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# Course and Predictors of Posttraumatic Stress Disorder Among Gulf War Veterans: A Prospective Analysis

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Rates and predictors of posttraumatic stress disorder (PTSD) over time are not well understood. This study is the first to look at the rates of PTSD immediately following war and 2 years later using a large cohort ($N$ = 2,949) of Gulf War veterans. Using a cut score to indicate presumptive PTSD, 3% of participants exceeded the cutoff at Time 1 compared with 8% at Time 2. Those who exceeded the cutpoint at Time 1 were up to 20 times more likely to exceed the cutpoint at Time 2 than those who did not exceed the cutpoint at Time 1. Women and those with high levels of combat exposure were at increased risk for PTSD at both times. Being young, being single, and having previous combat experience were associated with increased risk at Time 1 only, whereas reservists and enlisted personnel were at increased risk at Time 2 only. These findings indicate that, although low initially, rates of PTSD increased substantially over time.

The *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., *DSM–IV*; American Psychiatric Association, 1994) defines posttraumatic stress disorder (PTSD) as the reaction to exposure to a severe stressor causing marked horror, helplessness, or fear. The disorder is characterized by major symptom constellations involving reexperiencing phenomena, emotional numbing and/or behavioral avoidance, and physiologic hyperarousal. Research on the initial development of PTSD following trauma has focused mainly on assessing symptom concordance with these criteria and associated predictors. This research confirms that the constellation of symptoms characterizing PTSD is strongly associated with exposure to very severe life events, especially those involving life threat, physical injury, and extensive personal loss (Green, Grace, Lindy, Gleser, & Leonard, 1990; McFarlane, 1988). Considerably less information is available, however, about the progression of PTSD over time and the influence of predictors at various time points. The primary goal of the present study was to use longitudinal data to evaluate rates and predictors of PTSD over time in a large sample of male and female Gulf War veterans.

To date, most epidemiological studies have suggested that rates of PTSD following the Gulf War are low. For example, a study by the Iowa Persian Gulf Study Group (1997) found that only 2% of deployed Gulf War veterans met criteria for PTSD. Other cross-sectional studies (Holmes, Tariot, & Cox, 1998; Joseph, 1997; Perconte, Wilson, Pontius, Dietrick, & Spiro, 1993) are generally consistent with this finding, reporting that the rate of PTSD in Gulf War samples is between 2% and 6%. Although these cross-sectional studies provide important information about rates and predictors of PTSD, they provide little information about the course of PTSD over time or the factors associated with this course.

Several studies have examined rates and predictors of PTSD over time in civilians exposed to trauma (e.g., Carlier, Lamberts, & Gersons, 1997; McFarlane, 1988). Using a large sample of trauma-exposed police officers, Carlier et al. examined personal and organizational risk factors for PTSD symptomatology at 2 weeks, 3 months, and 12 months. For the year following trauma exposure, 7% of the sample met criteria for PTSD, with the majority meeting criteria within the first 3 months (85%). Stressor severity was the strongest predictor of traumatic stress symptoms at both 3 and 12 months, whereas other factors, such as introversion and poor social support, differentially contributed to PTSD at the two time points. McFarlane found that rates of PTSD were highest at two points following trauma exposure (4 months and 29 months), with a decrement in between (assessed at 11 months) in his sample of firefighters. Thus, there is some indication that rates of PTSD increase over 2 to 4 years.

A handful of studies examining rates of PTSD over time in Gulf War veterans have shown mixed results. Southwick et al. (1995) longitudinally assessed a small Gulf War cohort following deployment and found that PTSD symptom levels increased over 2 years, particularly for hyperarousal. Moreover, symptom increases were greatest between 1 and 6 months. However, McCarroll, Ursano, and Fullerton (1995) conducted two evaluations of Gulf War veterans over a similar period and found that symptoms tended to decrease over a 1-year period. These studies, however, were conducted on fairly small samples representing a limited number of military units and experiences. As a result, they may not generalize

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to the larger Gulf War force. In addition, rates of respondent attrition were fairly high.

Expanding on this prior work, especially that of Southwick et al. (1995), the present study addressed the rates and predictors of PTSD at two time points, using a large sample of Gulf War veterans spanning 68 different military units. Longitudinally followed cohorts offer the opportunity to evaluate PTSD at multiple time points and to assess factors potentially antecedent to this outcome with more confidence in the causal inference underlying documented relationships. Since 1991, we have followed a cohort of nearly 3,000 male and female Army veterans who served in the Gulf region between December 1990 and April 1991. The first evaluation point was at 5 days postreturn, before personnel had been outprocessed and had joined their families (Time 1). We conducted a second evaluation between 18 and 24 months later (Time 2). We had a number of questions about the adjustment of these veterans. First, what was the rate of PTSD among returnees at Time 1 and which factors were associated with this disorder? Second, what proportion of our sample had PTSD at Time 2 and which Time 1 factors predicted this outcome? Finally, we were especially interested in which variables might be linked to delayed onset of PTSD at Time 2. That is, if we control for PTSD status at Time 1, which factor or combination of factors would predict PTSD status at Time 2?

