment of the artery being sampled by the ultrasound.[22]

Hyperventilation was performed until a stable, minimum basilar flow velocity was achieved, which usually occurred within 60–90 seconds. Hyperventilation produced a significantly greater reduction in basilar artery flow velocity (62% vs 36%) and a much greater increase in the pulsatility index in patients with panic disorder than in comparison subjects. Two patients were found to have a greater than 80% reduction in basilar artery flow velocity during hyperventilation, however, both these patients had low baseline basilar mean flow velocity (lower than all cases and con-

trols). One of these cases had a history of unexplained syncope in adolescence which returned in conjunction with severe anxiety as an adult, which responded to treatment with nimodipine for 4 weeks.[23]

Keppel Hesselink (1993) in a letter reported that they studied the effect of two doses of nimodipine on the blood flow during hyperventilation in 24 healthy male volunteers using a double-blind, placebo-controlled crossover study. To monitor severity of cerebral ischaemia they used quantitative EEG analysis.[24]

Standardised hyperventilation produced 60% reduction in blood flow in the middle cerebral artery. During hyperventilation blood velocity was reduced by 59% in the placebo group and by 56% in both nimodipine groups. Although no differences between the blood flow velocity could be detected, a clear anti-ischaemic effect was demonstrated for both doses of nimodipine, without preventing hyperventilation-induced ischaemia.[25]

Adler et al (1971) conducted a retrospective study of 32 men experiencing 35 ischaemic strokes, admitted during two six month periods (1965–66, 1967–68). Individuals unable to provide information or who died early were not included in the sample. Twenty-three cases had primarily intracranial and nine cases had primarily extracranial lesions. Twenty-three interviews were obtained within 72 hours of the first symptom of stroke. Close relatives were also interviewed.[26]

The authors reported on the unpleasant affects in the month preceding the stroke. It was based on self-reports and reports of relatives. The great majority of patients were rated as exhibiting 2 to 4 unpleasant affects during the prestroke month; 6 revealed none. The most prevalent affects were:

- hopelessness — 26 strokes out of 35;
- anger — 25 times out of 35;
- shame — 13 times;
- sadness — 11 times;
- helplessness — 9 times;
- guilt — 6 times;

while loneliness and anxiety were rare.[27]

Lidenstrom et al (1993) in a prospective study of lifestyle factors and risk of cerebrovascular disease in women (Copenhagen City Heart Study) found an association between use of tranquillisers (OR =1.25 95% CI 0.96-1.62) and first ever stroke or transient ischaemic attack (TIA), using Cox regression mode. The significance of this finding is not clear.[28]

Type A personality, anger & aggression

Eaker and Feinleib (1983) reported on the relationship of psychosocial characteristics and stroke incidence during a 10 year period in the Framingham study. Between 1965–1967, 1317 coronary and cerebrovascular disease free individuals were administered an extensive psychosocial questionnaire.[29]

The incidence of stroke among women was significantly associated with increased emotional lability, anger-in, and symptoms of tension and anger. Type A women had significantly higher rates of cerebrovascular accidents (CVA) than type B women (RR=5.0 p=0.04). Working women in blue collar occupations had higher rates of CVA than either clerical or white-collar workers (5.2 vs 2.2 and 0.0 % respectively). Working women who developed CVA also scored higher on a measure of work-overload (p=0.001). In addition, women with non-supportive subordinates had higher rates of CVA than those with supportive subordinates (p<0.005). Housewives who reported they were not able to relax during the day were at a higher risk than those reported they could relax (RR=4.62, p=0.01).[30]

The incidence of CVA among men was significantly associated symptoms of anxiety (p=0.02) and marginally with symptoms of anger (p=0.06). Men identified as type A (job-related component) were at higher risk than type B's if they experienced work-overload (6.6 vs 1.1%, p=0.05). In addition, men who anticipated a poor chance of achieving the income they'd like had significantly higher rates of CVA than men who reported a good chance.[31]

After controlling for age, systolic BP, cholesterol and cigarette smoking, all of the above relationships remained significantly associated with the incidence of CVA with the exceptions of symptoms of tension in women and symptoms of anger in both men and women.[32]

Carasso et al (1981) studied all 384 patients admitted to the Emergency Room of Ichilov Hospital, Tel-Aviv, with a diagnosis of CVA. Of these

384, 200 (52%) had a known history of cardiovascular disorders (no details provided), while 184 had no such history. Each patient was asked to answer questions on the Holmes and Rahe Social Readjustment Rating Scale (SRRS) and the Jenkins Activity Survey (JAS). Only five with known cardiovascular history refused.[33]

Most of the CVA patients were type A personalities; 88.2% (range 87.5% to 92%) of those with a known history of cardiovascular disorders and 80.9% (range 78.7% to 100%) of those without a known past history of cardiovascular disorders were type A personalities. As the severity of the stroke increased the frequency of type A personalities increased slightly.[34]

Type A behaviour was characterised as follows by the authors:

1. An intense, sustained drive to achieve self-selected, but usually poorly defined goals;
2. Profound inclination and eagerness to compete;
3. Persistent desire for recognition and advancement;
4. Continuous involvement in multiple and diverse functions constantly subject to time restrictions;
5. Habitual propensity to accelerate the rate of execution of many physical and mental functions; and
6. Extraordinary mental and physical alertness.[35]

Matsumoto et al (1993) evaluated the relation between atherosclerotic risk factors, including anger and aggression, and the severity of carotid atherosclerosis on the basis of the findings of B-mode ultrasonography. The study was carried out on 34 Japanese patients (22 males, 12 females) in Japan from August 1991 to January 1992. Five had chronic cerebrovascular disease (>6 mths) and 3 had TIAs. The remaining 26 had at least one risk factor for atherosclerosis (hypertension, hypercholesterolaemia, diabetes and/or cigarette smoking).[36]

Cornell Medical Index-Health Questionnaire was used to evaluate (self-reported) anger. Rosenzweig Picture-Frustration (P-F) study and Yatabe–Guiford (Y-G) test were used to evaluate self-reported aggression. Severity of atherosclerosis was evaluated by carotid B-mode imaging, and the subjects were divided into two groups based on the finding. Group A (16 patients) had more severe plaque (plaque score ≥5.0) and Group B (18 patients) had mild or no plaque (plaque score <5.0).[37]

There was significant positive linear correlation between the plaque score and anger (Gp A 65.3% vs Gp B 16.7%, $p<0.05$). There was also a significant positive linear correlation between the plaque score and extrapersistive aggression one of the extraggression characteristics (aggression directed towards the environment) in univariate analysis but not in multivariate analysis. The intraggression (towards oneself) scores and imaggression (evasion) scores had no significant correlation with the plaque score. On multivariate analysis significant correlations were seen for plaque score with age, hypercholesterolaemia and anger. However, generally accepted risk factors such as hypertension, being male, cigarette smoking, and diabetes mellitus were not significantly associated with carotid atherosclerosis.[38]

The above study should be interpreted with caution because the selection criteria of study subjects is not clear and the study sample is small. It also did not find significant association with many well accepted risk factors for atherosclerosis.

