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A Twin Study of the Association of Post-Traumatic Stress Disorder and Combat Exposure with Long-Term Socioeconomic Status in Vietnam Veterans

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This study examines the association between post-traumatic stress disorder (PTSD) and combat exposure with the socioeconomic status of 2210 male monozygotic veteran twin pairs in 1987. In the unadjusted analysis on individuals, modest correlations indicated that those with PTSD were more likely to have been divorced, and less likely to be currently employed or to achieve high status in income, education or occupation. In the crude analysis of veterans not suffering from PTSD, there were small positive correlations between combat level experienced and the likelihood of ever being married, ever being divorced, and the number of years employed at the current job. However, when we examined identical twins discordant for PTSD, and adjusted for pre-military and military service factors, only unemployment remained significant. Likewise, in combat-discordant twins, no significant effects on the socioeconomic indicators were seen. We conclude that PTSD and combat experience in Southeast Asia have not had a major impact on the socioeconomic status of veterans.

KEY WORDS: combat; marriage; education; occupation; PTSD.

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INTRODUCTION

Heavy combat exposure during the Vietnam War causes persistent psychological distress (Yager, Laufer, & Gallops, 1984; Goldberg, True, Eisen, & Henderson, 1990a). In many cases the extent of the stress fully or partially satisfies criteria for the diagnosis of PTSD (Kulka, Schlenger, Fairbank, Hough, Jordan, Marmar, & Weiss, 1990). Studies of veterans with PTSD or stress reactions have shown that these conditions are associated with poor socioeconomic status.

Other investigations have focused not on PTSD but on the role of combat. Combat is associated with increased substance abuse (Yager *et al.*, 1984; Goldberg *et al.*, 1990b), adverse effects on long-term physical health (CDC Vietnam Experience Study, 1989; Eisen, Goldberg, True, & Henderson, 1991), and increased post-service mortality (Boyle, Decoufle, & O'Brien, 1987). It is reasonable, therefore, to hypothesize that combat might adversely affect the post-discharge socioeconomic status of veterans independently from PTSD.

Issues such as marriage and divorce address singular events which could have occurred at any time in the postservice period. Questions of employment, occupational, educational, and economic achievement, assessed more than 15 years after the close of the war, probe the issue of long-term, persistent disparities between veterans with different experiences. In this study we examine events which might be more likely to have occurred immediately following service, and longer term characteristics, which might suggest a persistent, protracted effect of military service.

The present study reexamines the association of PTSD with socioeconomic status using the natural experiment provided by PTSD-discordant veteran twin pairs. Familial factors and childhood characteristics have been found to be associated both with PTSD prevalence (Kulka *et al.*, 1990) and with socioeconomic status (Card, 1983). Therefore, to control for familial factors in the current study, we have used a national sample of 2210 monozygotic veteran twin pairs.

METHODS

Data Sources and Study Eligibility

Data for the present study are derived from the Vietnam Era Twin Registry of 7375 male-male twins who served in the military during the Vietnam era (May 1965 to August 1975). The registry was developed using the Department of Defense's computerized military records and several ci-

vilian databases by matching same last name, date of birth, and similar social security numbers. A complete description of the registry has been published (Eisen, True, Goldberg, Henderson, & Robinette, 1987; Henderson, Eisen, Goldberg, True, Barnes, & Vitek, 1990).

Registry twins were surveyed in 1987 to collect information on a wide range of physical and psychological health indicators. The survey was completed by mail or telephone (99% of respondents), or by personal interview (1%); the pairwise response rate was 65% or 4774 pairs. Twins were eligible for the present study if the pair was originally ascertained from the Department of Defense computer files (thereby providing the most unbiased ascertainment method), both members of the pair responded to the survey, complete data were available for all socioeconomic indicators, and siblings were monozygotic. Zygosity was assigned using a validated questionnaire and blood group typing methodology (Eisen *et al.*, 1989). A total of 2210 monozygotic twin pairs were eligible for the present study.

PTSD Presumptive Diagnosis and Combat Exposure

A presumptive diagnosis of PTSD was made based on answers of respondents to 12 items in the 1987 health survey. These 12 items, about half of which were specific to military experience, were very similar to the *Diagnostic and Statistical Manual of Mental Disorders,* Third Edition, Revised diagnostic criteria for PTSD. This presumptive diagnosis has been found to have good reliability (Goldberg *et al.*, 1990a).

