Is Gulf War Syndrome Due to Stress? The Evidence Reexamined

Robert W. Haley

Medical policy-makers have concluded that stress from wartime trauma and deployment constitutes an important cause of the chronic physical symptoms observed in US veterans who served in the Persian Gulf War. The author reviewed scientific articles from peer-reviewed journals referenced in the final report of the Presidential Advisory Committee on Gulf War Veterans’ Illnesses and conducted a MEDLINE literature search. All reported prevalence rates of post-traumatic stress disorder (PTSD) in Gulf War veterans were defined by critical cutpoints on psychometric scales constructed by summing veterans’ responses on standardized symptom questionnaires rather than by clinical psychiatric interviews. Observed PTSD rates varied from 0% to 36% (mean, 9%). Correcting for measurement errors with previously determined values of the sensitivity (range 0.77 to 0.96) and specificity (range 0.62 to 0.89) of the psychometric tests yielded estimated true PTSD rates of 0% for 18 of the 20 reported rates. Mean scores on the Mississippi PTSD scale in all subgroups of Gulf War veterans were within the range of values for well-adjusted Vietnam veterans (50-89) and far below that of Vietnam veterans with psychiatrically confirmed PTSD (120-140). Most PTSD and “stress-related symptoms” reported in studies of Gulf War veterans appear to represent false-positive errors of measurement reflecting nonspecific symptoms of other conditions.

In the 6 years since the Persian Gulf War, approximately 100,000 of the 697,000 US veterans who served in the war have registered with the US Departments of Defense and Veterans’ Affairs for health complaints which most attribute to the war. Although some have standard medical or psychological conditions that are unrelated to wartime exposures, many present with a common array of vague, nonspecific symptoms of disputed etiology.

Noting the similarity of Gulf War veterans’ health complaints to fatigue-related syndromes which followed prior wars (1) and citing published studies on post-traumatic stress disorder (PTSD) in Gulf War veterans, summarized by the Presidential Advisory Committee on Gulf War Veterans’ Illnesses (2), medical decision-makers in the US Departments of Defense and Veterans Affairs have attributed the vague, undiagnosable illnesses to wartime stress (1, 3, 4). On the basis of this determination, the US Department of Defense is sending combat stress reduction teams with US troops in Bosnia to attempt to prevent future post-deployment syndromes (3, 4).

In the final report of the Presidential Advisory Committee, the main argument for stress as the etiology of chronic postwar symptoms was based predominantly on numerous studies of PTSD from traumatic wartime experiences (5) in Gulf War veterans published in peer-reviewed scientific journals as well as unpublished reports and expert testimony in public hearings (2). A secondary argument, which has received more attention in political debates following the report’s appearance, attributed veterans’ chronic symptoms to chronic fatigue syndrome, fibromyalgia, and other physical conditions putatively caused by the general life stresses of wartime deployment to the war zone (2–4). Whereas PTSD is officially recognized as a condition caused by a specific traumatic experience (5, 6), the popular view that general life stress plays an important causal role in chronic illnesses, such as
sustained hypertension, fibromyalgia, and chronic fatigue syndrome (2, 3), is a theoretical and popular concept (7, 8) not supported by the preponderance of scientific evidence (9, 10).

In a study of Gulf War veterans from a US Navy mobile construction battalion ("Seabees"), my research group identified three syndromes associated epidemiologically with exposure to neurotoxic combinations of chemicals (11, 12). Although some veterans had elevated scores on a psychometric scale of PTSD, veterans with one or more of the three primary syndromes we identified had more evidence than matched controls of diffuse neurotoxic injury as the primary disease process (13). This led us to wonder whether the stress theory for the etiology of Gulf War-related illnesses might have been accepted prematurely.

**MATERIALS AND METHODS**

**Diagnosis of PTSD**

A definitive diagnosis of chronic PTSD requires that all six of the following features be present: 1) occurrence of a specific, severely stressful event beyond ordinary life experiences, 2) intrusive thoughts of re-experiencing the event ("flashbacks"), 3) persistent avoidance of reminder stimuli, 4) symptoms of increased arousal which may interfere with cognition and other mental and physical functions, 5) persistence for more than one month, and 6) impairment of general functioning (5). In contrast, acute stress disorder begins within 4 weeks of the traumatic event and lasts a maximum of 4 weeks (5).