Adler et al (1971, discussed above) conducted a retrospective study of 32 men experiencing 35 ischaemic strokes, admitted during two 6 month periods (1965–66, 1967–68). Individuals unable to provide information or who died early were not included in the sample. Twenty-three cases had primarily intracranial and 9 cases had primarily extracranial lesions. Twenty-three interviews were obtained within 72 hours of the first symptom of stroke. Close relatives were also interviewed. Certain personality features were commonly represented, including a behavioural pattern designated pressured, to assure satisfaction of selfset goals; chronic problems in the control of anger; and an object-relating style characterised by assumption of personal responsibility for gratification of needs.[39]

The authors also reported on the unpleasant affects in the month preceding the stroke. It was based on self-reports and reports of relatives. The great majority of patients were rated as exhibiting 2 to 4 unpleasant affects during the prestroke month; 6 revealed none. The most prevalent affects were:

- hopelessness — 26 strokes out of 35;
- anger — 25 times out of 35;

- shame — 13 times;
- sadness — 11 times;
- helplessness — 9 times;
- guilt — 6 times;

while loneliness and anxiety were rare.[40]

Gianturco et al (1974) conducted a small case-control study to study the effects of personality patterns and life stress in ischaemic cerebrovascular disease. Cases constituted 26 with completed cerebral infarctions and 16 with TIAs (males aged 45–64 years admitted to Duke University Hospital, North Carolina). Strokes occurred within few weeks to three to six months prior to the admission. In one-half of the cases of TIAs, the TIAs started approximately six months before hospitalisation. Cases with confusion, altered consciousness etc were excluded. Controls consisted of 14 white men who had been admitted to the hospital during the same period for non-vascular illness. The control group was younger than the cases and more of them had college education or professional occupations compared to the cases. Patients with chronic illnesses such as congestive heart failure, peptic ulcer or severe arthritis were excluded from both cases and controls, as these illnesses may cause emotional and behavioural changes.[41]

Information was obtained by interviewing patients and their wives. The psychiatric examination consisted of a semistructured interview [which featured questions on "pressure pattern", "object relating style (dependent vs independent)", "affect at onset of illness", "patterns of coping with anger", "circumstances evoking anger", and "nature of life stress preceding illness (internal vs external)] which followed a written guide listing the personality characteristics described by Adler et al (discussed above). The interviewing psychiatrist rated the responses according to a five-point scale.[42]

In 70% with cerebral infarction, 31% with TIA and 36% of controls, "pressured" features were the major, if not predominant, aspect of their personality. There was little difference in the ratings between cases and controls with regard to the affective state prior to the onset of illness. Anger was the most frequent affect in cases and controls preceding the stroke or the illness requiring hospitalisation and occurred in 14 (54%) of cases and six (43%) of controls. No differences were observed between cases and controls with regard to either their pattern of coping with anger or the number and types of circumstances evoking anger.[43]

Men with a history of ischaemic heart disease had a higher frequency of an unpleasant affective state, particularly anger, preceding their stroke. There was no evidence, however, that these men had problems in coping with anger nor were they found to have an excess number of circumstances evoking anger.[44]

The above study had a number of deficiencies. Number of study subjects was small and the cases and controls were not well matched. Representativeness of the sample is questionable. The high pressure features were more common in patients with cerebral infarction compared to patients with TIAs. This may reflect the differing proportions of cerebral thrombosis and cerebral embolism in these two groups or reporting bias.

Life events / Non specific stress

Kleinman et al (1992) studied the frequency of stroke admissions before, during and after the Gulf war (Dec 1990 to March 1991) in Bikur Cholim Hospital in Jerusalem. The authors noted an increase in the frequency of haemorrhagic strokes (includes haemorrhagic infarction and intracerebral haemorrhage but not subarachnoid haemorrhage) during the Gulf war period. Classification of ischaemic vs haemorrhagic stroke was done according to CT findings. Haemorrhagic strokes constituted 24.4% of the total strokes during the Gulf war period (4 months), which was significantly higher than the frequency during the previous four month period and about twice as frequent when compared with the identical periods before and after the war.[45]

Of the 39 patients with haemorrhagic stroke in this series (Aug 89–Mar 92) 30 had a history of hypertension. The authors stated that the threat of war etc could have caused an increase in blood pressure contributing to haemorrhagic strokes.[46]

The total number of patients admitted to the emergency room at Bikur Cholim Hospital was lower during the war period, although the number of hospitalised patients was higher during this period.[47]

The authors stated that a similar observation

Table 2. Types of stroke admissions at Bikur Cholim Hospital[48]

Period	No. pts with haemorrhagic strokes (% of total strokes)	No. of patients with ischaemic strokes
Aug 89 - Nov 89	5 (17.8%)	23
Dec 89 - Mar 90	4 (13.8%)	25
Apr 90 - Sept 90	5 (11.9%)	37
Aug 90 - Nov 90	3 (7.1%)	39
Dec 90 - Mar 91	**10 (24.4%)**	**31**
Apr 91 - Sept 91	2 (7.4%)	25
Aug 91 - Nov 91	5 (15.6%)	27
Dec 91 - Mar 92	5 (13.8%)	31

was made at the Hadassah University Hospital, Jerusalem, where haemorrhagic strokes were 19.2% of the total (5 of 26) during the Gulf war compared to 10.5% (6 of 57) in the control period before the war.[49]

Rosengren et al (1991) in the prospective Multifactor Primary Prevention Trial in Goteborg, included some questions on self perceived stress. The study began in 1970 and the study subjects consisted of a random sample of all men in Goteborg who were born between 1915 and 1925 (except 1923). In all, 7495 men aged 47 to 55 years (75% response) attended a screening examination between Jan 1970 and March 1973; 76% of the men still alive and living in Goteborg participated in a second screening between 1974 and 1977. This study was designed as an intervention study with special measures for smokers, as well as for men with hypertension or hypercholesterolaemia with two equally large control groups.[50]

All participants completed a postal questionnaire before the screening examinations which contained a question on self perceived stress which was defined as feeling tense, irritable or filled with anxiety, or as having sleeping difficulties as a result of conditions at work or home. Psychological stress was graded as follows by subjects:

(1) never experienced stress;
(2) ≥1 period of stress;
(3) some period of stress during the last 5 years;
(4) several periods of stress during the last five years;
(5) permanent stress during the last 1 year;
(6) permanent stress during the last 5 years.