Military service in Southeast Asia (SEA) was determined from the response to the question, "When you were in the military, were you stationed in Vietnam, Laos, or Cambodia; in the waters in or around these countries; or fly in missions over these areas?" For individuals responding affirmatively, combat exposure was measured by a set of questions about 18 specific combat roles or experiences (e.g., serving as a "tunnel rat," checking enemy base camps, or demolitions expert in the field) (True, Goldberg, & Eisen, 1988). For each item, the veteran was asked to indicate whether he had that role or experience. A global index of combat exposure was created by summing all positive responses. For analytical purposes, a five-level, ordinal index of combat exposure was constructed: non-SEA service (combat index 0); SEA service, no combat (combat index, 1); low level of combat (combat index, 2 to 3); medium level of combat (combat index, 4 to 7); and high level of combat (combat index, >7). The reliability and validity of this combat exposure index have been demonstrated (Janes, Goldberg, Eisen, & True, 1991).

Measures of Socioeconomic Status

Information regarding socioeconomic status was grouped into four categories: three measures of marital status (ever married, age at first marriage, ever divorced), three measures of occupational status (current employment status, occupational category, length of time in years at current employment), highest education, and family income.

Categories for age at first marriage are 21 or younger, 22 to 25, and 26 or more. Ever married and ever divorced were dichotomous variables. The number of respondents ever divorced and the age at first marriage were only calculated for pairs where *both* twins married after the date of military enlistment.

Current employment status was defined as unemployed or employed (full time or part time). For those currently employed, occupational data on type of employment were coded according to the Standard Occupational Classification System (1980) of the Bureau of the Census. Occupations were then grouped into seven categories: executive-managerial; professional specialties; office, clerical, sales, and administrative support; service and transportation; precision production, craftsmen, and repair workers; operators and laborers; farmers, foresters, and fishermen. This grouping was chosen to agree with that used in the Centers for Disease Control Vietnam Experience Study (1989), thereby permitting direct comparison of results. We also obtained data on the length of time (in years) a person was employed at their present job.

Educational attainment was measured as the highest grade completed. Total yearly household income was obtained by asking the respondent to select one of ten categories that ranged from less than 5000 to 50,000 dollars or more; for analytical purposes we collapsed this into less than 20,000, 20,000 to 49,999, and 50,000 or more.

Statistical Analysis

The objective of the statistical analysis is to determine the association between PTSD and each of the individual socioeconomic measures. In addition, in order to assess combat effects independently of PTSD, the association between combat experience and socioeconomic status was examined in that subset of subjects who did not have a presumptive diagnosis of PTSD. Even in this subset without PTSD, there was still a good distribution of combat experience. In the initial descriptive analysis, unpaired polychoric correlations between socioeconomic categories and either PTSD status or

combat experience were calculated for the complete database (Neale & Cardon, 1992).

Next, we took advantage of the presence of monozygotic twins in the database to simulate a natural experiment. The most informative pairs for this purpose are those monozygotic twin pairs that are discordant for PTSD or combat. That is, one member of the pair had the exposure of interest (e.g., PTSD or combat) but his twin brother did not. Since monozygotic twins have identical genetic makeup and shared a common familial environment while growing up, the twins are matched on numerous known and unknown potentially confounding familial factors. Since they have dissimilar exposures, we can study the effect of the exposure on the outcome, independent of familial factors.

Our first step in the analysis of PTSD- or combat-discordant twins was a simple description of the distribution of each socioeconomic measure. However, this analysis does not maintain the distinction of matched-pairs. We explicitly accounted for the paired structure of the data using conditional logistic regression analysis (Breslow & Day, 1980). This method allows us to calculate matched pair odds ratios that measure the strength of association between PTSD or combat with the socioeconomic measures. An odds ratio less than one indicates a reduced likelihood for that outcome in the exposed group (e.g. those with PTSD). Conversely, an odds ratio greater than one indicates an increased odds of the outcome. Odds ratios are significant at $p < 0.05$ if the confidence interval does not include 1.0. (In the conditional logistic regression, we regrouped the socioeconomic variables to be dichotomous.)

