Chapter Five

GULF WAR SCIENTIFIC LITERATURE LINKING STRESS TO HEALTH PROBLEMS

OVERVIEW

This chapter evaluates available data bearing directly on the possible role of exposure to potentially stressful conditions as an etiologic factor in the health problems of veterans of the Persian Gulf War. After describing our method for identifying relevant studies and briefly characterizing different approaches used by these studies to measure stress exposure and health outcomes, this chapter will evaluate the extent to which study findings support a link between stress exposure and subsequent health problems. Following the organizational structure of Chapter Four, discussion of the literature will first focus on the studies linking stress to mental health outcomes. No studies were found linking stress to physical disease per se, although a few studies examined the relationship between stress and bodily symptoms that might be due to either physical or mental conditions. As in Chapter Four, we provide a brief review of evidence pertaining to whether certain individuals or groups were at greater risk for developing stress-related health problems. However, we found no Gulf War–specific studies that expressly addressed whether stress exposure fostered the perception of illness or illness behavior. So, unlike Chapter Four, this chapter does not address that topic.

STUDY SELECTION CRITERIA

Excluding reviews of the literature and secondary data analyses, we identified 36 empirical studies relevant to a possible link between exposure to potentially stressful conditions in the Gulf War and symptoms experienced by returning Gulf War veterans. Studies met each of the following criteria. First, we required that studies include a measure of stress exposure as defined by self-report or documented exposure to potentially stressful conditions (e.g., graves registration duty). Thus, we excluded from this chapter those studies that relied
solely on a comparison of deployed versus nondeployed personnel (e.g., Gray et al., 1996; Hammelman, 1995; Kang and Bullman, 1996; Pierce, 1997; Pontius et al., 1992; Rodell et al., 1992; Ross and Wonders, 1993; Rothberg et al., 1994). Deployment was associated with a number of potentially stressful situations, as discussed briefly in Chapter Three. Similarly, comparisons of deployed and nondeployed troops revealed increased symptoms in deployed personnel, as described in the introduction. Nonetheless, troops may have been exposed to other potentially health-impairing agents such as chemicals or biological weapons, depleted uranium, smoke from oil well fires, pesticides, insect repellents, prophylactic drugs, and infectious diseases (for discussion, see Presidential Advisory Committee, 1996). Unless these other variables are ruled out as explanatory factors, increased symptom levels in deployed troops relative to nondeployed personnel cannot be used to implicate stress by itself. Second, we required that studies include at least one health outcome measure. Finally, with the exception of one British study (Deahl et al., 1994), we required that studies include U.S. Gulf War veterans, as opposed to other participating allied forces, Israeli citizens, or populations indigenous to the Persian Gulf. We reviewed each study design to determine the extent to which valid inferences concerning stress and health could be made from the data. In particular, we evaluated sampling procedures and associated biases that might have resulted.

HOW STRESS EXPOSURE WAS MEASURED

Most studies that we reviewed measured stress exposure in at least one of the following ways: (1) by asking for self-reported stress exposure as part of a structured interview or self-administered questionnaire, or (2) by identifying soldiers who experienced situations that were considered to be potentially very stressful (e.g., witnessing deaths from friendly fire, handling human remains). Most of the self-reported stress-exposure studies used traditional measures of combat exposure that may not have been sufficiently sensitive to noncombat war-zone events that, as shown in Chapter Three, have also been recognized as significant sources of stress. Studies of personnel with documented exposure to potentially stressful events provide the strongest evidence of a link between stress and health problems. However, to the extent that these studies focus on relatively rare and extreme events affecting comparatively few individuals (e.g., being subjected to a SCUD-missile attack), results may be less generalizable to the majority of Gulf War veterans.

HOW HEALTH OUTCOMES WERE MEASURED

Virtually all studies examining the link between stress exposure and health measured outcomes in terms of self-reported psychological or bodily symp-
toms. Psychological diagnoses were rarely established via interview, even though accurate classification of individuals as manifesting mental disorders requires a formal assessment using a diagnostic interview. Similarly, physical diagnoses or symptoms were rarely assessed by actual clinical tests or laboratory results. These limitations compromise the ability of these data to yield definitive evidence that stress exposure is linked to verified psychiatric or physical disease. Nonetheless, since stress-related reactions take many forms, including self-reported psychological or bodily symptoms that may not exceed thresholds for disease, these studies are pertinent to evaluating the possible link between stress exposure and poor health.