Follow-up extended through March 1983 (mean 11.8 y from 1st screening and 7.1 y from 2nd screening). Only men without a prior history of myocardial infarction were included in the study leaving 6,935 men. Cause of death was ascertained by collection of death certificates and computer matching of cause-specific death register. Incidence of non-fatal disease was also collected.[51]

Stress rated as 5 or 6 was associated with a higher mortality from stroke compared to grades 1 to 4. The results are presented in the table below:

The study group also conducted a second prospective study on a smaller group of men (n=1,016) aged 50 years. This study utilised the question on stress employed in the first study and

Table 3. Incidence of Stroke and Self-perceived stress[52]

Stress rating		No of subjects	Stroke incidence % (n)
(1)	never experienced stress;	1,162	1.4% (16)
(2)	≥1 period of stress;	1,494	1.3% (20)
(3)	some period of stress during the last 5 years;	1,300	1.3% (17)
(4)	several periods of stress during the last five years;	1,909	1.7% (33)
(5)	permanent stress during the last 1 year;	281	1.1% (3)
(6)	permanent stress during the last 5 years. [53]	789	2.9% (23)
Crude Odds Ratio [Stress rating 5-6 vs 1-4] & 95% CI			1.7 (1.1-2.6)
Adjusted* Odds Ratio [Stress rating 5-6 vs 1-4] & 95% CI			1.8 (1.1-2.8)

* adjusted for age, systolic blood pressure, serum cholesterol, smoking body mass index, diabetes, family history of myocardial infarction, occupational class, marital state, leisure time physical activity and registration for alcohol abuse.

a life events questionnaire. Subjects were followed up for 6 years. It was clear from the analysis of this group, that psychological stress as defined in the first study had very little to do with life events such as bereavement, separation or unemployment, and was more closely related to worries. With the exception of life events, the stress questionnaire used in the first study had not been validated against other measures of stress.[54]

House et al (1990) in a retrospective case-control study examined life events and difficulties in the year before stroke onset, using a semi-structured interview. One-hundred and thirteen surviving stroke cases from the *Oxfordshire Community Stroke Project* (first ever strokes notified between Nov 85 and Nov 86; 90% had CT scans) and 109 (87% response rate) age and sex-matched population controls (identified from General Practitioner's Registers) were employed. Necessary information for the study was obtained one month after the stroke in 84/113 cases, and 6 months after the stroke in 29 cases. Controls were interviewed between April and December 1987. Follow-up interviews were possible with 109/113 cases. The subjects were interviewed using the Bedford College Life Events and Difficulties Schedule (LEDS). "***Events***" by convention were episodic in nature: acute illnesses, accidents, court appearances, death of family, etc, while "***difficulties***" have persisted for more than four weeks, for example, chronic ill health, protracted marital friction.[55]

The threat was not simply rated on the basis of the subject's report, nor the basis of some predetermined rating scale, but according to a judgement about how threatening the average person would have found such an experience given the same circumstances. Events were rated on a 1–4 scale and difficulties on a 1–6 scale, with 1 the most severe in both cases. Events were also rated according to whether they are threatening only in the short term, or carry long term implications, for example, the death of a spouse. Events and difficulties relating to the physical health of subjects were excluded from the result to reduce effects of risk factors for stroke.[56]

Severe life events included deaths in close family members, illness in close family members, serious marital conflict/separation, undesired residence change, separations other than marital etc. Rating bias between interviewers was diminished by audiotape recording and joint-rating of interviews.[57]

The stroke patients reported fewer non-threatening events and events with only a short-term threat, while difficulties were reported with equal frequency by the two groups. However, the proportion of subjects who experienced at least one severe event in the preceding 52 weeks was higher among the stroke patients (26% vs 13%, OR =2.3, 95% CI 1.1–4.9); for the preceding 24 weeks the figures were 17% vs 8% (OR =2.2, 95% CI 0.9–5.7). The risk of experiencing at least one severe event was higher among stroke cases throughout the 52 weeks and there was no evidence of a further increase in proximity to the stroke, compared to the controls. Both groups reported more life events for weeks nearer the interview. The number of severe events in the follow-up year among cases fell to the level found in the control group. The authors stated that the difference in severe events between cases and controls would only disappear if 5 out of the 15 refusers experienced severe events in the preceding 52 weeks. Recognised risk factors for stroke were found equally in those patients with and without severe events before onset, except that hypertension was rather less common in the patients who had experienced a severe event.[58]

CT brain scans had been obtained in 112/113 stroke patients. Severe events were reported by 25% with definite haemorrhagic strokes vs 24% of the remainder.[59]

Carasso et al (1981, discussed above) studied all 384 patients admitted to the Emergency Room of Ichilov Hospital, Tel-Aviv, with a diagnosis of CVA. Of these 384, 200 (52%) had known history of cardiovascular disorders (no details provided), while 184 had no such history. Each patient was asked to answer questions on the Holmes and Rahe Social Readjustment Rating Scale (SRRS) and the Jenkins Activity Survey (JAS). Only five with known cardiovascular history refused.[60]

Patients with known CVA risk factors tended to have more severe strokes. A strong association was found between the Life Events Score and the severity of the CVA among those without a history of cardiovascular risk factors ($p<0.001$), but not so among those with a history of cardiovascular risk factors ($p<0.1$).[61]

Parkes et al (1969) followed up a total of 4,486 widowers 55 years of age and older for nine years since the death of their wives in 1957. Of these widowers, 213 died during the first six months of bereavement, 40% above the expected rate for married men of the same age. There after the mortality fell gradually to that of married men and remained at about the same level. Coronary thrombosis and other arteriosclerotic and degenerative diseases accounted for the significant excess deaths. Vascular lesions affecting CNS were not significantly increased.[62]