Conditional logistic regression is also used to adjust for pre-military and military service factors that may confound the association between PTSD or combat and the socioeconomic measures. The following potentially confounding pre-military and military variables were abstracted from military service records and are included in the logistic regression analysis: age at enlistment, education at enlistment, enlistment aptitude test score, branch of service, length of service, and year of discharge. For several of the socioeconomic measures, a pair were included only if both members are at risk for the event. For example, only pairs where *both* siblings have been married are included in the ever divorced analysis.

RESULTS

Polychoric correlations between the various socioeconomic measures and veteran experience are presented in Table 1. For PTSD, correlations were generally modest, ranging from –0.35 (for currently employed) to 0.17

Table 1. Correlations Between Socioeconomic Measures and Veteran Experience

Socioeconomic Measures	PTSD	Combat[a]
Marital status measures		
Ever married	−0.04	0.15[b]
Age at first marriage	−0.04	−0.01
Ever divorced	0.17[b]	0.05[b]
Occupational measures		
Currently employed	−0.35[b]	0.03
Occupational group	−0.06[b]	−0.02
Years employed at current job	−0.04	0.10[b]
Educational and income measures		
Present educational level completed	−0.14[b]	−0.03
Household income	−0.24[b]	0.01

[a]Effects of combat were studied in those veterans not suffering from PTSD.
[b]Significantly different from zero at $p < 0.05$.

(for ever divorced). The correlations that differed significantly from 0 ($p < 0.05$) suggested a slight increase in the likelihood of ever being divorced and a reduced likelihood of being employed, having a high occupational status, completing a high level of education, or having a high household income. In the group without PTSD, there was little association of combat exposure and socioeconomic status. Significant but weak correlations were seen for combat with ever married ($r = 0.15$), ever divorced ($r = 0.05$), and years employed ($r = 0.10$).

Table 2 displays the prevalence of each of the socioeconomic measures in monozygotic twin pairs discordant for the exposure of interest (PTSD or some level of combat). There was little difference in the percent ever married between twins on the basis of PTSD; 87.8% of those twins who have a presumptive diagnosis of PTSD were ever married compared to 90.0% of their co-twins who did not have PTSD. Similarly, twins exposed to combat (but without PTSD) showed no difference in the percent married compared to their co-twins not exposed to combat (87.9% versus 85.6%). The majority of twins with and without PTSD and those exposed and unexposed to combat, have been married at least once, most commonly for the first time between ages 22 and 25. Slightly more than 40% of twins have been divorced regardless of PTSD status. Nor is there any difference in the prevalence of divorce (approximately 27%) in twins who are discordant for combat exposure.

Table 2. Socioeconomic Status in Twin Pairs Discordant for Either PTSD or Combat[a]

Socioeconomic Factors	PTSD		Combat[b]	
	Yes (%)	No (%)	Yes (%)	No (%)
Marital status measures				
Ever married	(*n* = 229)	(*n* = 229)	(*n* = 430)	(*n* = 430)
Yes	87.8	90.0	87.9	85.6
No	12.2	10.0	12.1	14.4
Age first marriage	(*n* = 185)	(*n* = 185)	(*n* = 335)	(*n* = 335)
< 22 years	25.4	30.3	22.1	27.2
22–25 years	53.0	46.5	50.2	43.6
> 25 years	21.6	23.2	27.8	29.3
Ever divorced	(*n* = 187)	(*n* = 187)	(*n* = 335)	(*n* = 335)
Yes	43.9	40.6	27.8	27.2
No	56.1	59.4	72.2	72.8
Occupational measures				
Currently employed	(*n* = 273)	(*n* = 273)	(*n* = 556)	(*n* = 556)
Yes	84.6	88.6	95.5	96.2
No	15.4	11.4	4.5	3.8
Years employed	(*n* = 208)	(*n* = 208)	(*n* = 508)	(*n* = 508)
0–4 years	32.2	27.4	29.5	24.2
5–9 years	22.6	26.4	22.2	23.4
10–14 years	22.6	25.5	23.8	25.6
15 or more years	22.6	20.7	24.4	26.8
Occupational group	(*n* = 207)	(*n* = 207)	(*n* = 503)	(*n* = 503)
Farmers, foresters, fishermen	1.9	1.9	2.4	2.0
Operators, laborers	15.0	14.5	10.7	11.9
Precision production, craftsmen, repair workers	22.7	20.8	23.5	22.9
Service, transportation	14.0	15.9	12.9	11.7
Office, clerical, sales, administrative support	13.0	8.2	9.7	8.6
Professional specialties	11.1	15.5	18.3	19.9
Executive, managerial	22.2	23.2	22.5	23.1
Educational and income measures				
Educational level	(*n* = 283)	(*n* = 283)	(*n* = 570)	(*n* = 570)
No high school diploma	5.3	5.7	2.8	3.2
High school diploma or GED	31.8	32.2	29.7	30.5
Vocational/technical school	20.5	14.8	13.3	12.6
Some college	35.7	38.2	41.1	41.4
Some graduate school	6.7	9.2	13.2	12.3
Income	(*n* = 272)	(*n* = 272)	(*n* = 553)	(*n* = 553)
Less than $20,000/yr	30.9	22.8	15.9	14.8
$20,000–$49,999/yr	58.1	62.5	63.8	63.1
$50,000/yr or more	11.0	14.7	20.3	22.1

