

Vietnam Veterans, Postwar Experiences and Health Outcomes

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Glossary

Autoimmune disease A disease produced when the body's normal tolerance of its own antigenic markers on the surface of cells is lost.

Cohort study An observational study design commonly used in epidemiological studies of populations exposed to pathogens that could result in future diseases.

Diagnostic Interview Schedule (DIS) A mental health diagnostic interview based on standard psychiatric nomenclature that made population mental health surveys and population-level estimates possible.

Diagnostic and Statistical Manual of Mental Disorders, Third Edition (DSM-III) The third edition of standard psychiatric nomenclature used to classify all emotional and mental health disorders in 1980 and the edition in which the definition of PTSD was included.

Heritability The proportion of variance of the liability to a disease that is due to shared genetic factors.

Hypothalamic-pituitary-adrenal (HPA) system Three key anatomic structures that collectively participate in hormonal responses to stressors by regulating human neuroendocrine functions and, hence, the body's adaptation to environmental stressors.

National Vietnam Veterans Readjustment Study (NVVRS) A national cross-sectional survey of male and female Vietnam veterans and non-veterans conducted to determine the prevalence and etiology of psychosocial readjustment problems and mental disorders among Vietnam veterans.

Operation Ranch Hand The U.S. military's operational code name for the application of herbicides (chiefly agents orange, blue, green, pink, purple,

and white) in Vietnam by aircraft in order to destroy enemy cover and food crops.

A follow-up study of the health status of the men involved in the Operation Ranch Hand herbicide operations.

Posttraumatic stress disorder (PTSD) A specific disabling psychiatric disorder that develops after exposure to psychologically traumatic events; the disorder could last for decades. Symptoms include the reexperiencing of the event, avoidance of stimuli related to the event, and persistent symptoms of increased arousal associated with the event.

Psychoneuro-endocrinology A field of medical research that focuses on the association between neuroendocrine function and psychological status, especially as this relates to steroidogenic biological alterations and psychiatric illness.

Syndromes A group of symptoms of a disordered function related to one another by means of a common pathology.

Vietnam Experience Study (VES) A national cohort study of male, U.S. Army Vietnam-theater and non-Vietnam-theater veterans, conducted to determine the prevalence and etiology of diseases and medical conditions associated with Vietnam service.

Vietnam Era Twin (VET) Registry A registry composed of male twin pairs who both served in the U.S. military between 1965–1975 in order to study the effect of genetic factors on health status.

Operation Ranch Hand Study
Posttraumatic stress disorder (PTSD)

Psychoneuro-endocrinology

Syndromes

Vietnam Experience Study (VES)

Vietnam Era Twin (VET) Registry

The Vietnam War

Although U.S. involvement in the Vietnam War officially ended over 30 years ago for the 3.14 million men and 7200 women who served there, the impact of their postwar experiences altered society in many ways. The postwar experiences of Vietnam veterans were different from veterans of many previous wars. For example, unlike earlier U.S. wars in the twentieth century, the Vietnam veteran returned home from a conflict that was controversial and unpopular. Furthermore, many veterans were draftees who often came from lower socioeconomic (SES) households. In addition, of all men eligible for the military draft, only a specific subgroup was primarily inducted, due to the Selective Service System's deferment policy, which generally exempted men from higher SES groups. Within this context, it became clear to at least some health-care professionals during the war

that many returning veterans were experiencing postwar adjustment problems. During this period, the work of Charles Figley stood out as a classic in stress research because it documented the emotional and psychological trauma many veterans began to manifest by war's end. Based on Figley's work, and that of others, health-care researchers and medical professionals in the late 1970s formulated specific etiological models of the pathogenesis of mental disorders among Vietnam veterans. They also contributed to the development of case definitions to characterize these syndromes. These efforts eventually culminated in the inclusion of posttraumatic stress disorder (PTSD) in the *Diagnostic and Statistical Manual of Mental Disorders* (3rd edn.; DSM-III). Once this was achieved, more accurate assessments of the scope and nature of traumatic stress (and related disorders) among Vietnam veterans and others were possible. Finally, studies of the postwar experiences of Vietnam veterans have led to many research developments and have accelerated the accumulation of knowledge related to the psychology and biology of PTSD, including the possible long-term medical and health consequences of this syndrome.