The definitive diagnosis of PTSD is made from a psychiatrist’s or psychologist’s clinical interview, usually following a structured interview technique such as the Structured Clinical Interview for DSM-IV (SCID) (14) or the Clinician-Administered PTSD Scale (CAPS) (14–18). Various psychometric scales, calculated from symptom questionnaires filled out by patients, are used in conjunction with definitive clinical interviews, but these are not considered diagnostic per se (17, 18). Rational scales (i.e., those calculated from questions that ask directly about the symptoms of PTSD) include the Mississippi Scale for Combat-Related PTSD (M-PTSD) (17) the Impact of Event Scale (IES) (19, 20) and the PTSD questionnaire for DSM-IV criteria (D-PTSD) (5, 18). Empirical scales (i.e., those calculated from less specific questions on general test measures for other conditions and found statistically to predict PTSD) include the PK subscale (also called the Keane-Fairbank, or K-F subscale) calculated from items on the Minnesota Multiphasic Personality Inventory (MMPI) or the MMPI-2 (21–23), the War-Zone-Related PTSD scale (24), and the PTSD Checklist-Military (PCL-M) (25).

In 1992, the National Center for Posttraumatic Stress Disorder published a new version of the M-PTSD scale modified for Desert Storm veterans (M-PTSD-DS) (26). The changes involved altering the wording of questions to refer to traumatic situations specific to Operation Desert Shield/Desert Storm, adding three new 5-point questions, and making the wording applicable to both genders (26). The addition of 15 points from the new questions changed the range of the scale from 35–175 for the M-PTSD to 50–190 for the M-PTSD-DS; however, validation studies were not repeated, and cutoffs for defining PTSD were not uniformly moved up (26–30). Sutker et al. (28, 29) estimated that the change would cause a positive bias of eight points on the M-PTSD-DS scale.

**Literature review**

I reviewed the 16 studies from peer-reviewed scientific journals cited in the Presidential Advisory Committee’s final report in support of the possibility that the Gulf War syndrome was due to PTSD (2, 3). I also performed a MEDLINE search for articles indexed under the National Library of Medicine Medical Subject Headings (MeSH) “stress disorders, posttraumatic” and “stress, psychological” and the text phrase “Gulf War,” which netted three additional articles that addressed etiology. For each article, I recorded whether the subjects were a population- or unit-based sample, the size of the target population, the number and type of subjects studied, the method of subject selection, the participation rate and whether nonparticipants were studied further for possible selection bias, the use of comparison groups, the methods of detecting PTSD, the observed prevalence rates of PTSD, the mean values on the M-PTSD or M-PTSD-DS scales, potential biasing features, and the conclusions.

**Estimating true rates**

Because the measurement of all published PTSD prevalence estimates in Gulf War veterans involved psychometric PTSD scales, I reviewed the methodological studies in which the sensitivity and specificity of the most commonly used scales had been determined (17, 18, 24). I then estimated the true prevalence rates of PTSD in each study by correcting the observed estimates for the sensitivity and specificity of the psychometric scale used. The relation among these parameters is given by

\[ \hat{p} = pU + (1 - p)(1 - V), \]

where \( \hat{p} \) is the observed prevalence rate of PTSD, \( p \) the true prevalence rate, \( U \) the sensitivity, and \( V \) the spec-

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ificity, all measured on a scale of 0 to 1 (31). For most diseases and populations where prevalence rates are low (far less than 50 percent), imperfect specificity, which influences the far larger quantity, \(1 - p\), has a much greater biasing impact on the observed prevalence rate than the same value of sensitivity, which influences the far smaller quantity \(p\).