The authors noted that other studies have also noted an excess mortality among bereaved spouses, but have not provided information on the causes of death [Rees & Lutkins (1967), Cox and Ford (1964)].[63]

Adler et al (1971, discussed above) conducted a retrospective study of 32 men experiencing 35 ischaemic strokes, admitted during two six month periods (1965–66, 1967–68). Individuals unable to provide information or who died early were not included. Twenty-three cases had primarily intracranial and nine cases had primarily extracranial lesions. Twenty-three interviews were obtained within 72 hours of the first symptom of stroke. Close relatives were also interviewed. The onset of ischemic stroke at the moment of an intense peak of emotion was unusual, occurring only twice among the 35 strokes. On the other hand, 28 of the 35 strokes were judged to have occurred during periods of sustained or recurring severe emotional disturbance. In 17 of these there had been a significant intensification of the emotional distress over minutes up to a month immediately preceding the stroke. In 12, emotional disturbance had been sustained for some period before the stroke but no further change was noted within the month preceding the stroke. In five, no clear cut temporal relationship between the stroke and any psychologic disturbances could be established.[64]

The ature of life events contributing to the emotional disturbance during the period in which stroke occurred are listed below:[65]

- personal failing — 27 of 35 strokes; declining physical strength and/or mental powers, intercurrent physical problems;
- environmental demands, burdens or obstacles — 19 of 35 strokes; family obligations or demands, excessive work imposed by others, failure of others to meet deadlines, criticism by customers etc;
- loss (or threat of loss) of status as being useful and needed — in 19 out of 35.
- personal failure — 17 of 35 strokes; eg failures of performance in work, social relations, sexual activity or roles in family life.
- real or threatened object loss — 16 occasions.
- failure of others to meet the patients standards — 10 times.

Gianturco et al (1974, discussed above) conducted a small case-control study to study the effects of personality patterns and life stress in ischaemic cerebrovascular disease. Cases constituted 26 with completed cerebral infarctions and 16 with TIAs (males aged 45–64 years admitted to Duke University Hospital, North Carolina). Strokes occurred within few weeks to three to six months prior to the admission. In one-half of the cases of TIAs, TIAs started approximately six months before hospitalisation. Cases with confusion, altered consciousness etc were excluded. Controls consisted of 14 white men who had been admitted to the hospital during the same period for nonvascular illness. The control group was younger than the cases and more of them had college education or professional occupations compared to the cases. Patients with chronic illnesses such as congestive heart failure, peptic ulcer or severe arthritis were excluded from both cases and controls, as these may cause emotional and behavioural changes.[66]

Information was obtained by interviewing patients and their wives. The psychiatric examination consisted of a semistructured interview which followed a written guide listing the personality characteristics described by Adler et al (discussed above). The interviewing psychiatrist rated the responses according to a five-point scale.[67]

There was very little difference between cases and controls in regard to the nature of the stresses noted prior to their illness, ie., natural vs external life events. Most of the men had moderate to severe external stresses, but a few had serious internal stresses. The most common types of stress reported were occupational pressures and object losses such as death of close relatives.[68]

The above study had a number of deficiencies. Number of study subjects was small and the cases

and controls were not well matched, and the representativeness of the sample is questionable.

Macko et al (1996) evaluated 37 patients with acute ischemic stroke (determined by CT scan), and 81 controls (47 community controls from hospital volunteers, employees and patients from a hypertension outpatient clinic; and 34 hospitalised neurological cases) at LA County-University of Southern California Medical Centre. Cases with hematological disorders, major organ failure, recent MI etc were excluded. Controls were matched for age and season of recruitment.[69]

Psychological stress was evaluated with the use of scales of negative affect and stressful life events. The negative-affect scale, modified from the list of negative emotions of Zevon and Tellegen included five categories: (1) nervous, distressed, scared; (2) sad, depressed; (3) angry, upset, irritable; (4) angry at self, guilty, dissatisfied with self; (5) calm, content (scored negatively). Subjects were instructed to indicate the intensity for each emotion category during the preceding week using a 5-point scale ranging from 0 (none) to 4 (very much). An elevated negative affect score of ≥10 points was defined based on the upper quartile of scores from community control subjects (n=47).[70]

The questionnaire regarding stressful life events included five descriptions of potentially major stressful experiences, and subjects were asked to answer whether they had such experiences within the past month. Those answering "yes" were instructed to indicate the intensity they had been upset by such events, using a 5-point scale with "0" indicating none, '2" indicating moderate, and "4" indicating "upset very much". An elevated stressful life event score was defined as the presence of at least one stressful experience within the preceding month subjectively perceived as greater than moderately upsetting (≥3 points).[71]

No significant differences were observed between the three groups in the mean scores for negative affect and stressful life events. There was a nonsignificant trend towards increased prevalence of recent life events perceived as stressful in the community control group. There was a strong positive correlation between scores for stressful life events and negative affect ($r=0.61$, $p<0.0001$). However, the authors have not provided any information on the mental status of the stroke patients (for example, the presence of poor memory following stroke). The results are displayed in the table below:

Ecker (1953) has provided some information on a series of 20 cases with intracranial haemorrhage referred for neurosurgical consultation in whom an adequate personal history was obtained at some later date. The pertinent history provided by the author is presented for each of the cases in the table on the following page, for cerebral haemorrhage and cerebral ischaemia. The circumstances surrounding the remaining cases relating to subarachnoid haemorrhage (cases 3–8 were SAH without aneurysm, cases 9–11 SAH with aneurysm), spontaneous subdural haematoma (case 12) and haemorrhage into a benign tumour (case 13) have not been expanded on.[72]

Occupational Stress

Siegrist et al (1992) examined the role of hypertension, left ventricular hypertrophy and psychosocial risks in cardiovascular disease in a prospective study of 416 male (range 25–55 years, mean 40.8±9.7) blue collar workers, followed up over 6.5 years (2000 P-Y). Occupational stress was ascertained by structured inter-

Table 4. Negative affect scale & stressful life events data for stroke and control groups[73]

	Stroke group (n=37)	Community Controls (n=47)	Hospitalised controls (n=34)
Negative Affect Score	4±3.9 (n=34)	5.1±4.3	5.3±4.2 (n=30)
Life events score	1±2.2 (n=34)	1.6±2.1	1.6±2.8 (n=30)
Increased recent stressful life events (<1 month)	5/34 (15%)	16/47 (34%)	5/30 (17%)
Increased stressful life events or elevated negative affect	7/34 (21%)	18/47 (38%)	7/30 (23%)