Although clinical documentation of the adverse psychological effects of combat exposure goes back at least as far as the U.S. Civil War, the etiology of these syndromes were neither clearly understood nor well defined. Ninety years ago during World War I, soldiers with acute adverse psychological reactions after combat were believed afflicted with shell shock, thought to result from the concussion effects of artillery bombardments. During World War II, combat fatigue was used to categorize soldiers exhibiting acute adverse psychological reactions after combat because it was thought that exhaustion played a role in this condition. From the 1950s to 1970s, the term war neurosis often was used to broadly characterize soldiers' adverse psychological reactions after combat. For example, the psychiatric literature during this period associated a wide range of postwar psychological problems with combat exposure, including irritability, jumpiness, disturbed sleep, hysteria, disorientation, and panic attacks. However, for years the long-term effects of combat exposure remained elusive, in part because of a poor case definition and in part because reliable and valid observational studies were not available until years after World War II. After reviewing these and other findings related to natural disaster and concentration camp survivors, Dohrenwend concluded that there was clear and compelling evidence that many individuals develop functional psychiatric disorders after extreme stress exposures that had not been present before these experiences, a discovery that had been made earlier by Freud.

Vietnam Veteran Studies

Initial Research

Initial studies of the postwar experiences of Vietnam veterans provided the first clinical and scientific evidence linking combat exposures in Vietnam to post-discharge problems and adjustment difficulties also observed among previous veterans. However, in part because Vietnam veterans often came from lower SES groups, the postwar status of these veterans was controversial. In addition, many early studies were methodologically flawed. One difficulty was that these studies were limited because of biases associated with using nonrepresentative samples. Another problem was the use of nonstandardized mental health measures or the use of measures that assessed only mental health symptoms. Thus, although clinicians had observed that many individuals exposed to combat exhibited certain postwar syndromes afterward (including hyperalertness, exaggerated startle responses, sleep disturbances, and other symptoms) linking these to combat exposure was problematic because of existing methodological shortcomings. However, when DSM-III was being developed in the late 1970s, clinicians and others involved with Vietnam veterans were successful in eventually incorporating these syndromes into DSM-III under the diagnostic nomenclature defining PTSD, originally labeled the post-Vietnam syndrome and later conceptually broadened to include other types of trauma, such as sexual abuse. Once PTSD was included in DSM-III, undertaking large-scale, standardized surveys of Vietnam veterans was feasible and had other research benefits. During this early research period, Robert Laufer's Legacy Study, although not based on a true probability study, stood out as a landmark investigation. This is because it included over 1000 subjects (both Vietnam veterans and civilians) and used several standard symptom scales common in the 1960s and 1970s. Thus, at the time, this study provided the best assessment of the mental health status of Vietnam veterans and served as a benchmark for future studies.

Later Research

As part of Public Law 98-160, the U.S. Congress in 1983 mandated that research on Vietnam veterans be undertaken to determine "the prevalence and incidence of post-traumatic stress disorder and other psychological problems in readjusting to civilian life." In addition to Public Law 98-160, the U.S. Congress passed other public laws mandating studies of the health effects of Vietnam service. As a consequence of these new laws, several well-designed

cohort studies of Vietnam veterans were undertaken during the 1980s. These studies avoided many of the shortcomings of previous research, chiefly because of advancements in sampling and measurement that evolved from earlier research. One of these included the availability of the Diagnostic Interview Schedule (DIS), which for the first time permitted the gathering of DSM-III psychiatric diagnoses by means of population surveys, something previously not possible. This later research confirmed that Vietnam combat veterans had higher rates of postwar adjustment difficulties, mental health disorders, medical morbidity, and postwar mortality than non-combat veterans or comparable nonveterans. Most important, however, these studies indicated that the postwar adjustment difficulties and health problems experienced by these veterans were often due to combat exposures in Vietnam, not to the selection biases or measurement inadequacies that had affected earlier studies. Among the later studies, the National Vietnam Veterans Readjustment Study (NVVRS), which involved over 2000 Vietnam-theater and non-theater veterans (in addition to hundreds of civilian nonveterans), is considered one of the most comprehensive psychosocial assessment to date. The NVVRS indicated that 15% of male Vietnam veterans were current PTSD cases (9% of female veterans) and that 31% of male veterans (27% of female veterans) had PTSD during their lifetimes. Those with PTSD also were more likely to have other stress-related psychiatric disorder, such as depression and anxiety disorders, as well as many other postwar adjustment problems. The NVVRS further indicated that the PTSD-positive veterans often had profoundly disrupted lives in almost every domain of life, including in employment and family relationships. Furthermore, the prevalence of PTSD and other postwar psychological problems were found to be significantly higher among those with greater combat exposure and among Hispanic and African American veterans.

