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Medical Comorbidity of Full and Partial Posttraumatic Stress Disorder in United States Adults: Results from Wave 2 of the National Epidemiologic Survey on Alcohol and Related Conditions

Robert H. Pietrzak, Ph.D., M.P.H.[1,2], **Risë B. Goldstein, Ph.D., M.P.H.**[3], **Steven M. Southwick, M.D.**[1,2], and **Bridget F. Grant, Ph.D., Ph.D.**[3]

[1]National Center for Posttraumatic Stress Disorder, VA Connecticut Healthcare System, West Haven, CT, USA

[2]Department of Psychiatry, Yale University School of Medicine, New Haven, CT, USA

[3]Laboratory of Epidemiology and Biometry, Division of Intramural Clinical and Biological Research, National Institute on Alcohol Abuse and Alcoholism, National Institutes of Health, Bethesda, MD, USA

Abstract

Objective—This study examined associations between lifetime trauma exposures, PTSD and partial PTSD, and past-year medical conditions in a nationally representative sample of U.S. adults.

Methods—Face-to-face interviews were conducted with 34,653 participants in the Wave 2 National Epidemiologic Survey on Alcohol and Related Conditions. Logistic regression analyses evaluated associations of trauma exposure, PTSD and partial PTSD with respondent-reported medical diagnoses.

Results—After adjustment for sociodemographic characteristics and comorbid Axis I and II disorders, respondents with full PTSD were more likely than traumatized respondents without full or partial PTSD (comparison group) to report diagnoses of diabetes mellitus, noncirrhotic liver disease, angina pectoris, tachycardia, hypercholesterolemia, other heart disease, stomach ulcer, HIV seropositivity, gastritis, and arthritis (odds ratios [ORs]=1.2-2.5). Respondents with partial PTSD were more likely than the comparison group to report past-year diagnoses of stomach ulcer, angina pectoris, tachycardia, and arthritis (ORs=1.3-1.6). Men with full and partial PTSD were more likely than controls to report diagnoses of hypertension (both ORs=1.6), and both men and women with PTSD (ORs=1.8 and 1.6, respectively), and men with partial PTSD (OR=2.0) were

more likely to report gastritis. Total number of lifetime traumatic event types was associated with many assessed medical conditions (ORs=1.04-1.16), reducing the magnitudes and rendering non-significant some of the associations between PTSD status and medical conditions.

Conclusions—Greater lifetime trauma exposure and PTSD are associated with numerous medical conditions, many of which are stress-related and chronic, in U.S. adults. Partial PTSD is associated with intermediate odds of some of these conditions.

Keywords

Comorbidity; epidemiology; posttraumatic stress disorder; medical illness; cardiovascular

Posttraumatic stress disorder (PTSD) is associated with a broad range of medical conditions, including cardiovascular disease, arthritis, asthma, chronic pain, diabetes, bone or joint conditions, and gastrointestinal disorders (1-5), as well as reduced health-related quality of life (2, 4, 6-8), high rates of medical service utilization (9, 10), and excess mortality (11, 12).

Evidence regarding associations of specific medical disorders with PTSD is derived largely from select populations, such as Veterans, so its generalizability to the general adult population remains to be determined. It is also unclear whether PTSD is independently associated with medical disorders after adjustment for sociodemographic characteristics and additional psychiatric comorbidities, including Axis II personality disorders (PDs). Because mood, anxiety, substance use, and personality disorders are independently related to medical comorbidities, these conditions may confound purported associations between PTSD and medical conditions, and studies that fail to adjust for them may overestimate these associations (2). While studies have found associations of PTSD with medical conditions independent of comorbid Axis I disorders (2, 3, 5, 8), some have not adjusted for all of these variables (4), and none have adjusted for PDs.

To our knowledge, only one study has examined medical comorbidity of PTSD in a nationally representative sample of U.S. adults (3). This study, which used data from the National Comorbidity Survey-Replication (NCS-R), found a graded relationship between trauma exposure, PTSD, and lifetime medical comorbidities, with PTSD associated with elevated rates of medical conditions such as chronic pain, heart disease, and ulcer; and trauma exposure associated with intermediate rates of these conditions. This study also found that the number of lifetime traumas (cumulative trauma burden) may explain associations between PTSD and medical morbidities, although these associations were difficult to disentangle given greater cumulative trauma burden among respondents with PTSD. While this study provided the first characterization of medical comorbidity of PTSD in a national sample of U.S. adults, it was based on the Part II subsample of the NCS-R, which oversampled respondents with clinically significant psychopathology (3); only some of the medical conditions were queried as those diagnosed by a health professional; and analyses of associations between PTSD and medical conditions did not adjust for PDs, which are common in PTSD (13-15) and independently associated with medical morbidities and physical disability (16-18). Additional studies of large, representative samples that query healthcare professional-diagnosed medical conditions and adjust more comprehensively for psychiatric comorbidity, including PDs, are needed to evaluate independent associations of medical conditions with PTSD. Further, because the number of lifetime trauma exposures may be related to medical conditions independent of PTSD status (3, 5), more research is needed to evaluate the extent to which cumulative trauma burden and PTSD status are associated with specific medical conditions in population-based samples.