In addition to a number of previously implicated predictors (age, education, race, prior combat experience, and combat exposure), we added several variables often unstudied in veteran populations. These included gender, military status (reserve or National Guard vs. active duty), and military rank (officer vs. enlisted). Regarding gender, previous cross-sectional, community-based studies (e.g., Breslau, Davis, Peterson, & Schultz, 1997; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995) have found that women are at greater risk for PTSD than are men. One proposed reason has been the differential trauma exposure of women and men (Wolfe & Kimerling, 1997). Most previous research on war-zone experiences has been limited in the degree to which gender can be studied in this regard because of the historical limitations on women's military roles. In contrast, the present study, reflecting the recent large-scale inclusion of women in war-zone deployments, offers one of the first opportunities to investigate gender-based differences in settings where some critical wartime exposures might be comparable. In addition, this study is one of the first to assess gender effects on PTSD over time.

Although prior research has suggested that certain military factors may be related to the development and course of PTSD (Iowa Persian Gulf Study Group, 1997; Kulka et al., 1990), to our knowledge, no study has directly examined the effect of military rank and status over time. Stretch (1986; Stretch et al., 1996) found lower rates of PTSD in active-duty military personnel, suggesting that the military environment and military preparedness mitigate against the development of serious stress reactions in war. However, the reason for this is unknown, and several possible explanations exist. Active-duty personnel may be better prepared and have more realistic expectations about deployment experiences; hence, we predicted that active-duty military status would serve a protective function. There is also some suggestion that officer rank provides people with better training, more realistic expectations, and greater preparedness for battle, leading to stronger protection against traumatic stress (Adler, Vaitkus, & Martin, 1996).

We expected that PTSD rates would rise over time and that substantially higher rates would be found among women. Although we expected that reserve, National Guard, and enlisted personnel would be at greater risk for PTSD, we had no a priori theory as to the course of PTSD for these individuals over time.

## Method

### *Design and Procedure*

The Ft. Devens Operation Desert Storm Reunion Survey was designed to measure war stressors and their effects following the end of the Gulf War. Within 5 days of their return to the United States in 1991 (Time 1), we surveyed 2,949 Army personnel at Ft. Devens, Massachusetts, using a 45-min paper-and-pencil questionnaire (see Wolfe, Brown, & Kelley, 1993, for a full description of the survey). Members of this cohort represented a broad array of Army personnel, including those deployed from active duty ($n$ = 823), as well as those called from the reserves ($n$ = 587) and the National Guard ($n$ = 1,505). A total of 68 different units were included, representing military police (32%); medical (16%); combat (16%); transportation (14%); engineering (13%); and administrative, supply, and communication (9%) specialties. The cohort represented approximately 60% of the military personnel deployed from Ft. Devens to the Gulf region. Those not surveyed were in units that were unavailable for participation, primarily because of general administrative (e.g., outprocessing) purposes (Wolfe, Proctor, Davis, Borgos, & Friedman, 1998). We recontacted the full cohort for a follow-up survey (Time 2) at face-to-face unit meetings throughout New England in 1993–1994 (18–24 months following the initial survey) and by mail or phone where unit meetings were not feasible (20% of the follow-up sample). For both times, written informed consent was obtained following a complete description of the study.

### *Participants*

At Time 1, participants included 2,702 men and 240 women. Their mean age was approximately 30 years, with the men (30.3 years) significantly older than the women (28.1 years), $t(2878) = 3.98$, $p < .05$. The average education level was just over 13 years (completed high school), with the women (13.6 years) slightly more educated than the men (13.1 years), $t(2929) = 3.72$, $p < .05$. The majority of the cohort (82%) was Caucasian; 9% of the cohort was African American, 4% Hispanic, and 5% of other race or ethnicity. Although the percentage of ethnic minorities in the cohort was lower than that of deployed ethnic Gulf War veterans, the cohort's geographic base and relatively large number of reserve and National Guard personnel seem to account for this difference. Women in the sample were more likely to be members of an ethnic minority (27%) than were men (16%), $\chi^2(1, N = 2{,}942) = 18.53$, $p < .05$. More than half of the men were married (59%), whereas only about a third of the women were married (35%), $\chi^2(1, N = 2{,}927) = 55.47$, $p < .05$. Most of the cohort (72%) were from the reserves or National Guard, and most were enlisted personnel (92%).

At Time 2, roughly 78% of the original sample participated, including 2,119 men and 194 women. To assess any potential dropout effects, we compared those responding at follow-up with nonresponders on a number of variables collected at Time 1: gender, age, education level, race, marital status, military status, military rank, prior combat experience, Gulf War combat exposure, and PTSD. Nonresponders were more likely to be younger (mean age of responders = 30.6 years, mean age of nonresponders = 28.7 years), $t(1193.8) = 5.74$, $p < .01$; to be a member of a minority group (15% of responders identified as minority vs. 27% of nonresponders), $\chi^2(1, N = 2{,}949) = 57.4$, $p < .01$; and to be deployed from active duty (21% of responders vs. 53% of nonresponders), $\chi^2(1,$

$N = 2{,}915) = 254.6$, $p < .01$. No other significant differences were found (all $ps > .10$).