Rearranging the equation to estimate the true prevalence rate as a function of the observed prevalence rate and the sensitivity and specificity of the scale gives

\[
\hat{p}_c = \frac{\hat{p}_u - (1 - V)}{(U + V - 1)},
\]

where \(\hat{p}_c\) is the observed prevalence rate of PTSD corrected for known values of sensitivity and specificity, and \(\hat{p}_u\) is the original observed value uncorrected for errors in measurement (31).

### Validation studies

The published studies on PTSD in Gulf War veterans referenced three validation studies. These estimated the sensitivity and specificity for the diagnosis of PTSD for nine of the psychometric PTSD scales (table 1).

In their 1988 study of the M-PTSD scale, Keane et al. (17) administered the M-PTSD to three groups: 30 Vietnam combat veterans who had well-documented PTSD, 30 noncombat Vietnam-era veterans who were receiving inpatient care for nonpsychotic psychiatric illnesses, and 30 well-adjusted Vietnam veterans. They found that on the M-PTSD scale, which ranges from 15 to 175, a cutpoint score of 107 maximized classification accuracy, giving a sensitivity of 0.93 and a specificity of 0.89 (table 1). They found, however, that the distributions of scores in confirmed PTSD patients and in other populations overlapped substantially (figure 1). The further M-PTSD scores were below 107, the more they overlapped those of veterans with other psychiatric disorders and even those from well-adjusted veterans with only functional symptoms (17).

A 1991 publication by Kulka et al. (18) contained two further validation studies on the M-PTSD and

<table>
<thead>
<tr>
<th>Measure</th>
<th>Cutpoint defining PTSD</th>
<th>Keane et al. (17)</th>
<th>Kulka et al. preliminary validation study (18)</th>
<th>Kulka et al. NVVRS* sample (18)</th>
<th>Weathers et al. (24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mississippi PTSD Scale (M-PTSD)</td>
<td>107 or 109†</td>
<td>0.93</td>
<td>0.89</td>
<td>0.83</td>
<td>0.83</td>
</tr>
<tr>
<td>Mississippi PTSD Scale (M-PTSD)</td>
<td>89</td>
<td>0.94</td>
<td>0.80</td>
<td>0.77</td>
<td>0.83</td>
</tr>
<tr>
<td>Structured diagnostic PTSD interview for DSM-III/IV* symptoms (D-PTSD)/item sum</td>
<td>Not stated</td>
<td>0.96</td>
<td>0.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structured diagnostic PTSD interview for DSM-III/IV symptoms (D-PTSD)/DSM-III/IV rules</td>
<td>6 symptoms‡</td>
<td>0.87</td>
<td>0.73</td>
<td>0.22</td>
<td>0.98</td>
</tr>
<tr>
<td>Keane-Fairbank subscale of MMPI*</td>
<td>14</td>
<td>0.90</td>
<td>0.69</td>
<td>0.72</td>
<td>0.82</td>
</tr>
<tr>
<td>Keane-Fairbank subscale of MMPI</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact of Event Scale (IES)</td>
<td>Not stated</td>
<td>0.92</td>
<td>0.62</td>
<td></td>
<td>0.78</td>
</tr>
<tr>
<td>War Zone-PTSD scale of SCL-90-R*</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
<td>0.90</td>
</tr>
<tr>
<td>War Zone-PTSD scale of BSI*</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
<td>0.89</td>
</tr>
<tr>
<td>General Severity Index (GSI) of SCL-90-R (or of the BSI)</td>
<td>1.1</td>
<td></td>
<td></td>
<td></td>
<td>0.86</td>
</tr>
<tr>
<td>25 randomly selected SCL-90-R items</td>
<td>1.1</td>
<td></td>
<td></td>
<td></td>
<td>0.85</td>
</tr>
<tr>
<td>F scale of MPPI</td>
<td>67</td>
<td></td>
<td></td>
<td></td>
<td>0.82</td>
</tr>
<tr>
<td>Mississippi PTSD Scale-Revised for Operation Desert Storm (M-PTSD-DS)*†</td>
<td>89 or 97</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTSD Checklist-Military (PCL-M)*†</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* U, sensitivity; V, specificity; NVVRS, National Vietnam Veterans Readjustment Study; DSM-III/IV, Diagnostic and Statistical Manual for Mental Disorders, 3rd and 4th revisions; MMPI, Minnesota Multiphasic Personality Inventory; SCL-90-R, Symptom Checklist for DSM-III-R; BSI, Brief Symptom Inventory of the SCL-90-R.