Subthreshold or partial PTSD is also associated with functional impairment, though no study of which we are aware has examined specific medical disorders associated with this condition. Partial PTSD describes clinically significant PTSD symptoms among trauma-exposed individuals who do not meet full criteria for PTSD (7). It is typically identified when individuals meet Criterion B (re-experiencing) and either Criterion C (avoidance and numbing) or Criterion D (hyperarousal), or if they meet Criterion B and endorse at least one symptom each from Criteria C and D (6, 7). Studies of partial PTSD in Veterans (7) and civilian survivors of disasters and other traumas (6, 19) have found intermediate levels of psychiatric comorbidity and functional impairment relative to trauma-exposed individuals without PTSD and those with full PTSD. Because associations between partial PTSD and medical illnesses may have public health implications, evaluation of medical comorbidity among individuals with partial PTSD in a large, representative sample is indicated.

The current study examined associations between lifetime PTSD and partial PTSD and past-year medical conditions; as well as the relation between lifetime traumatic exposures, PTSD status, and medical conditions using data from the National Institute on Alcohol Abuse and Alcoholism (NIAAA) National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), one of the largest psychiatric epidemiology surveys ever conducted (Wave 1: N=43,093; Wave 2: N=34,653). Wave 2 of the NESARC included sections on PTSD and a broad range of respondent-reported, healthcare provider-diagnosed medical conditions. Thus, it provides a unique opportunity to examine specific medical conditions associated with PTSD and partial PTSD in a large, nationally representative sample of U.S. adults. In order to examine medical conditions associated with full and partial PTSD above and beyond traumatic exposure in general, and to permit comparison of odds ratios (ORs) of medical conditions associated with PTSD status to previous studies, the comparison group for this study consisted of respondents endorsing a lifetime Criterion A-qualifying traumatic event. Given the expansion of Criterion A-qualifying traumas in DSM-IV (20), this comparison group represents the vast majority of the population. We hypothesized that (a) rates of medical conditions in the comparison group would be comparable to those obtained in population-based studies of U.S. adults (21); (b) PTSD and partial PTSD would be associated with elevated rates of chronic medical conditions, especially stress-related ones such as cardiovascular, musculoskeletal, and gastrointestinal disorders, even after adjustment for psychiatric comorbidity; (c) partial PTSD would be associated with intermediate levels of these conditions compared to individuals with full PTSD and those exposed to trauma but with neither full nor partial PTSD; and (d) total number of lifetime traumatic event types would be associated with many of the medical conditions assessed and would consequently reduce the magnitudes of associations between PTSD status and medical conditions, rendering some of these associations non-significant.

METHOD

Sample

The 2004-2005 Wave 2 NESARC is the second wave follow-up of the Wave 1 NESARC, conducted in 2001-2002 and described elsewhere (22, 23). The Wave 1 NESARC surveyed a representative sample of the civilian, noninstitutionalized, U.S. population aged 18 years and older, residing in households and group quarters. Face-to-face interviews were conducted with 43,093 respondents; blacks, Hispanics, and individuals 18 to 24 years old were oversampled. The overall response rate was 81.0% (sampling frame response rate: 99%; household response rate: 89%; and person response rate: 93%).

In Wave 2, attempts were made to re-interview all 43,093 Wave 1 respondents. Excluding those ineligible for the Wave 2 interview because they were deceased, incapacitated, deported, or on active military duty throughout the follow-up period, the Wave 2 response

rate was 86.7%, comprising 34,653 completed face-to-face re-interviews. The cumulative response rate at Wave 2, the product of the Wave 1 and Wave 2 response rates, was 70.2%. As in Wave 1, the Wave 2 NESARC data were weighted to reflect design characteristics of the survey and account for oversampling. Adjustment for nonresponse across sociodemographic characteristics and the presence of any lifetime Wave 1 substance use disorder or psychiatric disorder was performed at the household and person levels to ensure that the sample approximated the target population, i.e., the original sample minus attrition between Waves 1 and 2 due to death, incapacitation or institutionalization, deportation or permanent departure from the United States, and military service for the full length of the Wave 2 interviewing period. When Wave 2 respondents were compared with the target population (Wave 2 respondents plus eligible nonrespondents) on Wave 1 sociodemographic and diagnostic measures, there were no significant differences between Wave 2 respondents and the target population with respect to age, race-ethnicity, sex, socioeconomic status, or the presence of any lifetime substance use, mood, anxiety, or personality disorder (each examined separately). Weighted Wave 2 data were then adjusted to represent the civilian population on socioeconomic variables including region, age, race-ethnicity, and sex, based on the 2000 Decennial Census.