### Measures

At Time 1, study participants completed a battery of self-report measures assessing background and demographic information, their experiences in the Gulf region, and psychological outcomes, including PTSD. They were administered another battery of self-report measures at the Time 2 follow-up; the Time 2 variable used in the present study was symptoms of PTSD.

Background and demographic information included gender, age (in years), education (in years), race (Caucasian vs. non-Caucasian), marital status (married, single, or divorced), military status (deployed from active duty vs. called from reserves or National Guard), military rank (officer vs. enlisted), and prior combat experience (prior combat experience vs. no prior combat experience).

We assessed Gulf War combat exposure with the Laufer Combat Scale (Gallops, Laufer, & Yager, 1981), augmented with items that described distinctive Gulf War experiences (e.g., being on alert for SCUD or biochemical attack; Rosenheck, 1992). This self-report measure contains 33 items, each scored using a 3-point Likert response format: 0 = *never*, 1 = *once or twice*, and 2 = *three or more times*. It was designed to assess a range of combat experiences, from being surrounded by the enemy to handling enemy prisoners of war. The reliability and validity of the Laufer Combat Scale has been well established (Gallops et al., 1981); in the present study, the coefficient alpha was .73. All 33 items were summed to create a total Gulf War combat exposure score.

We evaluated PTSD symptoms at both times using the Mississippi Scale for Combat-Related PTSD (Keane, Caddell, & Taylor, 1988). The measure is composed of 35 items, which are scored using a 5-point Likert-style scale ranging from 1 to 5. In the present study, minor wording changes were made in the Mississippi Scale to reference the Gulf War context (Wolfe et al., 1993). The Mississippi Scale has demonstrated excellent reliability, with internal consistency coefficients above .90 (Keane et al., 1988; Kulka et al., 1990) and a 1-week test–retest coefficient of .97 (Keane et al., 1988). Reliability was quite good in the present sample, with coefficient alphas of .89 and .93 at Times 1 and 2, respectively. The Mississippi Scale has been shown to correlate highly with measures of stressor exposure and to have excellent sensitivity and specificity (.93 and .89, respectively; Keane et al., 1988). In fact, Kulka et al. found the Mississippi Scale outperformed all other self-report measures of PTSD and retained it for use in their national survey (Kulka et al., 1990). Recent research (Zatzick et al., 1997) has indicated that a cut score of 94 on the Mississippi Scale is the most appropriate for identifying those with clinical levels of PTSD in a nonclinical population. As a result, participants were designated as meeting criteria for presumptive PTSD if they scored 94 or above on the Mississippi Scale.

### Analyses

Initially, we documented prevalence of PTSD at two measurement times. Rates were examined first by occasion (separately for Times 1 and 2) and then for consistency across occasion. This latter analysis provided information regarding the potential chronicity and delayed onset of PTSD over the study period. All prevalence estimates were derived for the sample as a whole and then separately for each gender.

Next, we used cross-sectional analyses to relate predictors and PTSD, which were both assessed at Time 1. Bivariate associations of each of the predictors with PTSD were computed, followed by a multivariate logistic regression analysis. Bivariate associations, although beneficial for examining relations between variables, do not adjust for collinearity among predictors. Multivariate logistic regression, however, estimates the unique effect of each predictor, adjusting or controlling for the effects of the other predictors in the model.

Finally, we conducted prospective analyses to evaluate change in PTSD over our study interval. Prospective analyses allow the researcher to look not only at the relation between the predictors and PTSD at each time point but also at the relation between the predictors and change in PTSD over the two time points. We regressed PTSD at Time 2 on the same nine Time 1 predictors used in the cross-sectional analyses, controlling for PTSD at Time 1. This strategy allowed the documentation of the unique contribution of the predictors on Time 2 PTSD, holding constant Time 1 PTSD status. A path model based on these analyses is presented.

## Results

### Rates of PTSD at Times 1 and 2

Overall, 3% of the sample exceeded the Mississippi Scale cutpoint for PTSD at Time 1. This increased to a rate of 8% at Time 2. At Time 1, women exceeded the cutpoint for PTSD at a rate over three times that of men (8% vs. 3%, respectively; odds ratio [OR] = 3.2, 95% confidence interval [CI] = 1.9–5.5). Similarly, at Time 2, women exceeded the cutpoint at a rate over twice that of men (16% vs. 7%, respectively; OR = 2.3, 95% CI = 1.5–3.5).