STRESS EXPOSURE AND MENTAL HEALTH OUTCOMES

Of the studies we identified, more than 80 percent focused on the link between stress in the Gulf War and PTSD or PTSD-like symptoms, an emphasis perhaps attributable to the legacy of Vietnam and the associated importance of PTSD in that war. Because of the large number of studies focusing on PTSD and the fact that PTSD itself is regarded as uniquely attributable to stress exposure, our review of the mental health literature distinguishes between findings relevant to PTSD symptoms and findings concerning other mental health symptoms.

Gulf War Stress Exposure and PTSD

What Is PTSD? PTSD is an anxiety disorder associated with the experience of a traumatic event. According to the Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition (DSM-IV; APA, 1994), an event qualifies as a trauma capable of producing PTSD if it involves experiencing, witnessing, or receiving news about a situation that involved actual or threatened death or serious injury, or a threat to physical integrity. The person’s response to the event must also involve intense fear, hopelessness, or horror. PTSD is characterized by three types of symptoms: (1) re-experiencing of the event (e.g., nightmares, flashbacks), (2) avoidance of stimuli associated with the trauma and a numbing of general responsiveness, and (3) increased arousal. To meet diagnostic criteria, core symptoms must persist for at least one month and cause clinically significant impairment in social, occupational or other important areas of functioning. Some symptoms of PTSD overlap with other psychological and bodily symptoms reported by CCEP and VA-registry soldiers (e.g., sleep disturbance, difficulty concentrating, and memory loss).

What Are the Rates of PTSD in Persian Gulf War Veterans? Several large studies examined the rates of PTSD diagnoses in samples of Persian Gulf War (PGW) veterans (e.g., Iowa Persian Gulf Study Group, 1997; WRAIR, 1994). In the Iowa Study, 1.9 percent of deployed regular military personnel had symptoms of
PTSD (as measured by the PTSD checklist) compared with only 0.7 percent of nondeployed. Comparable estimates for deployed and nondeployed National Guard/reservists were 2.0 percent and 1.1 percent respectively (Iowa Persian Gulf Study Group, 1997). Overall, observed rates of PTSD in other studies of active-duty troops or reservists found rates of PTSD under 10 percent (see Appendix A, Table A.1), although some of the studies of samples that experienced verifiable combat-related events, such as graves registration duty, reported higher rates of PTSD (the highest being 46 percent, Sutker et al., 1994).

While rates of PTSD were high in a few samples of Gulf War veterans exposed to combat-related events, the data most generalizable to the entire population of Gulf War veterans suggest that PTSD rates are relatively low overall, and substantially lower than those for Vietnam veterans (CDC, 1988a; Kulka, Schlenger, Fairbank et al., 1990).1 To place these rates in context, the lifetime prevalence of PTSD disorder in the general population is approximately 7.8 percent (Kessler et al., 1995).

Types of Studies. Twenty-eight studies that met our criteria reported on PTSD-related outcomes. The key features of these studies are summarized in Appendix A. For heuristic purposes, we classified the studies into two broad categories. The first class of studies focused on large samples (1000-plus) of veterans of the Persian Gulf War (including both reservists and active-duty personnel), to examine the prevalence of PTSD after Persian Gulf deployment, or to address specific relationships between war-related physical injury or illness and psychiatric symptoms. Five studies fit into this category. A second general category, consisting of 23 studies, incorporated smaller samples of special populations and examined the prevalence of PTSD symptoms in putatively at-risk populations (e.g., troops assigned to graves registrations duty, reservists, and clinical populations of help-seeking veterans after the war). One of these studies compared degree of combat exposure in veterans with and without presumptive PTSD.

How PTSD Symptoms Were Measured. Although administration of a diagnostic interview is the most reliable and valid means of establishing a diagnosis of PTSD, a number of self-administered questionnaires have been developed that

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1Haley (1997) has conducted a secondary analysis of empirical studies that reported prevalence estimates of PTSD in Gulf War veterans. In Haley’s reanalysis of these studies, he found that the rate of PTSD in the Gulf War veteran population is virtually zero after making adjustments for measurement error. To reach this conclusion, Haley applied corrections to Gulf War PTSD prevalence estimates based on data from Vietnam veterans. This application is based on certain assumptions. Whether or not these assumptions are entirely correct, Haley’s finding is consistent with the present study’s conclusion that the prevalence of PTSD is too low to serve as a sufficient explanation of the symptoms of Gulf War veterans. Determining whether the prevalence of PTSD in the Gulf War veteran population is actually zero or merely very low is an important issue, and resolving it will require additional empirical research.
provide some information about PTSD symptoms. The brevity and ease of administration of these scales render them valuable for use in situations in which it is not feasible to conduct a lengthy diagnostic interview. At the same time, these self-administered scales are not characterized by the precision of a diagnostic interview.