All potential NESARC respondents were informed in writing about the nature of the survey, the statistical uses of the survey data, the voluntary aspect of their participation, and the Federal laws that rigorously provide for the strict confidentiality of identifiable survey information. Those consenting to participate after receiving this information were interviewed. The entire research protocol, including informed consent procedures, received full ethical review and approval from the U.S. Office of Management and Budget and the U.S. Census Bureau.

Posttraumatic Stress Disorder (PTSD)

The diagnostic interview used in the Wave 2 NESARC was the NIAAA Wave 2 Alcohol Use Disorder and Associated Disabilities Interview Schedule-DSM-IV Version (AUDADIS-IV; (24), a computerized, fully structured instrument designed for experienced nonclinician interviewers. PTSD was assessed on a lifetime basis, starting with an enumeration of 27 types of potentially traumatic events operationalizing DSM-IV (25) Criterion A. The 6 event types involving terrorism were subdivided by whether or not they occurred on September 11, 2001. Respondents endorsing an event type were asked the age at which it first occurred and how many times they experienced it; for military combat, peacekeeping or relief work, being an unarmed civilian in a war or terror zone, or refugee status, number of times was replaced with total duration of exposure. Those endorsing events other than combat, peacekeeping or relief work, unarmed civilian or refugee status were also asked the age at which they most recently experienced each event type. Respondents endorsing multiple event types were asked to designate the event they considered most stressful. Consistent with Criterion A, they were further asked whether they felt extremely frightened, helpless, or horrified about that worst event, and whether they thought they or someone very close to them might die, be seriously injured, or become permanently disabled at the time the worst event happened.

PTSD was diagnosed when respondents endorsed at least 1 symptom within Criterion B, at least 3 within Criterion C, and at least 2 within Criterion D, lasting at least 1 month (Criterion E), *subsequent to* the worst event they experienced that involved intense fear, helplessness, or horror, and the belief that they or someone close to them might die or be seriously injured or permanently disabled. Diagnoses of full PTSD also required that the DSM-IV clinical significance criterion of impairment or distress (Criterion F) be met. Test-retest reliability of lifetime PTSD diagnoses was good (kappa=0.64; (26)).

Respondents were considered to have partial PTSD if they endorsed at least 1 symptom within each of Criteria B, C, and D, lasting at least 1 month, in response to the worst event they experienced that involved intense fear, helplessness, or horror, or actual or threatened death, serious injury, or threat to their or someone else's physical integrity (6, 7). While previous studies have defined partial PTSD solely on symptoms, this study also required that respondents meet either Criterion A1 or A2, and Criterion E, to avoid misclassifying individuals with normative stress reactions as having partial PTSD (27). Therefore, this study's definition of partial PTSD is somewhat more conservative than previous operationalizations (6, 7). Respondents who reported a potentially traumatic event but met criteria for neither PTSD nor partial PTSD were classified as the comparison group.

Past-Year General Medical Conditions

Respondents were asked whether a physician or other health professional had told them during the past 12 months that they had any of 17 medical conditions, spanning diabetes mellitus, cardiovascular (hardening of the arteries or arteriosclerosis, a heart attack or myocardial infarction, chest pain or angina pectoris, hypercholesterolemia ["high cholesterol"], high blood pressure or hypertension, rapid heart beat or tachycardia, any other form of heart disease, or stroke), liver (cirrhosis or any other form of liver disease), other gastrointestinal (stomach ulcer or gastritis), arthritic, and sexually transmitted (including HIV and AIDS) diseases.

Physical and Psychosocial Functioning

Past-month physical and psychosocial functioning were assessed using the Short-Form 12-Item Health Survey, version 2 (SF-12v2; (28)), a reliable and valid measure used in general population surveys. In addition to the Physical Component Summary (PCS) and Mental Component Summary (MCS) scales, the SF-12v2 yields 4 physical health and 4 mental health domain-specific profile scores. Standard norm-based scoring techniques were used to transform each score (range, 0 – 100) to yield a mean of 50 and a standard deviation of 10 in the U.S. general population. Lower scores indicate poorer function.