	Pathology	Pertinent personal history
Case 1	Intra-cerebral haematoma	25 year male. History obtained 6 months later. Being investigated for sterility. After two unsuccessful attempts at providing a semen sample, was due to visit the urologist to provide a semen sample. Developed anxiety, and developed headache which marked the onset of the stroke. Stroke was diagnosed sometime later (not very clear from the history provided. Appears that the patient had had headache for number of weeks at least).
Case 2	Haemorrhage into basal ganglia	11 year old girl. Failed to find mother at home, became frantic, ran from house to house and collapsed, with stroke.
Case 14	Probable thrombosis of the internal carotid artery at its origin	69 year old women. Best friend died suddenly 1 week earlier. Mother and sister died of stroke at ages 65 and 60 years respectively. Had history of significant hypertension for 10 years.
Case 15	Probable thrombosis of the internal carotid artery at its origin	57 year old man. Stroke happened in sleep. History of demotions at work, and white-coat hypertension (SBP>200), released from work due to hypertension. Rage against company reached a climax before the stroke.
Case 16	Hemiplegia without evidence of arterial thrombosis. (recovered within few days)	Problems associated with a time-study person watching his working speed to set up a standard pay schedule, in the previous month. Anxious, dependent, worries about everything, compulsive, and had a family history of mental illness.
Case 17	Hemiplegia without evidence of arterial thrombosis. (no filling middle and anterior cerebral arteries)	Child was placed in plaster case for hip dislocation 2 months before stroke. Headaches started around this time. Father suffered partial intestinal obstruction 1 week before the stroke and was critically ill for 2-3 days.
Case 18	Hemiplegia, gradual onset.	44 year old woman. Husband becoming more independent and less dependent on her. Suffered from dysmenorrhoea with depression for a number of years.
Case 19	Temporary blockage of internal carotid artery last probably minutes.	17 year old boy. Shy, passive and effeminate. Generally fearful and inhibited. Father, a successful athlete was intolerant of patients lack of vigour.
Case 20	Rt Hemiplegia	36 year old woman, full term (12^{th} pregnancy). Previous 4-5 pregnancies were due to failed contraception. Had transitory numbness of the right limbs 4 month earlier.

views and psychometric tests, measuring (1) occupational rewards, (2) extrinsic work load, and (3) intrinsic effort.

In the data presented the authors have considered acute myocardial infarction, death attributable to IHD, sudden deaths and fatal or nonfatal strokes together. The study subjects had a higher prevalence of risk factors for cardiovascular disease (31.6% hypertension, 25% hyperlipidaemia, higher prevalence of obesity and inactivity). Low promotion prospects, high work pressure, immersion (a state of exhaustive coping reflecting frustrated, but continued efforts) and poòr sleep were associated with higher risk in univariate analysis. In multivariate analysis, "status inconsistency (low reward)" (OR=2.86, 95% CI 1.04–7.80) and "immersion" (upper tertile OR=3.57, 95% CI 1.22–10.47) were associated with excess risk of cardiovascular disease (acute MI, stroke). Data was not presented separately for strokes.[74]

The authors stated in the discussion that stroke cases had a higher "immersion" score compared with non-cases.[75]

Aggravation of cerebrovascular accident

Numerous emotional and behavioural disorders occur following cerebrovascular accidents. Depression is the most common affecting up to 40% of patients. Post-stroke depression is probably multifactorial, contributed to by severity of the physical and cognitive impairment, nature of the brain injury, premorbid psychological health and genetic factors. While there is evidence that individuals who develop depression and/or have poor social support fare worse with regard to recovery from stroke and survival the cause for this is not clear.[76,77,78,79,80]

No information was encountered on factors which permanently aggravate cerebral ischaemia or cerebral haemorrhage.

Summary and conclusion

The literature on stress and cerebrovascular accidents is very sparse.

Military studies in general have failed to show elevated risk of cerebrovascular disease. POWs and veterans who served in Vietnam have not shown elevated risk compared to non-veterans serving during the same period. This is of relevance considering that Vietnam veterans[81] and POWs[82] would have a higher incidence of psychiatric disorders including PTSD. The National Vietnam Veterans Readjustment Study completed in 1988 in the US reported 30% lifetime and 15% current PTSD among theatre veterans.[83]

No consistent relationship was seen between depression, other psychiatric diseases and stroke mortality. No specific studies on PTSD were encountered. There is some evidence from a couple of very small experimental studies that hyperventilation (seen in panic attacks) can be associated with significant reduction in the cerebral blood flow velocity. Reduction in flow velocity was seen in normal individuals as well. The reduction in flow velocity may be clinically significant in individuals with atherosclerotic cerebrovascular disease.

There was a suggestion in the literature that type A behaviour and anger may be associated with strokes. However, there is insufficient literature with an adequate study design to reach any conclusions about the significance of this association at present.

Parkes et al (1969) did not find an increased incidence of strokes in 4,486 widowers followed up for 9 years. Rosengren et al (1991) found a higher incidence of stroke in those reporting permanent stress during the last 5 years, but this was not evident in those reporting permanent stress during the last one year. The authors found in a subsequent study that psychological stress as defined in the first study had very little to do with life events and was more closely related to worries. There is insufficient evidence at present to suggest that chronic stress would have any impact in the aetiology of strokes.

With regard to acutely stressful life events immediately preceding stroke there were only two reports, documenting an increase in haemorrhagic strokes among civilians during the Gulf war. Most of these subjects had a history of hypertension.

While it is plausible that acutely stressful events may cause increases in blood pressure (and/or other changes) which may contribute to strokes, particularly cerebral haemorrhage, the evidence in the literature is insufficient to reach any firm conclusions at present.

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APPENDIX

Conference Delegates

Brief Biographical Sketches of Conference Delegates

RMA Chairman

Professor Ken Donald MBBS, Qld 1962 — PhD, FRCPA, FRACMA, FRACS, who is currently Professor of Social & Preventive Medicine, and Head of Department of Social & Preventive Medicine, University of Queensland. Professor Donald was Chair of the Public Health and Research Development Committee of the National Health and Research Council and an Executive Member of the Council and past president of the Australian Cancer Society.

RMA Members

Professor Beverley Raphael MBBS, Sydney 1957 — MD, FRANZCP, who is currently Director, Centre for Mental Health, NSW. Immediately prior to this appointment she was Professor and Head of Department of Psychiatry, University of Queensland. Professor Raphael is a well known researcher, working especially in the field of Post Traumatic Stress Disorder. She has been President of RANZCP and member of many of their committees and the National Health and Medical Research Council.