The Mississippi Scale for Combat-Related PTSD was used most frequently to assess PTSD or PTSD symptoms (in 15 of the 28 studies). This scale is a self-report scale developed expressly for use with persons exposed to combat-related trauma (Keane, Caddell, and Taylor, 1988) and originally designed for use with veterans of Vietnam; it was adapted for use with veterans of the Persian Gulf War (e.g., Engel et al., 1993). One problem with this measure is that an individual could have an elevated score without having experienced a trauma, because some of the items assess symptoms that are not unique to a PTSD diagnosis. Sample items in the scale include “unexpected noises make me jump,” and “I am afraid to go to sleep at night.” The Impact of Events Scale (IES), another widely used self-administered scale included in eight of the 27 studies, assesses the presence and severity of symptoms of intrusion (e.g., “I had dreams about it”) and avoidance (e.g., “I tried not to think about it”) but not hyperarousal symptoms. Thus, the IES does not capture the full range of symptoms required for a diagnosis of PTSD. In only two cases (Sutker et al., 1994a, 1994b) were diagnostic instruments administered by a trained interviewer used to assess PTSD.

Findings. Five large-sample studies (see Table 5.1) reported analyses that directly examine the relationship between exposure to stress during the war and subsequent symptoms of PTSD (Adler, Vaitkus, and Martin, 1996; Iowa Persian Gulf Study Group, 1997; Stretch et al., 1996; WRAIR, 1994; Wolfe, Brown, and Kelley, 1993; Wolfe, Keane, and Young, 1996). Four of the five relevant studies demonstrated a clear link between extent of exposure to stress during the war and PTSD symptoms. For instance, in the study published by Stretch et al. (1996; previously published by WRAIR, 1994), IES scores were correlated most highly with combat exposure and the intensity of the respondent’s reaction to some combat situations. Five items in particular explained about 28 percent of the variance for the IES avoidance subscale (noise from guns or artillery; exposure to dead or dying bodies; threat of enemy chemical weapons or agents; threat of terrorist attack; and threat of SCUDs).

In addition, noncombat war zone stressors (e.g., crowding in base camps) were also important in explaining some of the variance in IES scores. Fewer soldiers had high IES scores in a second group tested in 1993 than in the group tested in 1991–1992, possibly reflecting attenuation of symptoms with the passage of time. The fifth study (Iowa Persian Gulf Study Group, 1997) was not able to establish a unique link between any specific self-reported exposure (including
psychological stress and physical trauma) and symptoms, but noted that most exposure measures were associated with many of the health outcomes. The report did not present any stress-specific analyses related to PTSD, however.

Twenty-three studies examined either populations with presumptive PTSD or personnel thought to be at risk for PTSD (e.g., reservists, troops assigned to graves-registration duty, troops who experienced front-line combat or suffered physical injuries, and treatment-seekers after return from the war). However, nine of these studies did not analyze the link between stress exposure and subsequent PTSD symptoms (Ford et al., 1992; Haley, Kurt, and Horn, 1997; Sloan et al., 1995a, 1995b, 1996; Sutker et al., 1994a, 1995a, 1995b; Unger et al., 1992). One additional study assessed PTSD retrospectively by asking graves-registration veterans three to five months after the war to recall their symptoms at the height of the war. This study did not include a measure of symptoms after the war ended (McCarroll et al., 1993a). Finally, one study conducted analyses to examine a link between war-zone stress and the diagnosis of any Axis-I disorder, including PTSD, but did not report specific analyses linking stress to PTSD itself (Brandt et al., 1997). Because both of the latter reports presented data linking stress exposure and other, non-PTSD mental health problems, they will be discussed in the section to follow.