† The DSM-III/IV definition requires one re-experiencing symptom, three avoidance symptoms, and two hyperarousal symptoms (5).

‡ The PTSD Checklist refers to Operation Desert Shield/Storm, three 5-point questions added, and wording adjusted to make it gender-appropriate; some studies used Kulka's cutpoint of 89 and others empirically increased the cutpoint to 97 to compensate for the increased scale. The revised scale has not been validated.

† No published validation study.
on 28 April 2018

Haley

Participants included 344 (85 percent) of 403 veterans selected to include true cases of PTSD and veterans with other scales based on larger numbers of veterans in a community sample. In a preliminary validation study, Kulka et al. examined 244 subjects with structured clinical interviews using the SCID to establish diagnoses, and then they used a trained interviewer, unaware of the SCID diagnoses, to administer the various PTSD scales. Kulka et al. found that the classification accuracy of the M-PTSD was maximized by a cutpoint of 89 (18). This cutpoint yielded slightly higher sensitivity (0.94) but lower specificity (0.80) on the M-PTSD than the cutpoint of 107 of Keane et al. (17) (table 1).

Kulka et al. (18) also presented validation analyses performed on a sample from the National Vietnam Veterans' Readjustment Study (NVVRS). The participants included 344 (85 percent) of 403 veterans selected to include true cases of PTSD and veterans with illnesses other than PTSD as well as 96 (83 percent) of 116 non-war theater Vietnam-era veterans. All subjects underwent a structured clinical interview and several psychological tests to establish a composite psychiatric diagnosis which was used as a comparison standard against which to estimate the sensitivity and specificity of three self-administered PTSD scales (table 1).

In their 1996 study, Weathers et al. (24) repeated the validation study with similar design in 202 subjects who contacted the National Center for Posttraumatic Stress Disorder to obtain treatment or to participate in research. From clinical psychiatric interviews, two-thirds of these subjects had PTSD and one-third did not. The authors found that the cutpoint that maximized sensitivity and specificity on the M-PTSD scale was 109, very close to the cutpoint of 107 in the original validation study of Keane et al. (17).

RESULTS

Methodological differences

The 19 studies were performed in widely differing populations and settings (table 2). Five attempted to measure PTSD in one or more specified military units (28, 30, 32, 33, 38), although in two of these the size of the unit and the means of selecting subjects were not described (28, 33). Four surveyed larger defined veteran populations in Hawaii and Pennsylvania (42–44) and in Iowa (48). Ten studied treatment-seeking or otherwise biased groups of veterans (26, 27, 29, 34–36, 39–41, 45).

Participation rates in the unit- or population-based studies, which could be estimated in eight of the nine studies, varied from 25 percent to 76 percent (mean 41 percent), but none of these included surveys of non-participants to evaluate selection bias (table 2). Six studies compared groups who had been deployed to the Persian Gulf theater of operations with non-deployed veterans (30, 34, 36, 43, 44, 48), and three compared groups exposed to low and high levels of self-reported war zone stress (28, 30, 36).

Estimates of the PTSD rates were reported in 10 studies using eight different psychometric scales (table 2). Versions of the Mississippi PTSD scale were used to estimate PTSD rates in seven studies, and of these studies, four used the original M-PTSD scale (33, 34, 36, 38) and three used the M-PTSD-DS scale (26, 28, 30). Of the four studies that used the original M-PTSD, three used Kulka's cutpoint of 89 (33, 36, 38), and one used Keane's cutpoint of 107 (34). Of the three studies that used the M-PTSD-DS, one adopted a cutpoint of 107 (30), one used both 89 and 107 (26), and one raised the Kulka cutpoint of 89 to 97 to
attempt to adjust for the positive bias from added questions (28).