When the rates were examined over occasions, 2% of the full sample exceeded the cutpoint for PTSD at both Times 1 and 2, 1% exceeded the cutpoint at Time 1 but not at Time 2, and 6% exceeded the cutpoint at Time 2 but not at Time 1; a large majority (91%) of the sample did not meet criteria at either time. Participants who exceeded the cutpoint for PTSD at Time 1 were 23 times more likely to exceed the cutpoint at Time 2 than those who did not meet criteria at Time 1 (OR = 23.0, 95% CI = 13.5–39.3). Thus, PTSD appears to be a relatively stable or chronic condition over the 2-year period from the point of initial evaluation, with the majority of those who met criteria at Time 1 (62%) continuing to meet criteria at Time 2. However, we also detected a large number of new cases at Time 2: 79% of the individuals who met criteria at Time 2 did not meet criteria at Time 1. These data suggest considerable rates of delayed onset.

For men, 1% exceeded the cutpoint at both Times 1 and 2, 1% exceeded the cutpoint at Time 1 only, and 6% exceeded the cutpoint at Time 2 only. Over 91% did not meet criteria for PTSD at either time. The OR was 20.9 (95% CI = 11.5–38.1), with 58% of men who exceeded the cutpoint at Time 1 continuing to do so at Time 2 and 82% who exceeded the cutpoint at Time 2 not meeting criteria at Time 1. This pattern was similar for women, although the numbers differed slightly on the basis of the higher rates among women. For women, 6% exceeded the cutpoint at both Times 1 and 2, 2% exceeded the cutpoint at Time 1 only, and 9% exceeded the cutpoint at Time 2 only. For women, 83% were below the cutpoint for PTSD at both times. This represents an OR of 24.3 (95% CI = 7.0–84.3), with 73% of those who scored above the cutpoint at Time 1 also doing so at Time 2 and 62% of those who exceeded the cutpoint at Time 2 not doing so at Time 1. A test of the homogeneity of the ORs for men and women was not significant, $\chi^2(1, N = 2{,}278) = 0.05$, $p = .83$, suggesting that the pattern of PTSD (i.e., the relationship between Time and PTSD) over this 2-year period did not differ for men and women.

### Bivariate Associations Between Predictors and PTSD

Table 1 shows the bivariate associations (i.e., OR or correlation coefficient) of PTSD at Times 1 and 2 with several potential

Table 1
*Bivariate Associations of Predictors and PTSD (at Each Time) for the Full Sample and by Gender*

| | PTSD Time 1 | | | | PTSD Time 2 | | | |
|---|---|---|---|---|---|---|---|---|
| Variable | Full sample | Men | Women | ♀[a] | Full sample | Men | Women | ♀[a] |
| Race | 0.70 | 0.65 | 1.29 | .29 | 0.99 | 1.06 | 1.18 | .84 |
| Marital status | 0.83 | 0.78 | 2.04 | .08 | 1.17 | 1.27 | 1.42 | .80 |
| Military status | 0.91 | 0.77 | 1.80 | .22 | 2.00* | 2.00* | 2.18 | .89 |
| Military rank | 3.58 | 5.67* | 0.81 | .01 | 4.13* | 6.78* | 1.76 | .17 |
| Prior combat experience | 1.61 | 1.37 | 10.00* | .01 | 1.42 | 1.38 | 4.83* | .08 |
| Age | −.05* | −.05* | −.02 | | .00 | .00 | .06 | |
| Education level | −.01 | −.03 | .07 | | −.03 | −.05* | .06 | |
| Combat exposure | .20* | .21* | .16* | | .19* | .19* | .19* | |

*Note.* For race, marital status, military status, military rank, and prior combat experience, effect sizes are odds ratios. For age, education level, and combat exposure, effect sizes are Pearson correlation coefficients. PTSD = posttraumatic stress disorder.
[a]Represents the $p$ value associated with the Breslow-Day test for homogeneity of odds ratios for men and women.
*$p < .05$.

predictors. Associations are given for both the full sample and by gender, including a statistical test of equal association for men and women. As seen in the left half of the table, Gulf War combat exposure was associated with PTSD at Time 1 for the full sample ($r = .20, p < .05$) as well as for men ($r = .21, p < .05$) and women ($r = .16, p < .05$) separately. Those who reported experiencing more combat were more likely to exceed the cutpoint for PTSD. Age was also significantly related to the disorder (for the full sample, $r = -.05, p < .05$), with younger soldiers more likely to meet criteria for PTSD. For men, this relationship was significant ($r = -.05$), but for women it was not ($r = -.02$).

Enlisted personnel were over 3 times more likely than participants with officer status to score higher on PTSD at Time 1 (OR = 3.6, 95% CI = 0.9–14.7), although the OR was only marginally significant. Examination across gender showed that this relationship was significant for men but not for women. Prior combat experience also appeared to be differentially related to PTSD as a function of gender. In the overall sample, prior combat experience was not associated with PTSD at Time 1. For women, however, those experiencing prior combat were 10 times more likely to meet criteria than those who did not experience prior combat (OR = 10.0, 95% CI = 2.5–39.6). It should be noted, however, that the number of women with prior combat experience was quite low ($n = 10$), and they may represent a unique subsample.