Of the remaining 12 studies, each found a significant relationship between exposure to stressors during the war and subsequent PTSD symptoms (Baker et al., 1992; Baker, Mendenhall, Simbartl, Magan, and Steinberg, 1997; Deahl et al., 1994; Engel et al., 1993; McCarroll et al., 1995a; Perconte et al., 1993a, 1993b; Sohler et al., 1992; Southwick et al., 1993, 1995; Sutker et al., 1993, 1994b). Some of these studies were correlational. For example, Baker et al. (1992) reported a positive correlation between self-reported combat stressors and PTSD symptoms measured on the IES two to five months after the war among 325 Reservists deployed to the Gulf. Others compared deployed troops with differing levels of stress exposure. For example, troops who were on-site during the SCUD missile attack in Dhahran, Saudi Arabia, had elevated levels of PTSD symptoms compared to those on guard duty three to five miles away (Perconte et al., 1993a). Although the strength of the association varied across studies, the linkages tended to be modest (e.g., correlations = .20-.40). Interestingly, among graves-registration troops with no direct combat exposure, the perception of life threat during the war predicted greater symptoms nine months after the war compared to those who did not perceive life threat (Deahl et al., 1994). As discussed in Chapters Two and Four, this finding is consistent with much theory and research concerning stress. In particular, perceived life threat, as well as actual exposure, is a potent predictor of subsequent adjustment.

Summary. All of the studies that examined the link between exposure to stressors during the Persian Gulf War and symptoms of PTSD found evidence of a
positive—albeit modest—relationship between these two factors. Despite this uniform finding, the studies suffer from methodological problems that hamper definitive conclusions regarding the role of stress exposure as a factor in the health problems of Gulf War veterans. These methodological problems will be discussed at the end of the chapter. Given the relatively low incidence of PTSD in veterans of the Gulf War, it does not appear that PTSD, as it is currently defined, can be invoked as a sufficient explanation of the unexplained symptoms of Gulf War veterans.

GULF WAR-RELATED STRESS EXPOSURE AND OTHER MENTAL HEALTH OUTCOMES

Twenty studies, some of which also assessed PTSD outcomes, were identified that examined mental health outcomes other than PTSD. The characteristics of these studies are summarized in Appendix A, Table A.2.

Types of Studies. The 20 studies that measured both stress exposure and mental health outcomes were divided into two groups as in the section above: four large sample studies and 16 smaller studies that examined symptoms in at-risk populations. Study designs varied depending on the purpose of the study. The majority of studies focused on the impact of specific exposures on psychiatric symptoms among Gulf War veterans. A few studies were primarily clinical or treatment evaluations for which control samples were not used (e.g., Baker et al., 1992; Ford et al., 1992; Perconte et al., 1993a).

How Mental Health Outcomes Were Measured. As with the empirical research focusing on PTSD, with few exceptions (e.g., Sutker et al., 1994a), all of the studies examining other types of mental health problems employed self-report checklists of psychiatric symptoms rather than diagnostic interviews. The well-validated Hopkins Symptom Checklist SCL-90 (SCL-90; Derogatis, 1983) and its variant (i.e., the Brief Symptom Inventory (BSI); Derogatis and Spencer, 1982) were the most commonly used psychiatric self-report measures. These instruments include subscales assessing various symptoms of psychiatric conditions (e.g., somatization, obsessive-compulsive disorder, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychotism) and yield domain-specific as well as overall measures of psychopathology. Other well-validated instruments included the State-Trait Anxiety Inventory (STAI), a 40-item measure of anxiety (Spielberger, Gorsuch, and Lushene 1970), the Beck Depression Inventory (BDI), a 21-item measure of depression (Beck et al., 1961), and the General Health Questionnaire (GHQ; Goldberg and Hillier, 1979), an instrument similar to the SCL-90. In most instances, only total scores, reflecting overall psychological distress, were reported.
Findings. Two of the four large-sample studies did not present analyses that examined links between stress exposure during the war and subsequent experience of mental health symptoms, other than PTSD (Stretch et al., 1996a, 1996b; Wolfe et al., 1996). For example, although Stretch et al. (1996b) assessed both stressors and psychological distress, no data examining the link between the two were presented. The third study, the Iowa study (Iowa Persian Gulf Study Group, 1997), found no link between self-reported psychological stressors and depression, but did not report analyses concerning other mental health problems measured in the study.