**Observed prevalence rates of PTSD**

In the seven studies that reported prevalence rates of PTSD, the 31 reported rates varied from 0 percent to 36 percent, with a mean of 9 percent (table 2). The magnitude of the prevalence rates was not statistically associated with the psychometric test or the cutpoint used.

**Estimating the true rates of PTSD**

In the seven studies that reported PTSD prevalence rates, 20 of the reported rates were calculated from validated psychometric PTSD scales (26, 28, 30, 33, 34, 36, 38). After using equation 2 to correct for the published values of sensitivity and specificity of the tests (17, 18, 24), I found that estimated true prevalence rates were 0 percent for 18 of the 20 rates (table 2). This suggests that virtually all of the PTSD reported in Gulf War veterans was due to false positive errors of measurement and that the true prevalence rates of PTSD were near zero.

There were two possible exceptions. Sutker et al. (28) found a PTSD prevalence rate on the M-PTSD-DS of 19 percent (corrected rate, 0 percent) in 215 veterans referred by unspecified criteria from five military units (containing possibly as many as 3,000 veterans) for study 4–10 months after the veterans returned from the war. In a subgroup of 110 veterans exposed to high war-zone stress measured by a self-report combat questionnaire administered at the same time as the M-PTSD-DS, the PTSD rate was 36 percent (corrected rate, 22 percent).

Perconte et al. (30) identified five cases of traumatic stress-related illness in 20 members of the 14th Quartermaster unit who survived the SCUD missile attack on their barracks and who were tested within a month of the traumatic event. Only one-third of the unit’s members volunteered to be tested; the psychometric testing followed a week of educational seminars that covered the causes and symptoms of PTSD; and the symptoms substantially diminished after a month of group psychotherapy.

**Mean PTSD scores**

Seven studies reported 16 mean PTSD scores measured by the M-PTSD or M-PTSD-DS (table 2) (26, 28, 30, 33, 34, 36, 38). Analysis of these scores suggested that the number of PTSD-related symptoms was higher in women (33) and in veterans who reported exposure to more war-zone stress (28, 30, 36). The studies, however, differed on whether higher mean scale values were found in veterans deployed to the war zone than in non-deployed veterans (30, 34, 36) and whether scores increased over time after veterans returned from the war (34, 38). The two highest mean PTSD scores for Gulf War veterans (figure 1) were measured with the M-PTSD-DS scale, on which scores may be inflated by as much as eight points (28, 30). Most importantly, the distribution of the 16 mean PTSD scores from studies of Gulf War veterans were entirely in the range found by Keane et al. to be typical of the nonspecific symptoms of well-adjusted Vietnam veterans (50 to 89) and were far below the range of scores (120 to 140) in Vietnam veterans with psychiatrically confirmed PTSD (17) (figure 1).

**DISCUSSION**

The studies reviewed in this paper constitute the main evidence in favor of the theory that physical symptoms in Gulf War veterans are caused by wartime stress (2). The reports of apparently high rates of PTSD and higher PTSD-related symptom scores in deployed veterans than in non-deployed veterans and in veterans exposed to more stressful war-zone experiences led to the belief that large numbers of Gulf War veterans must be suffering from PTSD as well as lesser stress-related symptoms (1, 3, 4).

My reanalysis of these studies, however, shows that, when the sensitivity and specificity of the psychometric scales used to measure PTSD rates were taken into account, virtually all of the apparent PTSD actually represents falsely positive errors of measurement. For example, if a survey of 100 veterans found that 15 veterans exceeded Kulka’s cutpoint of 89 on the M-PTSD (sensitivity of 0.94 and specificity of 0.80), one would expect to have overlooked no more than one veteran with true PTSD but to have falsely attributed PTSD to as many as 20 veterans with symptoms from other causes (equation 1) (31). This means that the apparent prevalence of 15 percent is probably due entirely to the falsely positive errors of measurement on the psychometric PTSD scale and that the true rate of PTSD is indistinguishable from zero (equation 2) (31).