Professor Richard Heller MBBS, London 1968 — MD, FAFPHM, who came to Australia in 1984 and is currently Professor of Community Medicine and formerly Director of the Centre for Clinical Epidemiology and Biostatics, University of Newcastle. Professor Heller's main field is cardiovascular epidemiology, exploring the reduction of heart disease mortality and he has headed an internationally known centre for teaching clinical epidemiology by distance learning to students from around Australia and Third World countries.

Professor John Duggan MBBS, Sydney 1951 — MD, FRACP, FRCP, MRACMA, FQSA who was Staff Specialist, Royal Newcastle Hospital 1958–89 and Clinical Associate Professor, University of Newcastle. Professor Duggan has vast experience as a general physician, with specialisation in gastroenterology. He also has a special interest in epidemiology and the use of tests for diagnosis. Professor Duggan is Chairman of the Quality Assurance Committee of RACP and Editor of the Journal of Quality in Clinical Practice.

Professor John Kearsley MBBS, Sydney 1977 — PhD, FRACR, FRACP who is currently Director, Division of Cancer Services, Cancer Care Centre, St George Hospital, Sydney and (conjoint) Professor of Radiology Oncology University of New South Wales. Professor Kearsley is a Member of the NSW Health Minister's Working Party on Radiation Oncology Services, Member of the Research and Ethics Committee SSAHS and reviewer of a range or publications including the Medical Journal of Australia, the Australian and New Zealand Journal of Medicine and British Journal of Cancer.

RMA Secretariat Medical Officers

Dr Alex Bordujenko, MBBS (Qld 1983) — MPH, FAFPHM is currently a Medical Officer attached to the Repatriation Medical Authority involved in the development and review of Statements of Principles. Dr Bordujenko had previously occupied several senior medical positions within the Department of Veterans' Affairs the most recent being that of Senior Medical Officer Health (Queensland). She was awarded the Sir William Keyes Fellowship in 1992 for work on Post Traumatic Stress Disease in the veteran population. Dr Bordujenko has special interests in the epidemiology of chronic disease and in the application of medical and scientific research in the development of government policy and legislation.

Dr Kym Hickey, MBBS (Qld 1986) — MPH, is currently a Medical Officer (acting) attached to the Repatriation Medical Authority involved in the development and review of Statements of Principles. Dr Hickey had previously occupied medical positions within the Department of Veterans' Affairs.

Dr Mekala Srirajalingam, MBBS (Qld 1987), MPH is currently Medical Officer attached to the Repatriation Medical Authority involved in the development and review of Statements of Principles. Dr Srirajalingam had been previously employed as a medical officer within the Department of Veterans' Affairs. She has special interests in epidemiology, public health and women's health issues.

International Delegates

Dr Terence Keane PhD is Professor and Vice Chairman of Psychiatry at the Boston University School of Medicine. He is also the chief of Psychology and the Director of the National Center for PTSD at the Boston VA Medical Center. Currently the immediate Past President of the International Society for Traumatic Stress Studies, Dr Keane has published extensively on the assessment and treatment of PTSD. He has lectured internationally on these topics. His contributions to the field of PTSD have been recognized by many honors and awards to include the Robert Laufer Memorial Award for Outstanding Scientific Achievement from ISTSS, a Fulbright Scholarship, and Outstanding Research Contributions from the Division of Public Sector Psychology of the American Psychological Association. Dr Keane is also a Fellow of the American Psychological Association and the American Psychological Society.

Dr George Vaillant is a Professor of Psychiatry at Harvard Medical School and Director of Research for the Division of Psychiatry, Brigham and Women's Hospital. He has spent the past 25 years as Director of The Study of Adult Development at the Harvard University Health Service. Dr. Vaillant has spent his research career charting adult development and the recovery process of schizophrenia, heroin addiction, alcoholism, and personality disorder. His published works include *Adaptation to life, 1977, The Wisdom of The Ego, 1993, The Natural History of Alcoholism-Revisited, 1995*. He has been a Fellow at the Center for the Advanced Study in the Behavioural Sciences and is a Fellow of the American College of Psychiatrists. A major focus of his work in the past has been to develop ways of studying defence mechanisms empirically. More recently he has been interested in successful aging.

Dr. Vaillant is a graduate of Harvard College and Harvard Medical School, did his residency at the Massachusetts Mental Health Center and completed his psychoanalytic training at the Boston Psychoanalytic Institute.

Professor Lars Weisæth MD, PhD, is currently Head of the Department of Military Psychiatry at the Division of Disaster Psychiatry, Oslo, Norway. Professor Weisæth completed military service (infantry) 1961–62 and medical studies at the University of Oslo 1962–68. He did his residency 1968–70, psychiatric training 1970–76 and then psychoanalytic training 1978–84. Since 1976 Professor Weisæth has done research in the field of traumatic stress involving war, man-made and natural disasters, violence, terror, hostage incidence, nuclear fallout etc. Professor Weisæth was a Major with the United Nations Interim Force in Lebanon (1978), Military Psychiatrist (1980–84 and has been Director of Psychiatry of the Norwegian Armed Forces and Professor of Disaster Psychiatry since 1984. Further, he has been a World Health Authority consultant in Kuwait (1991), Serbia (1991) and Croatia (1992) as well as a consultant to the United Nations on compensation for Gulf War Victims (1994).

Australian Delegates

Dr Trevor Anderson MBBS, Melbourne 1966 — FRANZCP is currently a visiting specialist in psychiatry at the Peter MacCallum Hospital, Melbourne. Dr Anderson joined the Royal Australian Army Medical Corps as a medical graduate and was initially posted as Officer Commanding 4 Camp Hospital in Townsville. From there he became Regimental Medical Officer for 6 Battalion, Royal Australian Regiment (6 RAR). Dr Anderson served as the Regimental Medical Officer for 6 RAR in Vietnam from May 1969 until he was wounded on 21 July 1969, resulting in total loss of eye sight. He then undertook psychiatric training in the Melbourne University DPM course, completing it in 1973. During his psychiatric training, Dr Anderson has worked at the Repatriation General Hospital Heidelberg, Royal Melbourne Hospital, Parkville Psychiatric Unit and the Royal Park Psychiatric Hospital. His experience has been in adult general psychiatry as a consultant in a community mental health clinic and as consultant psychiatrist to the Peter MacCallum Cancer Hospital. Dr Anderson also participates in clinical teaching of fifth year medical students and supervises staff from other disciplines in a community mental health setting. He has been a member of the National Advisory Committee on the Vietnam Veterans' Counselling Service to the Minister for Veterans' Affairs, since

it was established in 1981. Dr Anderson is also a vice president of the Royal Victorian Institute for the Blind board of directors and he represents the interest of the RVIB on the board of the Centre for Eye Research Australia.