In contrast, the Ft. Devens study (Wolfe et al., 1993), evaluated three major stressor categories (traditional combat-related wartime activities; nontraditional wartime events specific to the Gulf War; and non-war zone, deployment-related experiences in the areas of domestic, vocational, and psychosocial stressors) in a sample of 2344 Persian Gulf War veterans. Stress exposure was assessed using a traditional exposure scale and a newly developed scale designed to assess the fuller range of combat-stress exposure associated with Gulf War service. Multiple regression analyses adjusting for demographic characteristics, rank, prior service, and self-appraised preparedness for combat found a significant positive relationship between stress exposure and psychological distress, as measured by the BSI General Severity Index, a PTSD checklist, and the Mississippi Scale for combat-related PTSD.

Of the 16 smaller studies that examined at-risk populations, six only presented analyses that addressed the association between exposure and symptoms of PTSD (Ford et al., 1992; Sohler et al., 1992; Sutker et al., 1994a, 1995a, 1995b; Unger et al., 1992). As a body, the remaining 10 studies reported mixed support linking stress to other mental health problems. Four studies found stress exposure was related to other mental health symptoms (Brandt et al., 1997, Baker et al., 1992; Deahl et al., 1994; Sutker et al., 1993). One such study reported that soldiers with traumatic physical injury during the Gulf War (verified by records) were significantly more likely than soldiers evacuated for other medical reasons to have Axis I psychiatric disorders (Brandt et al., 1997). Another study (Sutker et al., 1993) compared 215 Army National Guard and Army Reserve troops who were deployed to the Persian Gulf with 60 troops from these same units who were activated but not deployed overseas. The study scored subjects on a seven-item self-report war zone stress scale, dividing them into high- and low-stress groups based on the median split of that scale. The high-stress group had more extreme scores on measures of psychological distress (BDI depression score 8.25, and STAI anxiety score 43.6) than did either the low-stress group (3.7 and 36.1, respectively) or the nondeployed group (5.0 and 38.0, respectively) (p significant at <.007).
For three additional studies, the link between stress exposure and mental health problems varied as a function of the manner in which mental health outcomes or stress exposure were measured (Labatte and Snow, 1992; Perconte, 1993a, 1993b). For example, reservist survivors of a SCUD missile attack reported greater psychological distress than did members of the same unit who were away from the site of the attack, as measured by the SCL-90 but not the BDI (Perconte et al., 1993a). In a study of troops who engaged in the ground war, sleep disturbance and nightmares after the war were found to be related to personal injury during the war, but not related to exposure to dead bodies (Labatte and Snow, 1992).

Finally, three studies found no significant relationship between stress exposure and subsequent mental health symptoms (McCarroll et al., 1993a, 1995a; Sutker et al., 1994b). For instance, no significant differences in SCL-90 scores (assessing current symptoms 3–5 months and 13–15 months after the war ended) were found between personnel who handled human remains and deployed mortuary workers who did not. In the same sample, however, a difference was found between these two groups in terms of PTSD symptoms 13–15 months after the war (McCarroll et al., 1995a). Stated differently, McCarroll et al. (1995a) found significant between-group differences with respect to symptoms of PTSD but not symptoms associated with other mental health problems. Another study found PTSD to be the only Axis-I psychiatric disorder related to war-zone exposure in a sample of 60 reservists serving in graves-registration duty (Sutker et al., 1994b).

**Summary.** Although differing in numerous respects, including sample sizes and the operational definition of both stress exposure and mental health, seven of 10 studies focusing on objectively verifiable stress exposure or self-reported combat-related exposure provided at least some evidence of a significant relationship between stress exposure and psychological distress. The strength of these associations, although significant, tended to be modest (e.g., correlations = .06–.27), suggesting that factors other than stress exposure also play a role in determining psychological distress.

**GULF WAR-RELATED STRESS EXPOSURE AND BODILY SYMPTOMS**

Few studies were designed or reported in a manner that permit firm conclusions concerning the relationship between stress exposure and bodily symptoms that might be due to physical health problems. Many of the studies described above that included the SCL-90 would have been able to provide information about self-reported bodily symptoms had they conducted separate analyses of the somatization subscale, which includes items that measure bodily symptoms (e.g., headache, back and joint pain, nausea, gastrointestinal dis-
orders). However, most of these studies reported only total distress scores on the SCL-90. The latter studies were reviewed in the mental health section above. Ten studies conducted analyses on self-administered checklists of bodily symptoms, such as the SCL-90 somatization scale.