The right half of Table 1 presents the bivariate associations of the Time 1 predictors with PTSD assessed at Time 2. As was the case with Time 1, Gulf War combat exposure was associated with PTSD at Time 2 ($r = .19, p < .05$) and enlisted soldiers were still more likely to meet criteria for PTSD (OR = 4.1, 95% CI = 1.5–11.3), although this continued to be true only for the men. The pattern with prior combat experiences was also very similar to the relationships reported for Time 1; women with prior combat experience had significantly increased risk.

There were also a number of differences from Time 1 to Time 2. Soldiers' age, significantly related to PTSD at Time 1, was not associated with PTSD at Time 2. Also, both education and military status, unrelated to PTSD at Time 1, were significantly associated with PTSD at Time 2. Reserve and National Guard personnel were twice as likely to meet criteria for PTSD at Time 2 than were active-duty personnel (OR = 2.0, 95% CI = 1.3–3.1). Those with more education were less likely to meet criteria for PTSD at Time 2, although this was true only for men.

### *Cross-Sectional Logistic Regression Analysis (Time 1 Data)*

Table 2 presents the results of the logistic regressions, the left half representing findings when all data were from Time 1. In this model, the dichotomous PTSD variable was regressed on the nine background and demographic variables and on all two-way gender interactions. None of the gender interactions were significant and, although modeled, are not included in the table.

As shown, gender, age, prior combat experience, and Gulf War combat exposure uniquely predicted PTSD. Gulf War combat exposure appears to be most strongly predictive, with a large standardized coefficient (.53). Gender and age were roughly equally predictive of PTSD, with women over six times more likely to meet criteria for PTSD at Time 1 and younger soldiers more likely to meet criteria for PTSD at Time 1, holding constant all other predictors in the model. Those who had experienced prior combat were three times more likely to exceed the cutpoint than those with no prior combat experience.

### *Prospective Logistic Regression Analysis (Time 1 and Time 2 Data)*

The right half of Table 2 represents the regression of PTSD at Time 2 on the predictors, controlling for PTSD at Time 1. As seen in the table, an individual categorized as having PTSD at Time 1, in conjunction with all other predictors specified in the model, was 13 times more likely to meet criteria for PTSD at Time 2 than an individual who was not similarly categorized at Time 1. Controlling for this stability, four of the predictors were significant: Gender, military status, military rank, and Gulf War combat exposure were each significantly related to PTSD at Time 2. Enlisted

Table 2
*Standardized Regression Coefficients and Odds Ratios From Two Logistic Regressions Predicting PTSD at Time 1 and Time 2*

| Variable | PTSD Time 1 | | PTSD Time 2 | |
|---|---|---|---|---|
| | Standardized regression coefficient | OR | Standardized regression coefficient | OR |
| PTSD Time 1 | — | — | 0.24* | 12.99 |
| Gender | .28* | 6.04 | 0.15* | 2.59 |
| Age | −.25* | 0.95 | 0.04 | 1.01 |
| Race | −.04 | 0.81 | −0.02 | 0.89 |
| Military status | .01 | 1.03 | 0.24* | 2.92 |
| Education level | −.13 | 0.88 | −0.11 | 0.90 |
| Marital status | .04 | 1.14 | 0.07 | 1.29 |
| Military rank | .17 | 3.22 | 0.25* | 5.24 |
| Combat exposure | .53* | 1.22 | 0.31* | 1.12 |
| Prior combat experience | .19* | 2.99 | 0.04 | 1.26 |

*Note.* All two-way interactions with gender were included in the logistic regressions. None of the interactions were significant and are not included in the table. PTSD = posttraumatic stress disorder; OR = odds ratio.
$*p < .05$.

personnel were over 5 times more likely to exceed the cutpoint than were officers, reservists and National Guard soldiers were almost 3 times more likely to exceed the cutpoint than were active-duty soldiers, and women were more than twice as likely to meet criteria for presumptive PTSD as were men. As with all previous analyses, Gulf War combat exposure predicted PTSD, such that those with higher levels of exposure were more likely to exceed the cutpoint.

With minor modifications to these logistic regressions, we generated a path model that graphically displays these prospective effects and allows for the quick calculation of both direct and indirect effects (through PTSD at Time 1) of the predictors on PTSD at Time 2. Using listwise deletion of participants who did not provide Time 2 data, we reestimated the cross-sectional and prospective logistic regressions. The two-way gender interactions were not included because of lack of support in previous analyses. Results are shown in Figure 1. Although all direct paths to PTSD at Times 1 and 2 were estimated, only those with significant ($p < .05$) coefficients are shown. Slight differences between values in Table 2 and Figure 1 are due to different sample sizes (listwise deletion is necessitated by combining the two logistic regressions into one diagram) and the exclusion of gender interactions in the figure.