Professor Don G Byrne holds the Chair of Clinical and Health Psychology in the Division of Psychology at the Australian National University. He is a graduate of the University of Adelaide (PhD 1975) having completed his doctoral research in the Department of psychiatry at that University. He is a Fellow of the Academy of the Social Sciences in Australia, the Australian Psychological Society, and the International College of Psychosomatic Medicine (of which he is the incoming President). His primary areas of current research interest focus on psychological studies of cardiovascular disease and on studies linking stress to adolescent smoking behaviour, though he has also published in such areas as depression, social support, and professional development issues in clinical and health psychology. Within these areas, he has authored or edited 10 books and is the author or co-author of around 100 invited book chapters or papers in medical and psychological journals.

Dr Gerard Byrne BSc(Med), MBBS(Hons), PhD FRANZCP is currently Director of Geriatric Psychiatry at the Royal Brisbane Hospital and Senior Lecturer in Psychiatry at the University of Queensland. He is a member of the executive committee of the Section of Psychiatry of Old Age, Royal Australian and New Zealand College of Psychiatrists (RANZP), and a member of the Board of Research , RANZP. Dr Byrne is a past-President of the Queensland branch of the Alzheimer's Association and a former member of the Mental Health sub-committee of the National Health and Medical Research Council (NH&MRC). He is the author of the NH&MRC monograph "The Recognition and Management of Mental Disorders in Older People" and editor of a recent textbook on behavioural and interpersonal dimensions of health care ("Medical Consultation Skills" — Addison Wesley Longman, 1997). Dr Byrne's research interests include grief and depression in older people, behavioural problems in nursing home residents, prevention of mental disorders in older people, clinical outcomes in mental health services for older people, early detection of dementia, and experimental drug treatments for Alzheimer's disease. He teaches in the new Graduate Medical Course at the University of Queensland and supervises the medical school admission interviews.

Professor Terry Dwyer, MBBS, NSW (1971) — BA, MPH, MD, is Director of the Menzies Centre for Population Health Research, Hobart managing a staff of 50 and coordinating several research projects including those on Sudden Infant Death Syndrome (SIDS). Professor Dwyer arrived in Tasmania from Sydney in 1985 where he worked as a senior lecturer in the School of Public Health and Tropical Medicine at the University of Sydney. Previously he had studied at Yale and worked at Baylor College of Medicine, Houston, and the CSIRO Division of Human Nutrition, Adelaide. As well as his interest in SIDS, he has had a significant involvement in research on the effect of lifestyle on health and in particular, on the role of diet and exercise in relation to coronary heart disease. He also has an interest in the epidemiology of cancer. In addition to his research activities he has a clinical involvement in preventive medicine and sports medicine.

Professor Murray Esler MBBS, Melbourne 1967 — BMedSc, PhD, FRACP, is a physician and medical scientist, whose clinical research interests primarily concern the sympathetic nervous system and its participation in human stress responses affecting the cardiovascular system. He has developed unique research methods for studying these matters, leading to 200 medical research publications. As a hospital based cardiologist, his clinical responsibilities involve, in particular, the management of patients with high blood pressure, coronary artery disease, heart failure and cardiac arrhythmias.

Air Commodore Warren Harrex is currently Director-General individual Health Readiness and Clinical Policy. He joined the RAAF as a medical undergraduate in February 1972. Following residency training at the Royal Hobart Hospital in 1975 he has completed a number of postings throughout Australia and overseas during his RAAF career.

Significant appointments include Commanding

Officer No.4 RAAF Hospital, Butterworth, Malaysia, Director of Air Force Medicine, Director General of Air Force Health Services and Director General Clinical Services in the Office of the Surgeon General Australian Defence Force prior to taking up his current appointment in July 1997.

Air Commodore Harrex graduated from the University of Tasmania with a Bachelor of Medical Science with Honours and a Bachelor of Medicine and Bachelor of Surgery. He obtained a Diploma in Obstetrics in 1979, a Diploma in Aviation Medicine m 1984 and a Master of Science in Occupational Medicine in 1985. He was appointed a Fellow in the Australasian Faculty of Occupational Medicine in 1988 and a Fellow in the Australasian Faculty of Public Health Medicine in 1991.

Professor Scott Henderson MD(Aberd) — DSc, FRACP, FRCP, FRANZCP, FRC Psych, is the Director, NHMRC Psychiatric Epidemiology Research Centre, a position he has held since 1975. Professor Henderson is also a Senior Visiting Specialist at the Canberra Hospital and has part research interests in the epidemiology of mental disorders, mental disorders and public health.

Professor Alan J Husband BScAgr(Hons 1), PhD, DSc, FASM, currently holds the Chair of Veterinary Pathology at the University of Sydney and is also Associate Dean (Research) in the Faculty of Veterinary Science. Professor Husband is internationally recognised for his research contributions in immunology and pathology, and the associations between behavioural/stress factors and health, in medical and veterinary areas. His interests are particularly focussed on diseases affecting mucosal surfaces (intestine, lung, reproductive tract, etc) and the development of vaccination strategies coupled with behavioural and environmental interventions to provide immune protection at these sites. He has over 25 years experience in both basic and applied research management and has worked closely with the pharmaceutical industry partners. After completing doctoral studies at the University of Sydney he spent a period at the Sir William Dunn School of Pathology at the University of Oxford, before taking up an academic appointment in the Faculty of Medicine at the University of Newcastle. Professor Husband has published several books and over 175 scientific papers and is now a member of the Editorial Boards of several international journals in immunology. He also serves on review committees for a number of research funding agencies and contributes to research policy development through membership of university, government and industry committees. He also has an active interest in commercialisation of research through interactions with the corporate sector in Australia and overseas and acts as a scientific consultant to several private sector organisations.