Other Psychiatric Disorders

Comorbid Wave 2 lifetime psychiatric disorders were included as covariates in analyses of medical morbidities. Wave 2 AUDADIS-IV assessments of substance use (alcohol and drug-specific abuse and dependence and nicotine dependence), mood (primary major depressive [MDD], dysthymic, and bipolar I and II disorders), and additional anxiety (primary panic with and without agoraphobia, agoraphobia without panic, social and specific phobias, and generalized anxiety) disorders were identical to those utilized in Wave 1 except for time frames. AUDADIS-IV methods to diagnose these disorders are described elsewhere (29-34). DSM-IV "primary" diagnoses exclude substance-induced disorders and those due to general medical conditions. MDD diagnoses also exclude bereavement. Attention-deficit/hyperactivity disorder was assessed on a lifetime basis at Wave 2. Wave 2 lifetime diagnoses reflect disorders occurring at any time over the life course, assessed over both waves.

Extensive questions operationalized DSM-IV criteria for alcohol and drug-specific abuse and dependence, including sedatives, tranquilizers, opioids other than heroin, cannabis, cocaine or crack, stimulants, hallucinogens, inhalants and solvents, heroin, and other illicit drugs. Wave 2 lifetime abuse diagnoses required 1 or more of 4 abuse criteria, and dependence required 3 or more of 7 dependence criteria, to be met during the same 12-month period for the same substance (alcohol or the same drug category) in respondents' lives. Nicotine dependence was diagnosed similarly. Drug-specific abuse and dependence

were aggregated in this study to yield diagnoses of any drug abuse and any drug dependence.

All DSM-IV PDs were assessed on a lifetime basis, as described in detail elsewhere (35, 36). Paranoid, schizoid, histrionic, avoidant, dependent, and obsessive-compulsive PDs were assessed in Wave 1. Antisocial PD was assessed in Wave 1 (31, 37), with a follow-up at Wave 2 of antisocial symptoms since the Wave 1 interview (35, 37, 38), and schizotypal, narcissistic, and borderline PDs were assessed in Wave 2 (35, 38). To receive a PD diagnosis, respondents were required to endorse the specified number of symptom criteria, at least 1 of which must have caused social or occupational impairment. For antisocial PD, respondents were required to endorse the specified number of conduct disorder symptoms before, and antisocial symptoms since, age 15.

As described in detail elsewhere, reliability (26, 33, 36, 39-42) and validity (29, 30, 33, 36, 39, 43-49) of AUDADIS-IV mood, anxiety, substance use, and personality disorder diagnoses were fair to good in both clinical and general population samples. Reliabilities of AUDADIS-IV PD diagnoses compare favorably with those observed in short-term test-retest studies using semistructured interviews in treated samples of patients (50). Selected mood and anxiety disorder diagnoses showed good agreement with psychiatrist reappraisals (39, 43).

Statistical Analysis

The analysis sample for this report consists of all Wave 2 NESARC respondents with PTSD (n=2,463) and partial PTSD (n=2,471), and neither full nor partial PTSD (i.e., comparison group; n=26,716). Following previous epidemiologic studies of PTSD (6, 51), respondents reporting no potentially traumatic events at the beginning of the PTSD section of the AUDADIS-IV were excluded. Nontraumatized respondents represented a significant minority of the sample, particularly with the broadening of the stressor criterion in DSM-IV (20), and including them would have precluded direct comparisons of ORs of medical conditions associated with full and partial PTSD to previous studies (e.g., (3)).

Standard contingency table approaches and chi-square statistics were used to compare (a) sociodemographics, and (b) past-year prevalences of medical diagnoses, by PTSD status. Where appropriate, *t*-statistics were used for pairwise comparisons of sociodemographic characteristics by PTSD status. Adjusted odds ratios (AORs) measuring associations between PTSD status and past-year medical conditions were estimated from logistic regression models controlling for sociodemographic characteristics and comorbid lifetime psychiatric disorders. To assess whether comorbid associations of PTSD status with medical conditions varied by sex, sex $\times$ PTSD status product terms were tested for statistical significance in all multivariable models, with an alpha to stay of 0.05. Where statistically significant sex $\times$ PTSD status interactions were identified, sex-specific AORs were computed; otherwise, AORs were computed for the entire sample, controlling for sex and other covariates. Logistic regression models controlling for sociodemographics and Axis I and II psychiatric comorbidity were also fit to evaluate the relation between total number of potentially traumatic event exposures endorsed at the beginning of the AUDADIS-IV PTSD module, PTSD status, and medical conditions. Each of the 27 event types queried at the start of the PTSD module was counted only once, regardless of the number of times it was experienced, and the total count was treated as a continuous variable. To compare scores on each of the SF-12*v*2 scales by PTSD status, adjusted weighted means and standard errors were derived, and pairwise contrasts computed, from multivariable linear regressions controlling for sociodemographic variables. All standard errors and 95% CIs were estimated using SUDAAN (52), which uses Taylor series linearization to adjust for design characteristics of complex surveys like the NESARC.