[a]For each of the four exposure groups, the percentage of that group in each socioeconomic category is shown.

[b]Combat was examined in those twin pairs in which neither twin had PTSD.

The unemployment rate in 1987 for those with PTSD was 15.4%, while the rate in the matched twins was 11.4%. Combat per se did not seem to have much influence on employment with 4.5% of the combat-exposed twins being unemployed compared with 3.8% of the combat-unexposed co-twins. The distribution of years employed was similar in PTSD-discordant twins and combat-discordant twins. Likewise, the type of occupation for employed PTSD-discordant and combat-discordant twins was similar. In both groups, veterans were most commonly employed as skilled workers or in executive/managerial positions.

The distribution of completed educational level in 1987 among twins with PTSD was very similar to their co-twins without PTSD. Over 40% of the twins had some college or graduate education, while approximately 5% never finished high school. More than 50% of combat-discordant twins had either attended college or received some graduate education; combat exposure had little effect on the educational attainment of veterans. Twins with PTSD had a tendency to have lower household incomes than co-twins without PTSD, although this may be secondary to their poor employment status. There was no difference in income between combat-exposed and -unexposed twins.

Unadjusted and multi-factor adjusted matched pair odds ratios and 95% confidence intervals are presented for PTSD and combat exposure for each of the socioeconomic measures in Table 3. As expected, many of the crude associations seen in Table 1 when individuals were studied were attenuated or eliminated when confounding factors were taken into account. For example, based on the polychoric correlations, those with PTSD were significantly more likely to have ever been divorced. However, the fully adjusted odds ratio for ever divorced in those with PTSD was 1.05, indicating only a nonsignificant 5% increase in the odds of ever being divorced in those with PTSD. Only employment status was significantly associated with PTSD in the final analysis; those with PTSD were half as likely (odds ratio = 0.49) to be currently employed. Similarly, adjustment for confounding eliminated all associations seen earlier between combat and socioeconomic status.

DISCUSSION

The present study examines the association of PTSD or combat in Southeast Asia with eight marital, occupational, educational, and income measures in a national sample of 2210 male Vietnam era veteran monozygotic twin pairs. In the unpaired analysis, a presumptive diagnosis of PTSD in 1987 was correlated with ever having been divorced, being currently un-

Table 3. The Association of Socioeconomic Measures with PTSD and Combat Exposure: Matched Pair Odds Ratios and 95% Confidence Intervals