Moreover, the mean scores on the Mississippi PTSD scales in various subgroups of Gulf War veterans were entirely in the range found in well-adjusted Vietnam veterans and far below the range expected in Vietnam veterans with psychiatrically confirmed PTSD (17). This was true not only in population samples of Gulf War veterans but also in subgroups who reported that they had the most combat experiences. Even the two highest mean scores from measurements made with the M-PTSD-DS scale, whose distributions were inflated by the addition of new questions tailored for Gulf War veterans (26, 28, 29, 34), fell just outside one standard deviation above the
## TABLE 2. Comparison of the design and findings of studies on post-traumatic stress disorder (PTSD) in Gulf War veterans

<table>
<thead>
<tr>
<th>Study</th>
<th>Publication year</th>
<th>Population-based sample</th>
<th>No. of subjects contacted</th>
<th>No. of participants (% of unit or population)</th>
<th>Studied non-participants?</th>
<th>PTSD-defining method/ cutpoint</th>
<th>Observed PTSD rate (%)</th>
<th>U†</th>
<th>V‡</th>
<th>Estimated true PTSD rate†</th>
<th>Mean ± SEM* on M-PTSD* or M-PTSD-DS*</th>
<th>Conclusions or potentially biasing features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labbate and Snow (32)</td>
<td>1992</td>
<td>Unit</td>
<td>97 in an infantry company</td>
<td>56 (58)</td>
<td>No</td>
<td>None</td>
<td>Yes/no questionnaire</td>
<td>NS*</td>
<td></td>
<td></td>
<td>25% had nightmares</td>
<td>6 months postwar (significantly more in the wounded)</td>
</tr>
<tr>
<td>Wolfe et al. (27)</td>
<td>1992</td>
<td>No</td>
<td>262 women ODS* veterans</td>
<td>76 (-)‡</td>
<td>Yes</td>
<td>Pre-war M-PTSD-DS/107</td>
<td>NS</td>
<td>NS*</td>
<td></td>
<td></td>
<td>Veterans with PTSD from Vietnam had higher SCL-90-R scores during ODS</td>
<td>Surveyed 3-4 days after return from ODS.</td>
</tr>
<tr>
<td>Wolfe et al. (33)</td>
<td>1993</td>
<td>Units (no. not reported)</td>
<td>ODS Reunion</td>
<td>2,344 (-)</td>
<td>No</td>
<td>M-PTSD/B9</td>
<td>4</td>
<td>0.94</td>
<td>0.80</td>
<td>0</td>
<td>61.8 ± 0.3</td>
<td>More physical and PTSD symptoms in higher war zone stress group; method of selecting the sample and recall bias not addressed</td>
</tr>
<tr>
<td>Southwick et al. (37, 38)</td>
<td>1993</td>
<td>Units</td>
<td>240 in 2 units</td>
<td>62 (25)</td>
<td>No</td>
<td>M-PTSD-DS/97§ or PCL-M/ &quot;sufficient symptoms&quot;</td>
<td>17</td>
<td>Not published</td>
<td></td>
<td></td>
<td>75.4 ± 1.3</td>
<td>Mean PTSD score declined from 3-6 months to &gt;6 months after the war</td>
</tr>
</tbody>
</table>