RESULTS

Sociodemographic characteristics by PTSD status are shown in Table 1. The groups differed on all sociodemographic characteristics examined. Relative to the comparison group, respondents with full and partial PTSD were significantly more likely to be 30-44 but significantly less likely to be older than 65 years of age; those with full PTSD were also significantly more likely to be 45-64 years old. In addition, respondents with full and partial PTSD were significantly more likely than comparison respondents to be female, previously married, with less than high school education, and with lower household incomes. Respondents with full PTSD were more likely to self-identify as Native American, whereas those with full and partial PTSD were less likely to self-report being of Asian, Hawaiian, or Pacific Islander race or ethnicity. Additionally, respondents with full PTSD were less likely than those with partial PTSD to report non-Hispanic White race or ethnicity, or current marriage or cohabitation; however, those with full PTSD were more likely than those with partial PTSD to self-report non-Hispanic Black race or ethnicity as well as widowed, separated, or divorced marital status. Details of respondents' trauma histories are available elsewhere (53). The median number of potentially traumatic event types was 5 (mean±SE: 5.9±0.08) among respondents with full PTSD; 4 (mean±SE: 4.9±0.06) among those with partial PTSD, and 3 (mean±SE: 3.3±0.03) among the comparison group. The most commonly reported worst events in the comparison group were indirect experience of 9/11 (24.5%), serious illness or injury of someone close (23.0%), and unexpected death of someone close (22.7%). Among respondents with full and partial PTSD, they were unexpected death of someone close (24.1% and 26.2%, respectively), serious illness or injury to someone close (15.7% and 15.0%), and sexual assault (9.2% and 12.7%).

SF-12v2 scores by PTSD status are shown in Table 2. Mean scores on the summary measures and all subscales differed significantly by PTSD status. Respondents with PTSD scored lower than both the comparison group and respondents with partial PTSD. Also, respondents with partial PTSD scored lower than the comparison group but higher than respondents with PTSD. Mean PCS and MCS scores were lower in the PTSD group compared to both the comparison and partial PTSD groups; the partial PTSD group scored lower on each than the comparison group.

Past-year respondent-reported, healthcare professional-diagnosed medical conditions by PTSD status are shown in Table 3. After adjustment for sociodemographic characteristics and psychiatric comorbidity, respondents with full PTSD were significantly more likely than the comparison group to report diagnoses of diabetes mellitus, noncirrhotic liver disease, angina pectoris, tachycardia, hypercholesterolemia, other heart disease, stomach ulcer, HIV seropositivity, and arthritis, but significantly less likely to report non-HIV STDs. Respondents with partial PTSD were significantly more likely than the comparison group to report past-year diagnoses of angina pectoris, tachycardia, stomach ulcer, and arthritis. Odds of past-year medical diagnoses did not differ between the full and partial PTSD groups. Significant sex $\times$ PTSD status interactions were noted for hypertension ($p<.001$) and gastritis ($p=.035$). ORs for hypertension were significantly higher for men, but not women, with full and partial PTSD. For gastritis, ORs were statistically significant in men and women with PTSD, and men with partial PTSD.

Secondary analyses revealed that respondents with full PTSD who endorsed a "direct" trauma (events that happened to respondents themselves, e.g., sexual assault; n=987) as their worst event were more likely to report a diagnosis of angina pectoris (12.7%±1.30 vs. 6.5% ±0.72, $\chi^2(1)=15.51$, p<.001) than those who endorsed an "indirect" worst trauma (events befalling someone else, e.g., unexpected death of someone close; n=1407). Respondents with partial PTSD who endorsed a direct worst trauma (n=942) were more likely than those

who endorsed an indirect worst trauma (n=1460) to report diagnoses of tachycardia (9.1% ±1.25 vs. 6.0%±0.70, $\chi^2(1)$=4.91, p=.03) and stomach ulcer (6.8%±1.06 vs. 2.9%±0.49, $\chi^2(1)$=9.45, p=.002). Rates of other self-reported medical diagnoses did not differ between respondents with direct versus indirect worst events in the full or partial PTSD groups.

Associations of past-year medical conditions with number of traumatic event types ever experienced and PTSD status are shown in Table 4. Total number of event types was associated with all assessed medical conditions, except cirrhosis, HIV seropositivity and AIDS. In these models, full PTSD was associated positively with angina pectoris, tachycardia, stomach ulcer, HIV seropositivity, gastritis, and arthritis, and negatively with non-HIV STD; partial PTSD was associated only with stomach ulcer.

DISCUSSION

This study is the largest to examine specific past-year medical disorders associated with trauma exposure, and full and partial PTSD, in a nationally representative U.S. sample. Our results extend findings from a previous national survey of U.S. adults (3) by providing estimates of associations between PTSD status and a broader range of medical conditions independent of comorbid psychopathology, including PDs. They also replicate and extend earlier research (1, 3-5), suggesting that a lifetime diagnosis of PTSD is associated with cardiovascular, gastrointestinal, and musculoskeletal disorders, diabetes, noncirrhotic liver disease, and HIV seropositivity, as well as reduced current physical and psychosocial functioning.