**Types of Studies.** We again divided the available studies into two types: three large-sample studies and seven smaller studies of populations thought to be particularly at risk for developing adverse health consequences due to stress exposure.

**How Health Problems Were Measured.** Bodily symptoms were generally assessed by self-report using either ad hoc checklists, the somatization scale of the SCL-90 and its variant the BSI, or the Health Symptom Checklist (HSC; Bartone, Ursano, Wright and Ingraham, 1989). These symptoms may be indicative of an underlying organic cause or may reflect psychological distress.

**Findings.** Three large-sample studies included measures of health (Iowa Persian Gulf Study Group, 1997; Wolfe, Proctor, Davis, Borgos, and Friedman, 1998; WRAIR 1994/Stretch et al., 1995). The Iowa study (Iowa Persian Gulf Study Group, 1997) found that no single exposure, including stress, was uniquely related to any health problem; but, as described in earlier sections, this study reported that most exposures were related to many of the health outcomes. The Wolfe et al. study (1998) found in its two-year follow-up of a large cohort (n=2119) of veterans that the degree of self-reported combat exposure was correlated with the extent of bodily symptoms. This finding did not remain significant when other covariate predictors, including PTSD symptoms, were included in the model. The authors interpreted this finding as suggesting that the apparent link between combat exposure and bodily symptoms may be mediated by the presence of PTSD. The WRAIR report (1994) did not include data on the link between stress and bodily symptoms, but concluded (based on unreported data) that bodily health symptoms (as measured in the BSI) were associated with the deployment itself, rather than the stress of combat per se. More recently reported data of primarily army combat units conducted both prior to combat and after return to the States, showed higher bodily symptom scores—as measured by the BSI—for precombat soldiers compared to their own scores after return from ODS (Marlowe, forthcoming), providing evidence that symptoms decreased after deployment.

The seven smaller studies also assessed bodily symptoms, five of which did not report the relevant analyses linking stress exposure to physical health symptoms (Kizer et al., 1995; Sutker et al., 1994a, 1994b, 1995a; Unger et al., 1992). In other words, although these studies included both measures of stress exposure and bodily symptoms, the papers focused on other issues and did not examine the link between stress and health. Mixed results emerged from the two re-
main studies. An examination of the relationship between self-reported bodily symptoms and self-reported combat-related exposure found that reserve troops who reported high levels of stress exposure had higher HSC scores than did either the low stress or the nondeployed groups (Sutker et al., 1993). Items on the HSC that were significantly different in the groups could have been manifestations of either psychological or bodily distress (e.g., concentration difficulties, nervousness/tension, and use of medications to sleep or calm down). On the other hand, a study of 249 veterans from the 24th Reserve Naval Mobile Construction Battalion found no link between an ad hoc measure of combat-stress exposure and three factor-analytically derived self-reported symptom clusters purported to represent distinct physical syndromes (Haley and Kurt, 1997). It is difficult to evaluate the claim by Haley and Kurt (1997) that stress was not linked to any syndrome because the authors only reported those associations that were significant at a criterion level of $p < .005$. This study employed a highly stringent significance standard to avoid focusing on chance findings due to multiple significance tests.

**Summary.** The literature linking stress exposure to bodily symptoms is scant, hampered by methodological limitations, and presents little definitive evidence regarding this question. Some available data attest to a possible relationship between stress and self-reported bodily symptoms, which may or may not reflect an underlying organic etiology.

**FINDINGS SPECIFIC TO VULNERABLE GROUPS**

As noted in Chapters Two and Four, the scientific literature suggests that certain individuals may be more vulnerable to the potentially negative health consequences of stress by virtue of genetic predisposition, prior history of psychopathology, biological constitution, prior life experiences, or personal (e.g., personality) or social (e.g., social support) resources as well as other factors. Specific to personnel in the Gulf War, several groups were postulated to be at potentially greater risk of stress-related problems. These include CS/CSS units; reservists; persons not assigned to their parent unit; persons who experienced high-magnitude stressors; and various other groups, including female soldiers (see Chapter Three). Demonstration of differential vulnerability requires evidence that groups who experience or perceive similar levels of stress exposure report different levels of health problems, after adjusting for preexisting differences between the groups.