The model, using standardized coefficients, portrays the large association of Gulf War combat exposure with PTSD at Time 1 (.52). Further, the indirect effect of Gulf War combat exposure on PTSD at Time 2 (through PTSD at Time 1) was calculated as the product of the paths from combat exposure to PTSD at Time 1 and from PTSD at Time 1 to PTSD at Time 2 ($.52 \times .24 = .12$). The total effect of Gulf War combat exposure on PTSD at Time 2 is the sum of the indirect and direct effects ($.12 + .30 = .42$). Thus, Gulf War combat exposure was largely associated with PTSD at Time 2; although much of this (.30) is accounted for by the direct effect of Gulf War combat exposure on PTSD at Time 2, there is also a substantial amount (.12) accounted for indirectly through PTSD at Time 1. A similar pattern was seen with gender, with both an indirect effect through PTSD at Time 1 (.06) and a significant direct effect (.13).

The other significant predictors were associated directly with PTSD at only one of the two time points. Age and prior combat experience were significantly directly associated with PTSD at Time 1 but not PTSD at Time 2. Thus, their association with PTSD at Time 2 was primarily through their relationship with PTSD at Time 1. Military status and military rank were directly associated with PTSD at Time 2 but not with PTSD at Time 1.

## Discussion

This study investigated rates and predictors of PTSD at two points following Gulf War service. We observed a number of important differences in PTSD rates over time, as well as changes in the predictors of PTSD at each point. Using a cutpoint of 94 on the Mississippi Scale, the rate of PTSD immediately on return to the United States was 3% (3% for men, 8% for women). This rate more than doubled to 8% (7% for men, 16% for women) by the time of follow-up assessment 18 to 24 months later. These rates are roughly comparable with those reported in other Gulf War studies (e.g., Joseph, 1997; McCarroll et al., 1995; Southwick et al., 1993). Although Sutker, Uddo, Brailey, and Allain (1993) reported a much higher rate of PTSD (19%) in a sample of Gulf War veterans, their sample was smaller and was composed primarily of combat troops. The present study offers the benefit of a large cohort with a very early initial assessment, relatively high retention, and a broader range of military occupational specialties and stressor exposure than has generally been available.

As in other studies (e.g., Holmes et al., 1998; Southwick et al., 1993), our research suggests that rates of stress symptomatology in Gulf War veterans are lower than rates from other eras. Rates in our sample fell below PTSD prevalence estimates from the Vietnam War (15% PTSD for male Vietnam War veterans approximately 19 years postwar; Kulka et al., 1990). We expected this difference for a number of reasons: Participants in our sample were