However, as significant as the psychosocial consequences of the war was for Vietnam veterans, their postwar experiences went beyond psychosocial outcomes. For example, the Vietnam Experience Study (VES) indicated that Vietnam veterans had higher rates of postwar mortality in the first 5 years after discharge, primarily due to suicides, homicides, drug overdoses, and motor vehicle accidents. Furthermore, VES findings related to the postwar medical morbidity experienced by these veterans confirmed that Vietnam-theater veterans as a group had higher rates of health-care use and reported themselves to be in poorer health than veterans without Vietnam service. In addition, theater veterans also tended to have

higher rates of hearing loss, evidence of past hepatitis B infection, and higher thyroid-stimulating hormone levels after discharge. In addition, when the postwar health status of Vietnam veterans was examined in relation to whether the veteran had PTSD, PTSD-positive veterans had substantially higher (i.e., 50–150% greater) postwar rates of many major chronic diseases, including circulatory, nervous system, digestive, musculoskeletal, and respiratory diseases, even after controlling for the major risk factors for these conditions. For example, 25% of PTSD-positive veterans reported physician-diagnosed circulatory diseases nearly 20 years after the service (vs. 13% of PTSD-negative veterans) and 19% reported physician-diagnosed nervous system disorders (vs. 6%). Altogether, 68% of PTSD-positive Vietnam veterans reported the occurrence of a chronic disease-related medical condition 20 years after Vietnam service (vs. 48% of PTSD-negative Vietnam veterans). Finally, PTSD-positive veterans also were significantly more likely to show electrocardiographic evidence of myocardial infarction and to have abnormally high white blood cell counts ($>11,000/\text{mm}^3$) and other immune system abnormalities 20 years after military service.

The most compelling evidence, however, linking PTSD to adverse health outcomes was a VES study that examined the causes of death among 15,288 male U.S. Army veterans 30 years after their military service (see [Table 1](#)). The analyses adjusted for race, Army volunteer status, Army entry age, Army discharge status, Army illicit-drug abuse, intelligence, age, and for cancer mortality, also pack-years of cigarette smoking. The findings indicated that adjusted postwar mortality for all, cardiovascular, cancer, and external causes of death (e.g., motor vehicle accidents, accidental poisonings, suicides, homicides, and injuries of undetermined intent) was associated with PTSD among Vietnam-theater veterans ($N = 7924$), with hazards ratios (HRs) of 2.2 ($p < 0.001$), 1.7 ($p = 0.034$), 1.9 ($p = 0.018$), and 2.3 ($p = 0.001$), respectively. For Vietnam-era veterans with no Vietnam service ($N = 7364$), PTSD was associated with all causes of mortality ($\text{HR} = 2.0$; $p = 0.001$). PTSD-positive Vietnam-era veterans also appeared to have an increase in external-cause mortality as well ($\text{HR} = 2.2$; $p = 0.073$). This study essentially suggested that Vietnam veterans with PTSD were at approximately twice the risk of postwar death from multiple causes. Other postwar studies were also conducted, such as the Operation Ranch Hand Study, which sought to assess the postwar health effects of exposure to herbicides used in Vietnam. Others include the Vietnam Era Twin (VET) studies, which focused on the genetic liabilities for PTSD, substance abuse, and other mental health disorders, not just the impact of Vietnam service.

Table 1 Cox proportional hazards regressions: crude and adjusted hazard ratios by veteran and PTSD status^a

Veteran status	All-cause mortality (total deaths = 820)			Cardiovascular mortality (total deaths = 241)			Cancer mortality (total deaths = 188)			External-cause mortality (total deaths = 175)		
	HR	95% CI	P value	HR	95% CI	P value	HR	95% CI	P value	HR	95% CI	P value
All veterans ^b												
PTSD (unadjusted)	2.5	2.1–3.0	<0.001	1.7	1.1–2.6	0.010	1.8	1.1–2.8	0.013	2.7	1.8–4.0	<0.001
PTSD (adjusted) ^c	2.1	1.7–2.6	<0.001	1.6	1.1–2.4	0.027	1.5	1.0–2.4	0.075	2.3	1.5–3.5	0.001
Vietnam-era veterans ^d												
PTSD (unadjusted)	2.6	1.7–3.8	<0.001	1.3	0.5–3.6	0.57	1.1	0.4–3.6	0.84	2.9	1.3–6.7	0.012
PTSD (adjusted) ^c	2.0	1.3–3.0	0.001	1.2	0.4–3.4	0.69	0.9	0.3–3.1	0.92	2.2	0.9–5.2	0.073
Vietnam-theater veterans ^e												
PTSD (unadjusted)	2.5	2.0–3.2	<0.001	1.8	1.1–2.8	0.015	2.2	1.3–3.7	0.003	2.6	1.6–4.1	<0.001
PTSD (adjusted) ^c	2.2	1.7–2.7	<0.001	1.7	1.0–2.7	0.034	1.9	1.1–3.3	0.018	2.3	1.4–3.9	0.001