	PTSD		Combat[a]	
Socioeconomic Measures	Matched Pair[b] Odds Ratio	Multi-Factor Adjusted[c] Odds Ratio	Matched Pair[d] Odds Ratio	Multi-Factor Adjusted[c] Odds Ratio
Marital status measures				
Ever married	0.74 (0.37–1.47)	0.72 (0.33–1.54)	1.06 (0.89–1.28)	1.08 (0.88–1.32)
Age at first marriage	1.41 (0.82–2.43)	1.67 (0.91–3.07)	1.13 (0.97–1.32)	1.05 (0.88–1.24)
Ever divorced	1.21 (0.74–1.97)	1.05 (0.62–1.77)	1.00 (0.87–1.14)	0.99 (0.86–1.15)
Occupational measures				
Employment status	0.66 (0.38–1.14)	0.49[e] (0.26–0.93)	0.99 (0.78–1.26)	0.93 (0.71–1.22)
Occupational group	0.70 (0.43–1.16)	0.85 (0.49–1.48)	1.00 (0.89–1.11)	0.99 (0.87–1.11)
Years employed at current job	0.94 (0.58–1.53)	1.04 (0.62–1.75)	0.95 (0.86–1.05)	0.92 (0.82–1.02)
Education and income measures				
Educational level completed	1.05 (0.68–1.62)	1.10 (0.68–1.76)	1.07 (0.95–1.21)	1.10 (0.96–1.26)
Household income	0.62 (0.33–1.15)	0.67 (0.34–1.33)	0.90 (0.78–1.03)	0.92 (0.79–1.06)

[a]Odds ratios represent increase in odds of outcome for a one unit increase in combat level.
[b]Only twins discordant for PTSD were included in this analysis.
[c]Factors included in the adjustment include education at enlistment, enlistment aptitude test score, branch of service, length of service, year of discharge, and age at enlistment, in addition to the matching of twins.
[d]Only twins without PTSD and discordant for combat were included in this analysis.
[e]Significantly different from 1.0 at $p < 0.05$.

employed, having lower income, lower educational achievement, and lower occupational status. After adjusting for familial factors and pre-military induction and service characteristics, only the likelihood of being unemployed remained significantly associated with PTSD. Correlations between level of combat and socioeconomic status revealed slight positive associations between combat and ever being married, ever being divorced, and having a greater length of employment at the current job. However, with adjustment, there were no longer any significant associations between socioeconomic status and combat exposure.

The advantages of this study are its large sample size and the effective control of confounding provided by the monozygotic twin design. In our analysis, the potential value of controlling for familial factors was first apparent on perusal of Table 2. For certain socioeconomic measures, the rates in the three groups without PTSD (i.e., PTSD-no and combat-yes and -no) appeared to differ depending on whether the veterans are members of twin pairs in which neither member has PTSD (combat-discordant groups) or whether the veteran's twin does have PTSD (PTSD-discordant pairs). These differences may indicate that familial tendencies exist for several of these variables simultaneously. That is, if there is a familial tendency towards PTSD (e.g., one brother has PTSD), there may also be a familial tendency for unemployment and divorce. In such a family, even the twin without PTSD appears more likely to have an adverse socioeconomic outcome than members of twin pairs without a familial tendency toward development of PTSD (neither twin suffers from PTSD). Previous work has demonstrated genetic influence on both liability to PTSD symptoms (True, Rice, Eisen, Heath, Goldberg, Lyons, & Nowak, 1993) and on exposure to combat (Lyons, Goldberg, Eisen, True, Tsuang, Meyer, & Henderson, 1993). Thus, the elimination of most associations in the present investigation when familial factors were controlled is perhaps not surprising.

The primary threats to the validity of the present study are inaccurate questionnaire responses and nonresponse bias. While it is difficult to control for conscious misrepresentation of facts, marital, employment, and educational status are less emotionally-charged and therefore more likely to be accurate. In addition, recall bias is unlikely to have contributed to our effects, since most of the items refer to current socioeconomic status or life events of sufficient importance to reduce the potential for faulty recollection (e.g., age at first marriage). Finally, self-reported Vietnam service is consistent with information abstracted from military service files and the combat exposure index has been validated against an objective measure of threat to life-and-limb and has high test-retest reliability (Janes *et al.*, 1991).

If veterans who responded to the questionnaire are systematically different from those who did not and this difference is related to both exposure (PTSD or combat) and outcome (socioeconomic status), the possibility for non-response bias exists. Prior studies (Goldberg *et al.*, 1990a) have indicated that responders differ significantly from non-responders in age and education at enlistment and service in Southeast Asia. While education at enlistment might be associated with socioeconomic status (particularly educational attainment and current income), these indicators failed to show a significant relationship to PTSD or combat, making the question of bias-related effect moot.