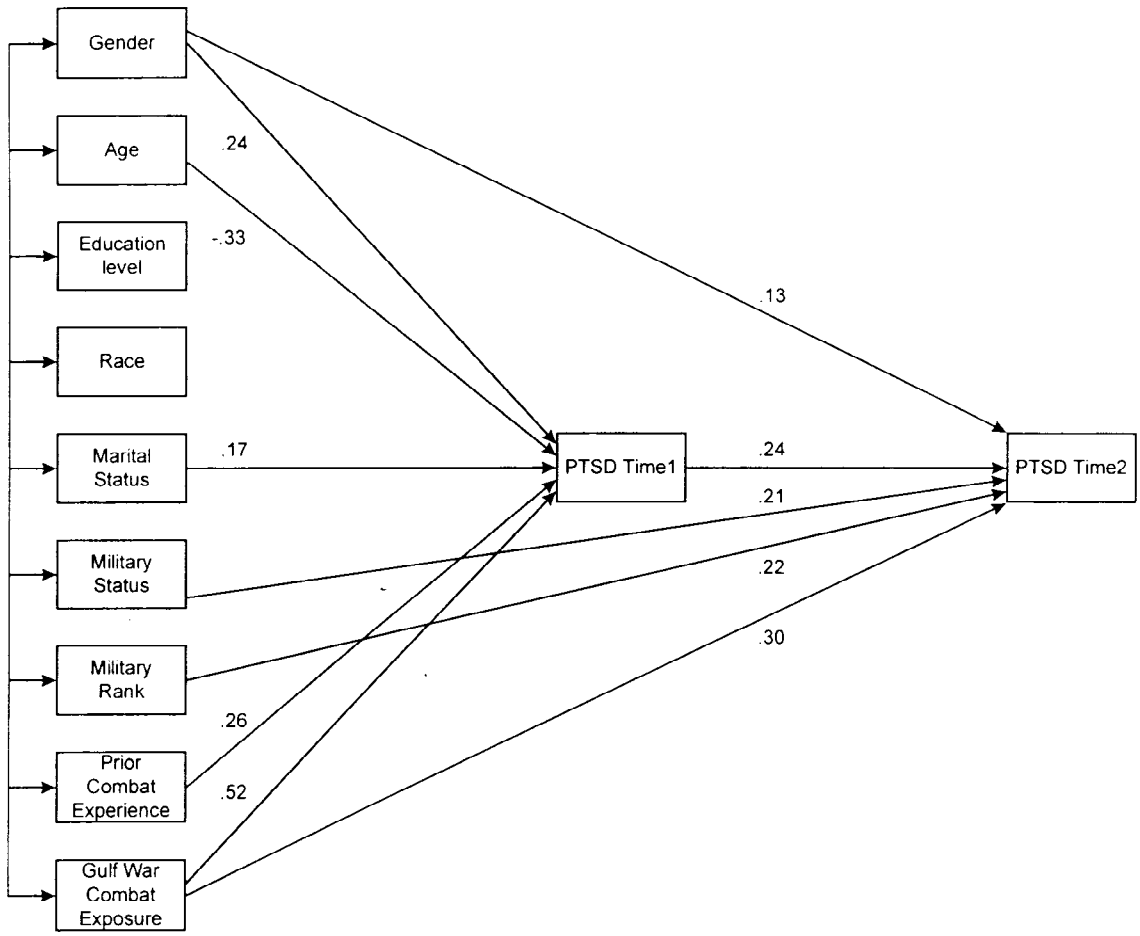


*Figure 1.* Path model (based on two logistic regressions) predicting posttraumatic stress disorder at Times 1 and 2. All paths (standardized coefficients) are estimated, although only significant ones ($\alpha$ = .05) are shown in the figure. PTSD = posttraumatic stress disorder.

considerably older, had more education, had less total combat exposure, and served in the war-zone on average for a much shorter time (approximately 4 months) than did the typical Vietnam War soldier. The fact that cohort data on Vietnam veterans were collected cross-sectionally some 10 to 20 years after the war's conclusion (Kulka et al., 1990) makes further comparisons with our study difficult, especially in terms of the course of PTSD over time.

Although some of the significant effects are small in magnitude, a number of compelling findings relate to predictors of PTSD and changes in PTSD rates over time. We found that meeting criteria for presumptive PTSD at Time 1 was the strongest predictor of presumptive PTSD at the Time 2 follow-up and that PTSD rates increased dramatically over time. Our finding that PTSD at Time 1 overwhelmingly predicted PTSD at Time 2 is consistent with other research (e.g., Carlier et al., 1997; Southwick et al., 1995), which has shown that, once they develop, symptoms of PTSD are relatively persistent. One possible explanation for this persistence is that the natural course of the disorder is, at a minimum, several years in length. A second possibility is that underlying risk factors for PTSD contribute to an increased susceptibility for further stressor exposure, a process seen in other populations (e.g., Resnick, Kilpatrick, Best, & Kramer, 1992). Animal models have shown that distinctive neuroendocrinological and physiological alterations frequently develop after stressor exposure and that ensuing functional disturbances are linked to chronicity of this disorder (Yehuda, Boisoneau, Lowy, & Giller, 1995). Although this model has not been definitively established in humans, it is likely that chronic PTSD in humans is associated with analogous changes in critical neuroendocrine parameters and behavioral functions (Yehuda et al., 1995).

Two factors were significantly associated with PTSD status at both time points in our study: the degree of combat exposure and female gender. Although numerous studies of veterans and civilians have shown that stressor severity, rather than typology per se, exerts the largest impact on psychological outcome (e.g., Carlier et al., 1997; Davidson & Foa, 1991; Kulka et al., 1990), we demonstrated this relationship even though the average amount of combat exposure was relatively low. Importantly, this dose–response relationship held for both time points. Combat exposure, although related to subsequent PTSD through its relation with initial PTSD, also had a direct effect on later PTSD; that is, combat exposure had an effect on change in PTSD status at follow-up. Thus, combat exposure may well have a latent or long-term effect.

We believe that this is also the first large-scale study to show that gender was associated with PTSD at both time points. Controlling for combat exposure, we found that women in our sample consistently exceeded the PTSD cutoff at rates over twice that of men. Most nonveteran studies of PTSD involving both men and women dramatically parallel this finding (e.g., Breslau, Davis, & Andreski, 1995; Kessler et al., 1995). In exploring potential causes, Wolfe and Kimerling (1997) proposed that women might be exposed to more severe trauma early in life (e.g., child sexual abuse) and that this exposure may lead to greater vulnerability for PTSD (cf. Breslau et al., 1997; Sharkansky et al., 1998). In one cross-sectional Gulf War study, Engel et al. (1993) found that women reported more precombat psychiatric history and precombat physical and sexual abuse than did men. Subsequent analyses revealed that, controlling for precombat psychiatric history, precombat abuse predicted PTSD symptomatology in women but not in men. Thus, women appear more likely to experience prior victimization, and this victimization may increase their likelihood of developing PTSD.

A second explanation for the higher rates of PTSD among women is that women and men did not experience comparable rates of traumatic stressors during the deployment (even though scores on the combat exposure scale were quite comparable). For example, women might have encountered higher levels of discrimination, harassment, or sexual assault, which prior research suggests may have contributed to the development of symptomatology (Wolfe, Sharkansky, et al., 1998). Future studies will need to evaluate a much broader range of potentially stressful experiences in both men and women, as the interplay between gender, trauma history, and PTSD could have clinical as well as theoretical implications.