We identified relatively few studies that specifically tested whether the effect of stress on health was greater for any of these hypothesized groups, and those that we identified suffered from methodological problems (summarized in the section below). The literature pertaining to the vulnerability of groups that ex-
experienced potentially high-magnitude stress was summarized in the previous sections. Soldiers who reported exposure to stress and traumatic factors were more likely to have developed PTSD symptoms and other psychological health problems, although the relationship between stress and physical disease was inadequately examined.

Four groups of investigators provided information relevant to the vulnerability of female, as opposed to male, Gulf War veterans. In the study by Perconte et al. (1993a), female soldiers on-site during the SCUD-missile attack reported higher scores on the Mississippi Scale for Combat-Related PTSD, the Beck Depression Inventory, and the SCL-90 than did male on-site soldiers. However, the comparisons were of small groups (3 females versus 17 males). In a larger sample of reservists, Perconte et al., 1993b, found that noncombat deployed males and females did not differ on the Mississippi Scale for PTSD, but that combat-deployed females did have higher scores than combat-deployed males in units hypothesized to have experienced significant stress (e.g., the 14th QMU whose barracks were destroyed by a SCUD missile). In studies of the Ft. Devens sample (Wolfe et al., 1993, 1996), women with high Laufer combat scores reported higher symptom scores on the BSI than did men with similar Laufer combat scores.

Similarly, women soldiers who witnessed death and reported more “hassles” (i.e., low-magnitude stressful events) also had higher Mississippi PTSD scores than did male soldiers who reported the same stressors. Sutker and colleagues (1993, 1995a) found no differences between male and female reservists in the effect of war-zone stress on self-rated symptoms of anxiety or depression. Women, however, reported more physical symptoms on a health-symptom checklist than did men, irrespective of service in the Gulf. Similarly, Engel et al. (1993) found no differences between men and women in the influence of combat exposure on PTSD symptoms in a study of help-seeking Desert Storm veterans. Thus, the differential vulnerability of female, as opposed to male, Gulf War veterans has not been clearly established.

Although no data bear specifically on whether combat support or combat service support units actually reported greater stress-related problems, these units were frequently composed of reservists. A few studies compared reservists to regular military personnel to determine whether different patterns of health problems emerged for the two groups. Assessing the two groups retrospectively—and five years after service in the Gulf—the Iowa Persian Gulf Group (1997) found, in particular, that National Guard/reserve personnel differed from active-duty personnel with respect to symptoms of chronic fatigue, alcohol abuse, and poorer mental well-being as measured by scores on the SF-36 mental-health composite. No other differences emerged between these two groups. Stretch and colleagues (1996; also see WRAIR, 1994) reported results
showing that deployed active-duty and reservist personnel had similar BSI scores two years post-ODS, although reservists in the Pennsylvania/Hawaii sample had higher risk of PTSD than did the active-duty population. Neither study addressed whether these differences were attributable to stress by itself or whether the differences might have predated service in the Gulf. The limited available data suggest that reservists may have experienced higher levels of both perceived stress and psychological distress.

A few Gulf War studies provided information relevant to determining whether adverse health consequences varied as a function of personal or social resources. For example, Wolfe et al. (1996) examined characteristics associated with the presence of PTSD symptoms 18–20 months after deployment in a sample of active-duty Army troops and found that symptoms were higher in soldiers with more avoidant and passive forms of coping, poorer unit cohesion, and less family cohesion. Sutker et al. (1995b) studied 775 troops deployed to the Persian Gulf to determine if factors such as personal hardiness and coping styles modified the impact of war-stress exposure. They found that soldiers classified as suffering from PTSD were more likely to have fewer personal and social resources. In particular, these individuals reported less psychological resilience, employed more avoidant rather than problem-focused coping strategies, and were characterized by less-cohesive families and greater dissatisfaction with social support provided by their social networks. Thus, some support exists for the general hypothesis that groups with certain personality styles and levels of social support may have been more vulnerable to the stress of war-zone exposure, although the absence of predeployment data render any firm conclusions problematic. On the other hand, the WRAIR report (1994) observed that greater physical and psychological distress associated with deployment did not differ as a function of post-ODS life stressors or by such tangible resources as job status, finances, and the presence of significant relationships.