Magnitudes of associations between PTSD and comorbid diabetes, heart disease, and ulcer were comparable to those in a previous study based on the NCS-R (3). Importantly, however, magnitudes of associations between full PTSD and some medical conditions were somewhat lower in this than in previous studies [e.g., OR of relation between PTSD and stroke in current study=1.5 (95% CI=0.9-1.4) vs. OR=1.9 (95% CI=1.0-3.6) in the study by Sledjeski and colleagues (3); OR of relation between PTSD and arthritis in current study=1.5 (95% CI=1.26-1.68) vs. OR=3.5 (95% CI=2.49-4.81) in the study by Sareen and associates (2)]. Apart from differences in assessment of PTSD and medical conditions and definition of comparison groups, one explanation for these discrepancies is that the current study estimated associations between PTSD status and medical diagnoses more stringently by adjusting for a broader range of psychiatric comorbidity (15, 51, 53). Thus, the ORs in this study may represent more conservative estimates of the associations between lifetime PTSD status and past-year medical morbidities. Results of the present study further suggest that respondents with full PTSD who reported a direct worst trauma may be more likely to have a past-year diagnosis of angina pectoris than those who reported an indirect worst trauma. As observed in two recent population-based studies (3, 5), a greater number of lifetime traumatic event types was associated with many assessed medical conditions; magnitudes of these associations were also highly comparable. While analyses adjusted for sociodemographics and additional psychiatric comorbidity revealed that respondents with PTSD had elevated rates of diabetes mellitus, noncirrhotic liver disease, angina pectoris, tachycardia, hypercholesterolemia, other heart disease, stomach ulcer, HIV seropositivity, arthritis, gastritis, and in men, hypertension, taking cumulative trauma burden into consideration reduced the magnitude of these associations, and rendered non-significant associations of full PTSD with diabetes mellitus, noncirrhotic liver disease, hypercholesterolemia, other heart disease, and hypertension. This finding suggests that greater cumulative lifetime trauma burden may be independently related to some medical conditions associated with full PTSD.

The current study provides the first known characterization of medical correlates of partial PTSD, demonstrating associations with angina pectoris, tachycardia, stomach ulcer, arthritis, and in men, hypertension and gastritis, as well as reduced physical and mental functioning. They also suggest that respondents with lifetime partial PTSD who reported a direct worst trauma may be more likely than those who reported an indirect worst trauma to have past-year diagnoses of tachycardia and stomach ulcer. Importantly, after adjustment for total number of traumatic events, partial PTSD was associated only with stomach ulcer. This finding suggests that greater lifetime trauma exposure *per se* likely accounts for elevated rates of angina pectoris, tachycardia, arthritis, hypertension, and gastritis observed in respondents with partial PTSD. Nevertheless, because partial PTSD is not a DSM-IV diagnosis (25) and may not be routinely identified in clinical settings, these findings underscore the importance of assessing and treating subsyndromal PTSD symptoms, which may have a deleterious effect on physical health and functioning independent of sociodemographic risk factors and other psychiatric conditions.

One possible explanation for the association of PTSD status with hypertension only in men is that men may show greater adrenocorticotropic hormone and cortisol release in response to stress (54, 55), as well as sensitized physiological hyperarousal symptoms and increased aggressive behaviors (56), which may in turn increase the likelihood of developing hypertension (57-61). Alternatively, premenopausal estrogen may protect against the development of hypertension in women (62); however, we were unable to assess this possibility empirically, as menopausal status was not assessed in either wave of the NESARC. Because most studies of the medical comorbidity of PTSD have not examined sex differences, more research is needed to evaluate biological mechanisms that may underlie associations of full and partial PTSD and hypertension in men.