In addition to the persistence of PTSD, we detected a number of new cases of PTSD at Time 2. This is particularly noteworthy in light of the low initial rates and the expectation that the war would have few adverse outcomes. One possible explanation is that this increase is artifactual; that is, the disorder was present at Time 1, but we did not detect it for a variety of reasons (e.g., participants' positive moods at the time of return, reluctance to endorse symptoms in a military setting, and misattributions about extant symptomatology). Thus, our initial evaluation may have underestimated the number of true cases. If so, this suggests that PTSD develops early on (i.e., before 2 years) but that we lacked the methodology to determine the points of exact onset. A second possibility is that the increase is due to unmeasured changes from Time 1 to Time 2 (e.g., history effects and measurement reactivity). The unexplained illnesses of Gulf War veterans began receiving considerable media attention as time passed and may have impacted participants' responses by heightening sensitivity to symptoms. This explanation is not likely, however, given that Time 2 data collection preceded much of this media attention. A third but critical possibility is that the observed increase in PTSD rates represents true delayed onset. In fact, using animal models, researchers have described a two-stage model of sensitization, in which initial poststressor responses remit but newer symptoms emerge over time (Sorg & Kalivas, 1995). Thus, intervening stressors, although not explored in the present study, could play a role. Although recognized in the *DSM–IV* (American Psychiatric Association, 1994), delayed-onset PTSD has not been well studied in humans, even though it has important implications for preventive efforts, as well as diagnosis and treatment.

Although factors linked to symptom expression are complex, our data point to two variables associated with delayed onset of PTSD: military status (i.e., reserve or National Guard vs. active duty) and military rank (enlisted vs. officer). In terms of military status, one possibility is that deployment is more traumatic for reserve or National Guard personnel (Malone et al., 1996; Perconte et al., 1993). The training and expectations of reserve or National Guard personnel may differ from those of active-duty troops. Active-duty personnel might benefit from a higher degree of overall military preparation and greater familiarity with war-zone activities. Also, military deployment likely constitutes a larger disruption in the daily routines of reserve or National Guard personnel, who are generally used in civilian settings and have wage-earning responsibilities outside of the military setting. Finally, active-duty troops might be exposed to greater (or more continuous) unit and leadership support through their day-to-day contact.

As suggested by Holmes et al. (1998), officer rank could serve a protective function. Officers in our study showed negligible levels of PTSD, suggesting that nonofficer rank was influential in the exacerbation of PTSD over time. This protective effect could relate to any number of factors, including differences in entrance-level characteristics, differences in training and preparation, or variations in actual wartime exposure. Although we cannot know for certain, it is possible that these vulnerabilities do not appear until certain contextual resources (e.g., the support of the military environment) are withdrawn.

The present study offers a number of methodological improvements strongly suggested by prior research (e.g., Holmes et al., 1998; Southwick et al., 1993), notably reduced selection bias and the use of early baseline measurement. Also, in addition to confirming the effects of certain variables (e.g., combat exposure, gender, and reserve or National Guard status) on outcome, we were able to demonstrate the longitudinal course of these predictors. Our results highlight the impact of these factors over time. There are, however, some limitations to the present study. First, we relied exclusively on self-report measures at both time points. Although we specified and supported our selection of a PTSD cutpoint, this approach cannot wholly substitute for the use of a well-developed, standardized diagnostic interview for PTSD (Wolfe & Keane, 1993). A common limitation to most wartime studies is that information on exposure to combat and other stressors is obtained retrospectively; accordingly, these reports are subject to the usual reporting biases (Sutker et al., 1993; Wolfe et al., 1993). On the other hand, we collected our initial data very early on, before many soldiers had an opportunity to read any (adverse) publicity about the war's aftermath and before soldiers reentered civilian or stateside life. Other limitations concern the sample in general. Although our sample was large, the cohort was composed exclusively of Army personnel, with a high proportion of personnel from the reserves or National Guard. This composition is not wholly representative of the larger U.S. force deployed to the Gulf, which included all branches of service and higher rates of active-duty personnel (U.S. General Accounting Office, 1992). Accordingly, generalizations from this study should be made with some caution.

Prior research on PTSD has often focused on the cross-sectional determination of rates and predictors of this disorder, with a particular emphasis on stressor magnitude. Our study is distinct in suggesting that a broader range of personal and situational characteristics should be considered. Further, these factors should be assessed in terms of their temporal or sequential effects. The association of female gender with PTSD is also important. The U.S. Armed Forces is composed of growing numbers of women, many of whom will be deployed to future war zones. Factors associated with the successful adaptation of both women and reserve and National Guard personnel to military stressors should be studied further, especially in light of the increasing reliance on reserve and National Guard troops. Studies highlighting the development and maintenance of stress resistance under varying levels of exposure are especially indicated.

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