^aHR = hazards ratio; CI = confidence interval; PTSD, = posttraumatic stress disorder. Adapted from J. A. Boscarino (2006). Posttraumatic stress disorder and mortality among US Army veterans 30 years after military service. *Annals of Epidemiology* **16**, 248–256. Reproduced with permission by Elsevier Publishing.

^bN = 15,288; person-risk years = 229,565; total PTSD cases = 1050.

^cAll models adjusted for race, Army volunteer status, Army entry age, Army discharge status, Army illicit drug use, age at interview, and intelligence. For cancer mortality, models adjusted for the above variables, in addition to pack-years of cigarette smoking.

^dN = 7364; person-risk years = 110,553; total PTSD cases = 214.

^eN = 7924; person-risk years = 119,453; total PTSD cases = 836.

To date, however, the VES has provided the most compelling evidence related to the adverse health effect of combat service and PTSD during that conflict.

Psychobiological and Biomedical Findings

There are clinical reasons to expect alterations in neuroendocrine system functions in chronic PTSD cases because long-term changes in the HPA system and the sympathetic arm of the autonomic nervous system have been reported following exposure to extreme stress. Evidence suggests that the physiological arousal often observed during the recollection of traumatic events is associated alterations in the neuroendocrine functions linked to the sympathetic-adrenomedullary and HPA stress axes. In the case of PTSD, it is thought that these neuroendocrine alterations reflect the consequences of an extreme state of psychophysiological conditioning that occurs following severe stress exposures. Furthermore, although this conditioning response is initiated in the central nervous system (CNS), it is subsequently carried out by multiple endocrine mechanisms that have wide-ranging effects on the body and nervous system. Similar findings related to this physiological-emotional conditioning process have also been observed with animal models.

Several studies have reported lower cortisol levels among Vietnam veterans with PTSD, as well as increased catecholamine concentrations. Furthermore, one recent large-scale study, based on the VES and involving thousands of veterans, found not only that Vietnam-theater veterans with current PTSD had lower cortisol but that past combat exposure levels were associated with plasma cortisol concentrations in an inverse dose–response relationship (see Figure 1). In brief, research with Vietnam combat veterans suggests that PTSD-positive veterans tend to have lower cortisol levels but, paradoxically, higher catecholamine concentrations, together with heightened responses of the stress system to traumatic memories and other stimuli associated with the original trauma. It is known that chronicity and excessiveness of stress system activation can lead to pathogenesis, causing weight changes, depression, hypogonadism, and other systemic alterations, including increased metabolic load on the body's systems. Thus, the physiological findings for PTSD-positive Vietnam veterans suggest that past traumatic stress exposure has resulted in neuroendocrine system alterations that make veterans potentially susceptible to a host of chronic diseases. As noted, PTSD-positive Vietnam veterans were found to have higher postwar rates