A small number of studies assessed whether preexisting life experiences moderated the impact of stress on health problems in Gulf War veterans. In particular, Engel et al. (1993) found that female soldiers who reported precombat histories of sexual and physical abuse experienced greater stress-related PTSD symptoms than did females who did not, even after adjusting for combat-exposure levels. Similarly, studies of inexperienced military mortuary workers showed that these workers exhibited greater anticipatory (McCarroll, Ursano, Fullerton, and Lundy, 1993b, 1995b) and subsequent psychological distress following actual recovery of war dead (McCarroll, Ursano, and Fullerton, 1993a) than did their more experienced counterparts, suggesting that occupational preparedness may soften the shock of exposure to human remains.
LIMITATIONS OF THE EMPIRICAL LITERATURE EXAMINING THE STRESS-HEALTH LINK

Several methodological and conceptual limitations are apparent among these studies. Few were designed to rule out alternative etiological explanations of postwar symptoms. This is particularly problematic because many of the symptoms of stress are nonspecific by nature, and thus may be attributable to multiple etiologies. Although PTSD is perhaps the only disorder that is regarded as uniquely attributable to stress exposure, many symptoms that appear on some self-administered PTSD checklists contain items that might be reflective of health problems other than those due to stress.

Second, virtually all of the studies used self-report symptom inventories, and did not employ diagnostic interviews or laboratory tests to verify the presence of health problems. In addition, many PTSD studies did not document exposure to a traumatic event. Yet, a definitive diagnosis of PTSD requires linkage of symptoms to a specific traumatic event.

Third, much of the research was retrospective in nature, often requiring respondents to recall events and reactions that happened months—or even years—earlier. Retrospective studies are well known to be vulnerable to recall bias (e.g., Chouinard and Walter, 1995). Assessments in the more recent studies, for example, extended from two to five years after the last troops withdrew from the Persian Gulf in July 1991. Many veterans who feel sick may be more likely to recall experiencing stress or other possible exposures during deployment because perception of illness can affect the recall or interpretation of the events leading up to the illness (Friedman and DiMatteo, 1989). In addition, recall of events may be affected by chronic psychological distress. Respondents may exaggerate the intensity or severity of the recalled event, giving a distorted picture of the relationship between stress and health. In this vein, the study by Wolfe et al. (1996) found that perceived stress levels and psychological distress increased with the passage of time. In another study, recall of whether an individual was exposed to actual stressful events—many of which were likely to have been highly salient and memorable, such as seeing others killed or wounded—varied over time (Southwick et al., 1997). As found in Southwick et al. (1997), this recall problem is particularly problematic insofar as memory is distorted in the direction of recalling exposure to greater numbers of stressful events with the passage of time.

Another problem concerned the manner in which stress exposure was measured. Many studies used ad hoc measures without adequate psychometric validation (e.g., Baker et al., 1992) or used measures originally developed for use with Vietnam veterans (e.g., Perconte et al., 1993a). Although some of these measures were modified for use in the Gulf War, as noted in Chapter Three,
they may have been insufficiently sensitive to the low-magnitude stressors connected with Gulf War service.

Finally, the studies were limited with respect to sampling and study participation rates. Few studies employed random sampling, and many studies relied on convenience samples that were often quite small. Strict matching of groups was usually not conducted (an exception is the Iowa Study). The adequacy of comparison groups, when used, was often unknown. When response rate data were reported, rates were variable and, in many cases, quite low. With some exceptions (Iowa Persian Gulf Study Group, 1997; McCarroll et al., 1995a; and Sutker et al., 1993, 1995a, 1995b), tests of differences in characteristics between participants and nonparticipants were not made. Thus, the extent to which results can be generalized to the entire population of Gulf War veterans is unknown. Lastly, although reserve/National Guard personnel comprised only 17 percent of personnel deployed to the Persian Gulf, most studies focused on reserve/National Guard samples. Thus, active-duty military service personnel were underrepresented.

SUMMARY OF THE STRESS-HEALTH LINK

The numerous design problems described above hamper our ability to draw definitive conclusions regarding the causal role of stress in health problems of Gulf War veterans. Nonetheless, existing studies suggest that exposure to stressful events in the Gulf War is associated with increased risk for PTSD symptoms. While overall rates of war-related PTSD were low, usually under 10 percent, higher rates were identified among those who served in front-line infantry, graves registration, or medical units. With some notable exceptions, most studies showed a modest link between stress and other mental health problems. Little evidence is available to link stress to bodily symptoms or actual physical disease, primarily due to the limited research on this topic.