Several hypotheses have been proposed to explain associations between PTSD and medical conditions. First, hypothalamic-pituitary-adrenal (HPA) axis, sympathoadrenomedullary, and immunologic abnormalities associated with PTSD may increase vulnerability to chronic medical conditions (63, 64). For example, PTSD is associated with altered HPA axis regulation, increased sympathetic tone, chronically elevated pro-inflammatory activity, and endothelial dysfunction (65), which may increase risk of cardiovascular, gastrointestinal, and musculoskeletal conditions. Increased PTSD symptom severity may further increase the likelihood of medical comorbidities. A recent prospective study found that each standard deviation increase in PTSD symptoms was associated with a 21% increased likelihood of coronary heart disease, even after adjustment for depression (66). Second, unhealthy behaviors often associated with PTSD, such as poor diet, lack of exercise, smoking, and risky sexual behavior, may increase risk of medical morbidities (8). Third, developing a serious medical condition may precipitate PTSD symptoms. For example, elevated rates of PTSD have been noted in individuals evaluated following a myocardial infarction (67) and cancer diagnosis (68). The severity and chronicity of these conditions, as well as mutual reinforcement of PTSD and associated medical conditions, may maintain PTSD symptoms long after a traumatic event. Fourth, associations between PTSD and medical comorbidities may be indirectly explained by comorbid disorders such as MDD and substance use disorders, which are independently linked to physical health. In the current study, a conservative approach to examining these associations was employed and these variables were carefully controlled. Finally, emerging research suggests that several genes implicated in stress reactivity (e.g., FKBP5) may increase risk for PTSD and possibly stress-related medical disorders (69, 70).

While the results of this study may suggest the importance of screening for trauma exposure and PTSD symptoms in medical patients, and for medical conditions in patients with PTSD symptoms, the finding that individuals with full and partial PTSD were identified with

higher rates of comorbid medical conditions may indicate that healthcare providers are adequately detecting these conditions in this population. Nevertheless, individuals with PTSD often do not seek mental health treatment and there are usually long delays from PTSD onset to treatment initiation (71). Brief screenings in primary care, which have proven beneficial (72) and cost-effective (73) in patients with depression, may aid in identifying individuals most at-risk for PTSD. Instruments such as the Primary Care PTSD Screen (74) may be helpful in identifying individuals with PTSD symptoms. Screening and referral for appropriate evidence-based PTSD treatments are important given the chronicity of PTSD (51) and its substantial medical comorbidity. PTSD is associated with poor treatment adherence (75), which may complicate treatment of both PTSD and medical illnesses. Therefore, efforts to integrate medical and mental health services (76) and enhance medical care providers' skills in recognizing, assessing, and treating psychiatric conditions (77) may be helpful. Psychoeducation of trauma-exposed patients is especially important in facilitating understanding of the interdependency of PTSD and medical conditions, and may help promote behavior changes to mitigate symptoms of both PTSD and medical comorbidities (78). While some studies have found that treatment for PTSD may help reduce the frequency of reported physical health difficulties (79), others have not observed this association (80). More research using a broader range of physical health outcomes is needed before firm conclusions may be drawn.

That partial PTSD was associated with past-year angina pectoris, tachycardia, stomach ulcer, arthritis, and, in men, hypertension and gastritis, highlights the importance of trauma exposure and subthreshold PTSD symptoms as potential risk factors for these conditions. The ORs of hypertension and gastritis in men with partial PTSD were comparable to those in men with PTSD, suggesting that men with subthreshold PTSD symptoms may be at significantly increased risk for these conditions. Importantly, because medical conditions associated with partial PTSD are common in the general U.S. population (81), even modest associations with partial PTSD have broad public health implications, especially since partial PTSD may be overlooked in clinical settings. Results of this study underscore the need for greater efforts to assess trauma exposure, subthreshold PTSD symptoms, and associated medical comorbidity.

Methodologic limitations of this study include its cross-sectional design, which do not allow causal inferences to be made regarding trauma exposures, PTSD status, and medical conditions; for example, individuals with current medical conditions may have differentially reported PTSD symptoms because of their current physical complaints or because of a desire to "explain" their current medical condition. While the utilization of self-report measures of healthcare provider-diagnosed medical conditions may also be considered a limitation, rates of hypertension, hypercholesterolemia, diabetes mellitus, and HIV seropositivity reported by the comparison group were broadly comparable to those recently reported from the National Health and Nutrition Examination Survey, which includes direct medical examinations of respondents (21). Further, prior studies have demonstrated good agreement between self- and physician-reported medical conditions in population-based studies (82). Nevertheless, additional research is needed to replicate these findings in other samples and evaluate whether types and magnitudes of medical conditions associated with full and partial PTSD may differ if medically verified, as opposed to self-reported, diagnoses are examined. While the consideration of lifetime psychiatric and past-year medical diagnoses may also be a limitation, the chronicity of both sets of diagnoses suggests that the patterns and magnitudes of observed associations are likely comparable irrespective of the time frames employed. Given difficulties in retrospective assessment of developmental timing of traumas, PTSD symptoms, and diagnoses of medical conditions in cross-sectional studies, as well as covariation of PTSD with exposure to multiple traumas, prospective studies are needed to disentangle the unique relations between trauma exposures and specific medical conditions,

and to determine the extent to which full and partial PTSD may account for these associations (3). Finally, because risk for PTSD may differ by race/ethnicity (83), and contextual factors such as neighborhood characteristics and unstable family structures may also be related to risk for both PTSD and medical conditions (84-86), additional research is needed to evaluate how these factors may influence associations between trauma exposure, PTSD status, and comorbid medical conditions.