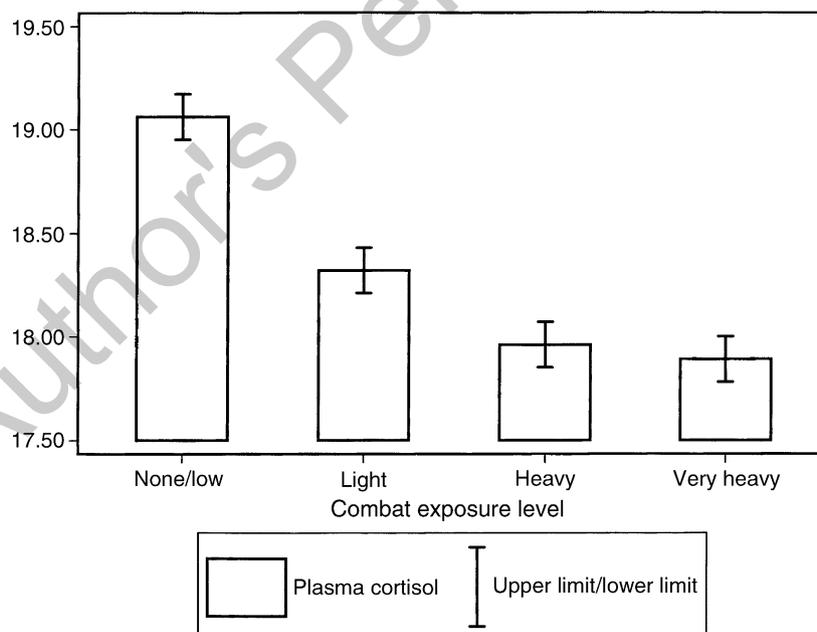


Figure 1 Adjusted plasma cortisol concentrations and standard errors bars (95% confidence limits) for Vietnam-theater veterans by combat exposure levels ($N = 2457$). Results shown are for morning, fasted plasma cortisol (in micrograms per deciliter). Combat level was measured by the Combat Exposure Index scale, a standard measure of combat exposure. Cortisol results are adjusted for demographic variables, alcohol use, drug use, smoking status, and body mass index using analysis of covariance. A trend test for cortisol by combat exposure level was statistically significant ($p = 0.0001$), confirming the inverse dose–response association between cortisol and combat exposure. Adapted from J. A. Boscarino (1996), Post-traumatic stress disorder, exposure to combat, and lower plasma cortisol among Vietnam veterans: findings and clinical implications, *Journal of Consulting and Clinical Psychology* **64**, 191–201. Reprinted with permission from the American Psychological Association.

of many chronic diseases, reinforcing this neuroendocrine-dysregulation disease hypothesis, which represents a cornerstone in human psychoneuroendocrinology research.

Related to HPA dysregulation, it has been suggested that PTSD-positive veterans may be at risk for autoimmune diseases as well. For example, although there have been inconsistencies, investigators, as previously noted, have found that individuals who developed PTSD, particularly men exposed to combat, appeared to have lower plasma cortisol concurrent with higher catecholamine levels. As suggested, Vietnam veterans with current PTSD not only had lower cortisol, but this had an inverse dose–response relationship with combat exposure. In addition, also as previously noted, research indicated that Vietnam veterans with current PTSD had clinically elevated leukocyte and T-cell counts, and similar findings have been reported in nonveteran studies as well. These veterans were also found to have other significant neuroendocrine abnormalities, such as elevated thyroid hormones. Consistent with these clinical findings, it has recently been reported that PTSD was in fact associated with several autoimmune diseases among Vietnam veterans, including rheumatoid arthritis and psoriasis. Again, analogous results have been reported in animal models as well. Of course, not all of the variance in disease outcomes should be associated directly with PTSD. Research with the VET Registry suggested that about one-third of the liability for PTSD was associated with genetic factors. Some of the same genes that make one liable for PTSD could also make one liable for specific diseases as well.

Studies of Other Veteran Populations after Vietnam

Following the first Persian Gulf War (PGW) in 1991, cohort studies were again used to evaluate the health impact of this conflict on war-theater military personnel. These studies are still in progress, and a number of them evolved from or were related to the original NVVRS and VES research designs. The PGW research to date has established a link between service in the PGW and mental illness, postservice injury, chronic fatigue syndrome, and other multisymptom conditions. The reasons for these associations are still being investigated, and the results from PGW research are being used to inform a new generation of veteran studies, related to personnel deployed in the Afghanistan and Iraq theaters of war following the September 11, 2001, attacks. For these recent conflicts, however, military personnel were being assessed both before deployment and after return, something

rarely done in the past but often desired after service exposure had occurred. Finally, following the September 11 attacks in New York City (NYC) in 2001, a number of the investigative teams, funded by the National Institutes of Health (NIH) and the Centers for Disease Control (CDC) to assess the population impact of this event, used the prospective cohort method as well as measurement instruments that had been developed originally for Vietnam veteran population studies. Thus, the field of disaster epidemiology has emerged as a subspecialty within epidemiology, informed, at least in part, by the original work with Vietnam veterans over the previous decades.