The impact of service in Southeast Asia, and particularly of increasing combat exposure, on PTSD has been well established in the present cohort (Goldberg *et al.*, 1990b) and in others (Card, 1983; Egendorf, Kadushin, Laufer, Rothbart, & Solan, 1981; CDC, 1989). However, only a few studies have focussed on the long-term effects of PTSD or combat on socioeconomic status. Egendorf *et al.* (1981) performed a 3- to 5-hr interview of 1440 Vietnam era veterans who served or did not serve in Vietnam, and non-veterans. Regarding current socioeconomic status, those veterans suffering from stress reactions were more likely to be unemployed and to have a low level of education and income.

Card (1983) used data obtained in 1960 (prior to the Vietnam era) and in 1981 (after the Vietnam era) and compared a large cohort of male non-veterans and Vietnam era veterans who did or did not serve in Vietnam. Using a crude measure of PTSD, she found an increased divorce rate in those with PTSD symptoms, but no association with educational achievement, job prestige, or yearly pay. Similarly, there was no association of combat with ultimate years of education attained.

In response to a Congressional mandate, Kulka and colleagues (Kulka *et al.*, 1990) conducted in-depth face-to-face interviews with a nationally representative sample of over 3000 Vietnam era veterans. Those veterans with PTSD symptoms were more likely to be unemployed, to have ever been divorced, and to have achieved lower educational status. Veterans who served in high intensity war zones were also less educated and had had more divorces at the time of the interview. However, there were no associations between having served in a high intensity war zone and current work or occupational status, or occupational instability.

Using a telephone interview methodology, the CDC Vietnam Experience Study (1989) examined a variety of indicators of social and psychological adjustment in a random sample of 7924 male Vietnam and 7364 non-Vietnam veterans who enlisted in the Army between 1965 and 1971. No relationship was found between level of combat exposure and being unemployed at the time of the interview.

Laufer and Gallops (1985) studied marital problems and patterns in a stratified probability sample of 1259 veterans and nonveterans in 1977–1979. Higher levels of combat were associated with increased divorce rates.

Thus, the results of the *unpaired* analysis of PTSD in the present study generally agree with the conclusions of the earlier studies. We observed significant associations between PTSD and unemployment and education, as did the studies of Kulka *et al.* (1990) and Egendorf *et al.* (1981). Likewise, we found associations of PTSD with income, as did Egendorf *et al.* (1981) and with divorce, as did Kulka *et al.* (1990) and Card (1983). However, after full adjustment for familial effects and military service variables,

all associations in the present study disappeared except for an increased unemployment rate in those with PTSD.

Our investigation of combat effects on socioeconomic status was carried out in those veterans not suffering from PTSD. In this subsample, we found no effects of combat in the fully adjusted analyses. This suggests that previously documented associations of combat with divorce and educational level may have been confounded by PTSD or other factors. We have found in our unadjusted analysis that PTSD appears to be associated with both divorce and education, and it is well documented that PTSD is more frequent in those exposed to high combat (Goldberg *et al.*, 1990a; Card, 1983; Egendorf *et al.*, 1981; CDC, 1989). Thus, our control of confounding by PTSD and other factors can account for the different findings in our study.

It is well to keep in mind that we, as well as others, have studied the prevalence of PTSD symptoms at a given point in time, a "snapshot". An association of PTSD with concurrent socioeconomic status does not imply that PTSD *caused* the problem. It may be that poor socioeconomic status causes or worsens PTSD-like symptoms. It is also possible that some other underlying problem causes *both* PTSD symptoms and low socioeconomic status simultaneously. While heavy combat is clearly associated with an increased prevalence of PTSD (Goldberg *et al.*, 1990a), there is a baseline prevalence of PTSD in veterans who did not serve in Southeast Asia. Thus, such an underlying problem may or may not be related to combat experiences. This hypothesis is supported by the observation that most of the crude associations with PTSD or combat disappeared when familial and other factors were controlled.

In summary, our results suggest that while PTSD is associated with a two-fold increase in unemployment, it is not associated with other occupational measures, marital status, educational attainment, or income. Furthermore, in the absence of PTSD, combat has little impact on several important socioeconomic indicators.