Professor John Kaldor BA, MA, PhD is currently Deputy Director and Professor of Epidemiology at the National Centre in HIV Epidemiology and Clinical Research, University of NSW. His field of special competence is in the epidemiology of HIV and other infectious diseases, epidemiology of cancer, disease surveillance, management of epidemiological research and monitoring programs, and training in epidemiology. In his role as Deputy Director and Head of the Epidemiology Unit, Professor Kaldor is responsible for the development and management of the Australian national HIV surveillance programs, head of the epidemiological research, and he is also responsible for teaching a range of courses in surveillance and epidemiology. He has also written more than 115 peer-reviewed papers and over 40 other publications.

Professor Alexander McFarlane MBBS, MD, Dip. Psychother, FRANZCP. Professor Sandy McFarlane was appointed as the Foundation Professor of Community and Rehabilitation Psychiatry at the University of Adelaide in 1990 and Head of the Department of Psychiatry for the North Western Adelaide Health Service in 1995. He is presently Acting Head, Department of Psychiatry, University of Adelaide. Prior to that, he held the position of Senior Lecturer in Psychiatry at the Flinders University of South Australia and was the Head of the Department of Psychiatry in 1989 and 1990. He graduated from the University of Adelaide in Medicine in 1976 with top distinction in the last three years of his course.

A major interest is in post traumatic stress disorder. He has conducted a series of investigations into several disasters. This has led to conducting a further body of research examining psychophysi-

ological aspects of post traumatic stress disorder. Currently he is part of a group looking at memory function in PTSD using PET, MRI and ERP.

He has also actively campaigned for legislative change to improve the management of natural disasters and the systems of compensation to the victims after the events.

Other research interests include the process of adaptation to experiencing a mental illness and the role these reactions play in determining the patterns of disability. As well, he has an active research interest in the categorization, description and measurement of disability in both psychiatric and physical illness. He has been involved in an epidemiological study of psychiatric illness and associated disabilities in a rural community. He is conducting a study looking at the immediate reactions to motor vehicle accidents and their role in predicting long term psychiatric morbidity.

He has published extensively in the international literature about the effects of traumatic stress.

Professor McFarlane was instrumental in the establishment of a treatment service for refugees in South Australia who have been the victims of torture and trauma.

He is a member of the Board and also President Elect of the International Society for Traumatic Stress Studies. He served on the DSM-IV Sub-Committee which revised the definition of post traumatic stress disorder. He is President of the Australasian Society for Traumatic Stress Studies.

He is the Royal Australian and New Zealand College of Psychiatrists' representative on the National Disaster Relief Committee. He is also a member of the College's Board of Research.

Late in 1993 he did a consultancy for the World Health Organisation in Kuwait investigating the impact of the Iraq-Kuwait war and is now involved in further long term research. Subsequently he has been asked to act as an advisor to the Kuwait Government on health issues arising from the occupation.

He is a member of the Clinical Reference Committee to the National Centre for Post Traumatic Stress Disorder in young veterans.

Professor Philip Morris BSc (med), MBBS, PhD, FRANZCP is currently Director of the Integrated Mental Health Service, Gold Coast Hospital, and a member of the Department of Psychiatry, University of Queensland. Formerly he was Director of the National Centre for War-Related Post Traumatic Stress Disorder at the Austin and Repatriation Medical Centre and Professor of Psychiatry at the University of Melbourne. Professor Morris trained in medicine at the University of NSW, Sydney and undertook post graduate training and research in psychiatry at Royal Prince Alfred Hospital and Royal Newcastle Hospital in Australia, and at Rhode Island Hospital and the Johns Hopkins Hospital in the USA. He became a fellow of the Royal Australian and New Zealand College of Psychiatrists in 1985 and was Board Certified by the American Board of Psychiatry and Neurology in 1991. Professor Morris has published more than 60 pieces of work. He reviews grants for four major research funding bodies and reviews articles for five psychiatric journals. His research and clinical interests cover post traumatic stress disorder, neuropsychiatry, brain imaging and alcohol addiction. He has been an investigator on 17 research grants in these and related fields.

Professor Jake Najman PhD. is Head of Department of Anthropology and Sociology at the University of Queensland. He has served on the State Executive of the Public Health Association and as President of the Queensland Branch. Presently Professor Najman is a member of the Executive of The Australian Sociological Association.

Professor Najman has taught and researched in the health care field since 1970. His major research commitment has been the Mater-University of Queensland Study of Pregnancy. This longitudinal study of 8,556 mothers and their children is the first major longitudinal study in Australia. The project has been funded for nine years by the National Health and Medical Research Council and has produced over 25 publications. It involves collaboration with major research groups in the United States and Great Britain and has been recognised as a major international study in the field of child and maternal health.

In addition to the above research, Professor Najman has taught extensively in the areas of evaluation methodology, health care evaluation, social factors influencing health and illness and

the computer analysis of quantitative data. Recent research interests include the merging and interaction of qualitative and quantitative research methods.

Professor Najman has written or co-written over 100 papers, many of which have appeared in national and international journals. These papers span a wide range of topics and include 25 from the Mater-University of Queensland Study of Pregnancy. The papers cover a diverse range of topics including death and bereavement, lifestyle and health, research methods and the evaluation of community health services.

Professor Christopher Tennant MBBS, Sydney 1967 — MPH, MRCPsych, FRANZCP, is currently Professor of Psychiatry at Sydney University, Director of Mental Health in the Northern Sydney Area Health Service and Head of Psychiatry at Royal North Shore Hospital. He has a long-standing interest in stress research, both from a life events point of view and also from specific stressor point of view, which has included combat related stress. His department has carried out research both in psychiatric and medical consequences of being a prisoner of war with the Japanese and also the psychiatric sequelae of combat exposure in Vietnam.

Professor Malcolm West BSc, MBBS, PhD, FRACP, graduated in Medicine from the University of Sydney in 1967. He undertook postgraduate training in cardiovascular disease at Royal Prince Alfred Hospital in Sydney. Work for his PhD degree on the topic "Circulatory Control in Hypertension" was carried out in the same institution. He spent time pursuing his research in the United Kingdom and in the United States before returning to the Department of Medicine, Flinders University of South Australia in Adelaide in 1975. He continued the same research theme using both animal models and human subjects over the next thirteen years.

In 1989 Professor West was appointed to the Chair of Cardiovascular Research within the Department of Medicine at the University of Queensland. His research interests remain centred on the cardiovascular system. The main thrust of his present work relates to generic aspects of hypertension, particularly the causal aspects of cardiovascular hypertrophy. He continues to be involved in patient care and in the education of students.