Implications for Medical Sciences, Research, and Treatment

The postwar findings reported for Vietnam veterans documented that veterans exposed to combat have more stress-related psychosocial disorders, altered neuroendocrine functions, higher medical morbidity, and greater mortality years after the war. The scientific findings related to the postwar experience of the Vietnam veteran suggest that psychobiological models are probably required to understand the impact of this experience on the lives of those who served there. For example, it has been suggested that traumatic stressors act as unconditioned aversive stimuli that evoke severe physiological distress. Consequently, previously neutral external stimuli (e.g., the sound of a helicopter) and internal stimuli (e.g., physiological states) that accompanied the traumatic stressor, can function as conditioned stimuli capable of producing psychological and physiological distress when the traumatic stressors are no longer present. Experience with psychotherapy treatments suggests that when stress victims are gradually exposed to aversively conditioned stimuli the symptoms may decrease because desensitization to the stressor could occur. A psychotherapeutic technique often used in PTSD therapy with veterans is to teach the patient to verbalize the traumatic experience with the help of a support group consisting of other veterans. This process allows veteran to redefine the external and internal stimuli that affect psychological arousal, develop better self-control, and, with assistance, desensitize him- or herself to a range of thoughts, actions, and situations associated with the traumatic events. A more structured and currently widely used approach that appears to be effective is cognitive-behavioral therapy. Thus, psychosocial processes appear to be instrumental in treating a condition that is psychosocial in origin but that also has a physiobiological basis – that is, research with Vietnam veterans and

others tells us that PTSD has both a psychosocial and a physiobiological foundation.

The recognition of a multifactorial PTSD model is consistent with the report that both pharmacotherapy and cognitive-behavioral psychotherapy are effective in treating PTSD. In the case of pharmacotherapy, the pathophysiology of PTSD, in part, appears to involve the serotonergic and the noradrenergic systems; thus, drugs known to potentiate these mechanisms have been effective. In the case of cognitive-behavioral therapy, this approach has been found to be effective in reducing PTSD-related symptomatology by achieving desensitization to stressful stimuli, by increasing control of aversive arousals, by enhancing anxiety management, and by using other known behavioral-psychological mechanisms. Although the underlying interventional mechanisms differ for pharmacological versus cognitive-behavioral therapy (e.g., pharmacokinetic vs. psychological), the outcomes are similar – the psychopathology and underlying pathophysiology are reduced and fewer adverse patient symptoms are manifested, hence lowering the risk of other adverse outcomes. Thus, we expect that as trauma-related symptoms are reduced through treatment, the risk for other adverse outcomes will also decrease. Recent research has, in fact, confirmed this hypothesis in NYC following the September 11 attacks. For example, it has been reported that NYC adults who received emergency crisis counseling at work shortly after the attacks not only had better mental health outcomes but also had better outcomes in terms of binge drinking, alcohol dependence, and alcohol consumption, lowering the possibility of future adverse health outcomes.

Although the findings discussed here chiefly involve veterans, exposure to combat, they are applicable to other populations. Traumatic stress reactions occur among individuals exposed to extreme, life-threatening situations, including natural disasters, physical attacks, wartime combat, and other situations. In addition, it is likely that human exposure and response to stress take place along a stress continuum, with traumatic stress on one end of this continuum. Furthermore, genetic liability is also likely involved with respect to whom may succumb to PTSD. Finally, the postwar experiences of the Vietnam veteran suggest that more than psychosocial explanations are needed to understand PTSD and to treat it effectively. In addition to higher-order cognitive models, findings in Vietnam veteran suggest lower-order biological models are also necessary. Research also consistently suggests that those with less social support exhibit greater levels of traumatic stress, which may explain the high rates of PTSD among Vietnam veterans, given the low community support during and after the war. This finding has clinical implications for the future treatment of both combat and noncombat-related stress victims.

Conclusion

Psychoneuroendocrinology represents a growing area of medical research that focuses on the association between neuroendocrine function and psychological status, especially as this relates to steroidogenic biological alterations and psychiatric illness. Just as with other areas of medicine – orthopedics, plastic surgery, emergency medicine, and so forth – developments in

Table 2 Key biological correlates of PTSD among a national random sample of Vietnam veterans^a

Biometric measure	PTSD negative (%)	PTSD positive (%)	P value
White blood cell count elevated	2.8	4.6	0.063
Total lymphocytes elevated	4.2	6.8	0.023
T lymphocytes elevated	2.9	6.2	0.001
B lymphocytes elevated	9.9	13.7	0.032
CD4 cells elevated	3.5	5.6	0.055
CD8 cells elevated	2.4	5.9	<0.001
Erythrocyte sedimentation rate elevated	6.1	9.6	0.013
Triiodothyronine (T ₃) uptake elevated	7.9	10.8	0.06
Thyroxine (T ₄) elevated	1.7	5.0	<0.001
Immunoglobulin-A elevated	16.4	23.5	0.001
Immunoglobulin-M elevated	1.2	3.4	0.001
Dehydroepiandrosterone reduced	2.3	4.6	0.008
Cortisol/dehydroepiandrosterone ratio elevated	4.4	7.1	0.023
N =	4139	323	–

^aData are from the Vietnam Experience Study and represent a national random sample of male U.S. Army veterans of the Vietnam War era, half of which served in Vietnam and half of which served elsewhere. PTSD cases represent both combat and noncombat cases. Assessment was done approximately 20 years after military service. PTSD, posttraumatic stress disorder.

military medicine and veterans' health have been translated into medical advances for other populations. For example, today, research related to the biological and medical consequences of anxiety disorders is more commonplace, as are epidemiological studies of other veteran populations and nonveteran studies involving exposure to human-made and natural disasters.