Note: U†, V‡, and Mean ± SEM* refer to statistical measures of the PTSD prevalence. NS* denotes non-significant results.
<table>
<thead>
<tr>
<th>Study Authors</th>
<th>Year</th>
<th>Type of Study</th>
<th>Operational Experience</th>
<th>PTSD Symptoms</th>
<th>Questionnaire</th>
<th>Score Range</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>West et al. (39)</td>
<td>1993</td>
<td>No</td>
<td>116 corpse handlers 118 non-handlers</td>
<td>234 (-)</td>
<td>None</td>
<td>IES</td>
<td>Not published</td>
</tr>
<tr>
<td>McCarroll et al. (40)</td>
<td>1993</td>
<td>No</td>
<td>55 corpse handlers 56 non-handlers</td>
<td>111 (-)</td>
<td>None</td>
<td>IES</td>
<td>Not published</td>
</tr>
<tr>
<td>Stretch et al. (42)</td>
<td>1995</td>
<td>Population (Pennsylvania and Hawaii)</td>
<td>All of states' 16,167 veterans</td>
<td>4,334 (31)</td>
<td>No</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Stretch et al. (43)</td>
<td>1996</td>
<td>Population (Pennsylvania and Hawaii)</td>
<td>All of states' 16,167 veterans</td>
<td>4,334 (31)</td>
<td>No</td>
<td>Deployed Non-deployed</td>
<td>BSI</td>
</tr>
<tr>
<td>Stretch et al. (44)</td>
<td>1996</td>
<td>Population (Pennsylvania and Hawaii)</td>
<td>All of states' 16,167 veterans</td>
<td>4,334 (31)</td>
<td>No</td>
<td>Deployed Non-deployed</td>
<td>WRAIR-PTSD*</td>
</tr>
<tr>
<td>Sloan et al. (26)</td>
<td>1995</td>
<td>No</td>
<td>66 veterans at a VAMC</td>
<td>30 (-)</td>
<td>None</td>
<td>M-PTSD-DS/107 M-PTSD-DS/89 D-PTSD/6 DSM symptoms</td>
<td>0 3 4</td>
</tr>
<tr>
<td>Sloan et al. (45, 46)</td>
<td>1995/96</td>
<td>No</td>
<td>66 veterans at a VAMC</td>
<td>30 (-)</td>
<td>None</td>
<td>Rorschach</td>
<td>Not published</td>
</tr>
<tr>
<td>Iowa Study (48)#</td>
<td>1997</td>
<td>Population (Iowa)</td>
<td>All of state's 28,968 veterans</td>
<td>3,696 (76) of 4,886</td>
<td>Deployed Non-deployed</td>
<td>PCL-M/50</td>
<td>1.9-2.0 0.7-1.1</td>
</tr>
</tbody>
</table>

* U, sensitivity, and V, specificity, measured by Keane et al. (17), Kulka et al. (18), and Weathers et al. (24); SEM, standard error of the mean; NS, not stated; ODS, Operation Desert Shield/Storm (deployed veterans served in the ODS theater of operations and non-deployed veterans remained in the United States); M-PTSD, Mississippi Scale for Combat-Related PTSD (17); M-PTSD-DS, Mississippi Scale for Combat-Related PTSD, modified for Desert Storm veterans by making wording more specific to ODS, adding three questions and making wording gender-appropriate (26) (validation and establishment of critical cutpoint to define PTSD were not repeated after these changes were made); SCL-90-R, Symptom Checklist, a test of general psychological function from which nine scales of clinical disorders (e.g., somatization, obsessive-compulsive, depression, etc.) are calculated (24); VUF, Veterans Updated Form, a brief self-report measure of change in the PTSD symptoms: re-experiencing, avoidance/numbing, and hypervigilance (27); GSI/BSI, General Severity Index Is a measure of the current level of general psychologic distress and is calculated from the Brief Symptom Inventory (short version of SCL-90-R) (51); PCL-M, PTSD Checklist-Military, an empirical PTSD scale from questions routinely asked on the SCL-90-R (48); D-PTSD, PTSD questionnaire for DSM-III-R symptoms of PTSD; six PTSD symptoms required to diagnose PTSD (18), including one from the re-experiencing/intrusive group, three from the avoidance group, and two from the increased arousal group; IES, Impact of Event Scale, a measure of "intrusion" and "avoidance" (but not the hypervigilance component of PTSD) anchored to a specific life event, considered a measure of PTSD (19, 20); WRAIR-PTSD, Walter Reed Army Institute of Research PTSD scale, composed of PTSD questions from IES and BSI, with wording referring to ODS (has not been validated) (44).  
† From equation 2, i.e., corrected estimate of the true prevalence rate, \( \hat{p} = \frac{p_2}{p_1^{1/2} - (1 - V)\hat{V} + V - 1} \).  
‡ (-) Indicates study where percent cannot be given because sample was neither population- nor unit-based.  
§ Increased the original cutpoint of 69 up to 97 to compensate for the positive bias from three questions added in the revised M-PTSD-DS version.  
¶ The sensitivity and specificity estimates determined for the M-PTSD may not apply to its revised versions such as the M-PTSD-DS.  
# Not cited in the final report of the Presidential Advisory Committee on Gulf War Veterans' Illnesses (2).  
** A semi-structured Interview by a trained psychologist is considered to be highly accurate.
mean of well-adjusted Vietnam veterans’ scores, and adjusting the values to correct for the scale inflation would put their corrected means (approximately 80 and 81) well within the range expected with well-adjusted veterans (17).