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REFERENCES

Boyle, C. A., Decoufle, P., & O'Brien, T. R. (1989). Long-term health consequences of military service in Vietnam. *Epidemiology Review, 11,* 1-27.

Breslow, N. E., & Day, N. E. (1980). *Statistical methods in cancer research: The analysis of case-control studies.* IARC: Lyon, France.

Card, J. J. (1983). *Lives after Vietnam: The personal impact of military service.* Lexington, MA: Heath.

Centers for Disease Control Vietnam Experience Study. (1989). *Health status of Vietnam veterans. I. Telephone interview.* U.S. Department of Health and Human Services, PHS, CDC.

Centers for Disease Control Vietnam Experience Study. (1987). Postservice mortality among Vietnam veterans. *Journal of the American Medical Association, 257,* 790-795.

Egendorf, A., Kadushin, C., Laufer, R. S., Rothbart, G., and Sloan, L. (1981). *Legacies of Vietnam. Comparative adjustment of veterans and their peers.* Government Printing Office, Washington, DC.

Eisen, S. A., True W. R., Goldberg, J., Henderson, W. G., and Robinette, C. D. (1987). The Vietnam Era Twin (VET) Registry: Method of construction. *Acta Geneticae Medicae et Gemellologiae, 36,* 61-67.

Eisen, S., Neuman, R., Goldberg, J., Rice, J., & True, W. (1989). Determining zygosity in the Vietnam Era Twin Registry: An approach using questionnaires. *Clinical Genetics, 35,* 423-432.

Eisen, S. A., Goldberg, J., True W. R., & Henderson, W. G. (1991). A co-twin control study of the effects of the Vietnam War on the self-reported health of veterans. *American Journal of Epidemiology, 134,* 49-58.

Goldberg, J., True W. R., Eisen, S. A., & Henderson, W. G. (1990a). A twin study of the effects of the Vietnam War on posttraumatic stress disorder. *Journal of American Medical Association, 263,* 1227-1232.

Goldberg, J., Eisen, S. A., True W. R., & Henderson, W. G. (1990b). A twin study on the effects of the Vietnam conflict on alcohol drinking patterns. *American Journal of Public Health, 80,* 570-574.

Henderson, W. G., Eisen, S., Goldberg, J., True, W. R., Barnes, J. E., & Vitek, M. E. (1990). The Vietnam era twin registry: A resource for medical research. *Public Health Report, 105,* 368-373.

Janes, G. R., Goldberg, J., Eisen, S. A., & True W. R. (1991). Reliability and validity of a combat exposure index for Vietnam era veterans. *Journal of Clinical Psychology, 47,* 80-86.

Kulka, R. A., Schlenger, W. E., Fairbank, J. A., Hough, R. L., Jordan, B. K., Marmar, C. R., & Weiss, D. S. (1990). *Trauma and the Vietnam war generation.* New York: Brunner/Mazel.

Laufer, R. S., & Gallops, M. S. (1985). Life-course effects of Vietnam combat and abusive violence: Marital patterns. *Journal of Marriage & Family, 47,* 839-853.

Lyons, M. J., Goldberg, J., Eisen, S. A., True, W., Tsuang, M. T., Meyer, J. M., & Henderson, W. G. (1993). Do genes influence exposure to trauma? A twin study of combat. *American Journal of Medical Genetics, 48,* 22-27.

Neale, M. C., & Cardon, L. R. (1992). *Methodology for genetic studies of twins and families.* Dordrecht, Netherlands: Kluwer Academic.

True, W. R., Goldberg, J., & Eisen, S. A. (1988). Stress symptomatology among Vietnam veterans. *American Journal of Epidemiology, 128,* 85-92.

True, W. R., Rice, J., Eisen, S. A., Heath, A. C., Goldberg, J., Lyons, M. J., & Nowak, J. (1993). A twin study of genetic and environmental contributions to liability for posttraumatic stress symptoms. *Archives of General Psychiatry, 50,* 257-264.

Yager, T., Laufer, R. S., & Gallops, M. (1984). Some problems associated with war experience in men of the Vietnam generation. *Archives of General Psychiatry, 41,* 327-333.