The medical promise of this body of research can be illustrated using the findings shown in [Table 2](#). As shown, PTSD-positive veterans have a distinct clinical profile, suggesting an increased inflammatory response related to a broad range of potential pathophysiology that could be associated with a host of diseases, including cardiovascular and autoimmune diseases. The reasons for the findings shown in [Table 2](#) are not clear at this time; they may be related to biological, psychological, or behavioral factors (or a combination of these) associated with PTSD and research also suggests that genetic factors are indeed involved. What is clear is that this area of research holds promise for understanding the psychosomatic basis for the causes and prevention of many human diseases. In conclusion, despite of the suffering caused by Vietnam War, or perhaps because of it, the postwar experiences of the Vietnam veteran have resulted in significant advances in our knowledge about the nature and consequences of human stress exposures and will probably result in future medical advances that cannot currently be imagined.

See Also the Following Articles

Acute Stress Disorder and Posttraumatic Stress Disorder; Allostasis and Allostatic Load; Anxiety; Autoimmunity; Catecholamines; Combat Reaction, Chronic; Combat Stress Reaction; Combat, Acute Reactions to; Corticosteroids and Stress; Depression Models; Disease, Stress Induced; Gulf War Syndrome, Psychological and Chemical Stressors; Hypothalamic-Pituitary-Adrenal; Korean Conflict, Stress Effects of; Major Depressive Disorder; Nuclear Warfare, Threat of; Persian Gulf War, Stress Effects of; Posttraumatic Stress Disorder in Children; Posttraumatic Stress Disorder, Delayed; Posttraumatic Stress Disorder, Neurobiology of; Psychotherapy; Salivary Cortisol; War Stress in the Former Yugoslavia; War-Related Posttraumatic Stress Disorder, Treatment of; Depression, Immunological Aspects; Posttraumatic Stress Disorder – Clinical; Posttraumatic Stress Disorder – Neurobiological basis for.

Further Reading

American Psychiatric Association (1980). *Diagnostic and statistical manual of mental disorders* (3rd edn.). Washington, DC: American Psychiatric Association.

- Archibald, H. C., Long, D. M., Miller, C., et al. (1962). Gross stress reaction in combat – a 15-year follow-up. *American Journal of Psychiatry* **119**, 317–322.
- Boscarino, J. A. (1995). Post-traumatic stress and associated disorders among Vietnam veterans: the significance of combat and social support. *Journal of Traumatic Stress* **8**, 317–336.
- Boscarino, J. A. (1996). Post-traumatic stress disorder, exposure to combat, and lower plasma cortisol among Vietnam veterans: findings and clinical implications. *Journal of Consulting and Clinical Psychology* **64**, 191–201.
- Boscarino, J. A. (1997). Diseases among men 20 years after exposure to severe stress: implications for clinical research and medical care. *Psychosomatic Medicine* **59**, 605–614.
- Boscarino, J. A. (2004). Association between posttraumatic stress disorder and physical illness: results and implications from clinical and epidemiologic studies. *Annals of the New York Academy of Sciences* **1032**, 141–153.
- Boscarino, J. A. (2006). Posttraumatic stress disorder and mortality among US Army veterans 30 years after military service. *Annals of Epidemiology* **16**, 248–256.
- Boscarino, J. A., Adams, R. E., Foa, E. B., et al. (2006). A propensity score analysis of brief worksite crisis interventions after the World Trade Center disaster: implications for intervention and research. *Medical Care* **44**, 454–462.
- Centers for Disease Control (1987). Postservice mortality among Vietnam veterans. *Journal of the American Medical Association* **257**, 790–795.
- Centers for Disease Control (1988). Health status of Vietnam veterans. I: Psychosocial characteristics. *Journal of the American Medical Association* **259**, 2701–2707.
- Centers for Disease Control (1988). Health status of Vietnam veterans. II: Physical health. *Journal of the American Medical Association* **259**, 2708–2714.
- Chrousos, G. P. and Gold, P. W. (1992). The concepts of stress and stress system disorders: overview of physical and behavioral homeostasis. *Journal of the American Medical Association* **267**, 1244–1252.
- Dohrenwend, B. P. (1975). Sociocultural and social-psychological factors in the genesis of mental disorders. *Journal of Health and Social Behavior* **16**, 365–392.
- Figley, C. R. (1978). *Stress disorders among Vietnam veterans: theory, research and treatment*. New York: Brunner/Mazel.
- Freud, S. (1953–1974). Introduction to psychoanalysis, war neuroses (1919). In: Strachey, J. (ed.) *Standard edition of the complete psychological works of Sigmund Freud*, (vol. 17), pp. 205–215. London: Hogarth Press and the Institute of Psychoanalysis.
- Frey-Wouters, E. and Laufer, R. S. (1986). *Legacy of a war: The American soldier in Vietnam*. Armonk, NY: Sharpe.
- Galea, S., Ahern, J., Resnick, H., et al. (2002). Psychological sequelae of the September 11 terrorist attacks in New York City. *New England Journal of Medicine* **346**, 982–987.