Two studies reported PTSD rates that remained elevated after correcting for the accuracy of the measurements. The high rates in the initial study of Sutker et al. (28) in a subgroup that reported high levels of war-zone stress may have been due to preferential referral of symptomatic veterans for testing, because neither the referral criteria nor the participation rate were reported. The five cases of PTSD identified by Perconte et al. (30) in 20 members of the 14th Quartermaster unit were identified within one month of the missile attack on their barracks and improved within one month with treatment. This time course suggests an acute, self-limited stress disorder (5) rather than chronic PTSD. Because the psychometric testing followed a week of educational seminars that covered the types of traumatic experiences that cause PTSD and the symptoms to be expected, and because only one-third of the unit’s members were tested, the PTSD scores and rates may have been exaggerated by information bias (as acknowledged by Perconte et al.) and by selection bias.

If Gulf War veterans are not generally suffering from PTSD—and my reanalysis suggests that they are not—what symptoms are being measured by the mild to moderate elevations of the psychometric PTSD scales described in the 19 studies? In their original validation study of the M-PTSD scale, Keane et al. (17) demonstrated that M-PTSD values below 107 do not distinguish the symptoms of PTSD from those of nonpsychotic psychiatric illnesses and even from the functional symptoms of well-adjusted veterans (figure 1). In other words, the studies on PTSD covered in this review demonstrate only that deployed veterans continue to have more nonspecific symptoms than non-deployed veterans, a fact also demonstrated by the population studies of both physical and psychological symptoms in Gulf War veterans from Pennsylvania and Hawaii (42) and Iowa (48). The excess of symptoms in deployed veterans could just as well be due to chronic neurotoxicity from exposure to chemicals (11–13), which may mimic psychiatric conditions (12, 49, 50), as from a wide range of other medical or psychological etiologies.

Ever since the diagnosis of PTSD was added to DSM-III in 1980 (5), the number of disability claims filed under the workers’ compensation system that cite PTSD from stressful events in the civilian workplace has been increasing (6). Plaintiffs and their attorneys have tended to press claims that involve alleged traumatic events or stress-related symptoms which are insufficiently severe or specific to meet the DSM criteria for PTSD (5). In reaction to such obvious abuses, legislatures and courts have increasingly required formal diagnoses of PTSD from psychiatrists or psychologists who must adhere strictly to the DSM criteria (5, 6). In the debate over the etiology of illnesses in Gulf War veterans, we find the positions reversed. It is now the governmental interests that are invoking the PTSD explanation with subdiagnostic criteria (1–4), while the veterans, analogous to the plaintiffs, are resisting it.

Finally, the argument for the stress theory by analogy to the postwar syndromes of past wars, made by Hyams et al. (1), must be challenged. Even though medical investigations into the causes of postwar syndromes following the American Civil War, World Wars I and II, and the Korean War may have been substantial for their day, conditions experienced in each war were different and researchers did not have access to the types of epidemiologic and neurobiologic research methods required to discover the nature and causes of those complex problems. Following the Vietnam War, meaningful epidemiologic research for physical causes was not undertaken until 10 years after the end of the war. Failing to find physical explanations with the primitive methods of the past and at remote time intervals from the wartime exposures, officials adopted psychological explanations by default. Undoubtedly those postwar “syndromes” represented complex mixtures of diverse conditions, perhaps some physical and others psychological, that were never disentangled. In my view, until plausible theories of physical causes are thoroughly studied, it is hazardous to jump to psychological explanations for the physical symptoms of Gulf War veterans on the basis of incompletely researched conclusions from prior wars.

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REFERENCES


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