- Hanson, F. R. (1949). The factor of fatigue in the neuroses of combat. In: Hanson, F. R. (ed.) *Special issue on combat psychiatry. Army Medical Bulletin* 9, 147–150.
- Helzer, J. E., Robins, L. N. and McEvoy, L. (1987). Post-traumatic stress disorder in the general population: findings of the Epidemiologic Catchment Area Study. *New England Journal of Medicine* 317, 1630–1634.
- Hoge, C. W., Auchterlonie, J. L. and Milliken, C. S. (2006). Mental health problem, use of mental health services, and attrition from military service after returning from deployment to Iraq or Afghanistan. *Journal of the American Medical Association* 295, 1023–1032.
- Hyams, K. C., Wignall, F. S. and Roswell, R. (1996). War syndromes and their evaluation: from the U.S. Civil War to the Persian Gulf War. *Annals of Internal Medicine* 125, 398–405.
- Institute of Medicine (2001). *Veterans and agent orange, update 2000*. Washington, DC: National Academy Press.
- Keane, T. M., Zimering, R. T. and Caddell, J. M. (1985). A behavioral formulation of posttraumatic stress disorder in Vietnam veterans. *Behavior Therapist* 8, 9–12.
- Kulka, R. A., Schlenger, W. E., Fairbank, J. A., et al. (1990). *Trauma and the Vietnam War generation: report of findings from the National Vietnam Veterans Readjustment Study*. New York: Brunner/Mazel.
- Mason, J. M., Giller, E. L., Kosten, T. R., et al. (1988). Elevation of urinary norepinephrine/cortisol ratio in posttraumatic stress disorder. *Journal of Nervous and Mental Diseases* 176, 498–502.
- McEwen, B. S. (2000). Allostasis and allostatic load: implication for neuropsychopharmacology. *Neuropsychopharmacology* 22, 108–124.
- Polner, M. (1971). *No victory parades: the return of the Vietnam veteran*. New York: Holt, Rinehart, Winston.
- Robins, L. N., Helzer, J. E., Croughan, J., et al. (1981). National Institute of Mental Health Diagnostic Interview Schedule: its history, characteristics, and validity. *Archives of General Psychiatry* 38, 381–389.
- Salmon, T. W. (1919). War neuroses and their lesson. *New York Medical Journal* 109, 993–994.
- True, W. R., Rice, J., Eisen, S. A., et al. (1993). A twin study for genetic and environmental contributions to liability for posttraumatic stress symptoms. *Archives of General Psychiatry* 50, 257–264.
- van der Kolk, B. A. and Saporta, J. (1993). Biological response to psychic trauma. In: Wilson, J. P. & Raphael, B. (eds.) *International Handbook of traumatic stress syndromes*, pp. 25–33. New York: Plenum Press.
- Wolkowitz, O. M. and Rothschild, A. J. (eds.) (2003). *Psychoneuroendocrinology*. Washington, DC: American Psychiatric Publishing.
- Yehuda, R. (2002). Current status of cortisol findings in post-traumatic stress disorder. *Psychiatric Clinics of North America* 25, 341–368.

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Violence

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Types of Biological Influences
Summary

Glossary

Adoption studies

Research wherein a child with one set of biological parents and a different set of psychological parents is studied.

Biological environmental influences

Events that affect a person biologically but are not encoded into the person's DNA.

Concordance rates

The frequency with which one twin is diagnosed with an illness, when his or her twin is also diagnosed with the same illness.

Cortisol