Despite these limitations, this study's findings provide the largest, most up-to-date examination of medical conditions associated with PTSD and partial PTSD in U.S. adults. Prospective studies employing rigorous assessments of trauma histories and both psychiatric and medical morbidities, including appropriate biologic markers, and adjusting for potentially confounding sociodemographic, psychiatric, and medical variables are needed to examine the temporal and causal relationships between trauma history, PTSD status, and specific medical conditions, and identify underlying mechanisms that may ultimately serve as targets for prevention and intervention.

Acknowledgments

Glossary

PTSD	posttraumatic stress disorder
PD	personality disorder
NCS	National Comorbidity Survey
NCS-R	National Comorbidity Survey-Replication
NIAAA	National Institute on Alcohol Abuse and Alcoholism
NESARC	National Epidemiologic Survey on Alcohol and Related Conditions
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders, 4th edition
AUDADIS-IV	Alcohol Use Disorder and Associated Disabilities Interview Schedule-DSM-IV Version
SF-12v2	Short Form Health Survey, Version 2
HIV	human immunodeficiency virus
STD	sexually transmitted disease
MDD	major depressive disorder
AOR	adjusted odds ratio
OR	odds ratio
CI	confidence interval
HPA	hypothalamic-pituitary-adrenal

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Table 1

Sociodemographic characteristics of NESARC respondents by PTSD status

	No PTSD (Comparison Group)[a] (n=26,716)	Partial PTSD[b] (n=2,471)	Full PTSD (n=2,463)	χ^2(df)	P
	% or mean (SE)	% or mean (SE)	% or mean (SE)		
Age				81.25 (6)	<.001
20-29	16.4 (0.37)	14.7 (0.94)	14.8 (0.91)		
30-44[c,d]	29.0 (0.39)	34.5 (1.25)	31.8 (1.04)		
45-64[e,f]	34.6 (0.37)	36.0 (1.36)	41.3 (1.20)		
65+[g,h,i]	19.9 (0.38)	14.9 (0.87)	12.2 (0.82)		
Sex				166.24 (2)	<.001
Male	50.8 (0.38)	32.6 (1.20)	30.7 (1.10)		
Female[c,f]	49.2 (0.38)	67.4 (1.20)	69.4 (1.10)		
Race/ethnicity				32.36 (8)	<.001
White[g,j]	72.4 (1.56)	72.9 (1.51)	69.6 (1.63)		
Black[f,k]	10.3 (0.62)	11.4 (0.93)	13.6 (0.97)		
Hispanic	10.9 (1.19)	10.3 (1.14)	11.4 (1.27)		
Asian/Hawaiian/Pacific Islander[h,l]	4.3 (0.56)	2.8 (0.50)	2.2 (0.45)		
Native American[d]	2.1 (0.17)	2.7 (0.42)	3.2 (0.51)		
Education				21.65 (4)	<.001
Less than high school[f,m]	12.7 (0.43)	15.2 (0.98)	16.3 (0.97)		
High school	27.3 (0.58)	26.8 (1.11)	26.1 (1.30)		
Postsecondary	60.0 (0.66)	58.0 (1.20)	57.7 (1.46)		
Marital status				65.43 (4)	<.001
Married/cohabiting[g,h,n]	65.0 (0.48)	60.9 (1.18)	57.1 (1.25)		
Widowed/separated/divorced[c,e,f]	17.6 (0.28)	23.6 (0.94)	27.9 (1.03)		

	No PTSD (Comparison Group)[a]	Partial PTSD[b]	Full PTSD	χ^2(df)	P
	(n=26,716)	(n=2,471)	(n=2,463)		
	% or mean (SE)	% or mean (SE)	% or mean (SE)		
Never married[o]	17.4 (0.49)	15.6 (0.88)	15.0 (0.91)		
Household income				94.18 (6)	<.001
$0-$19,999[c,f,p]	16.8 (0.44)	20.0 (0.96)	26.8 (1.18)		
$20,000-$34,999[f]	17.7 (0.40)	19.1 (1.00)	21.5 (1.05)		
$35,000-$69,999[h,q]	33.5 (0.47)	33.7 (1.16)	28.5 (1.14)		
$70,000+[h,i,q]	32.0 (0.82)	27.2 (1.21)	23.1 (1.38)		

[a]**Respondents in this group reported experiencing a traumatic event but had neither full nor partial PTSD.**

[b]**Defined as experiencing a traumatic event; helplessness, horror, or fear of death or severe injury or disability; and at least one symptom each from Criteria B, C, and D and duration of at least one month (Criterion E).**

[c]**Partial PTSD > comparison group, $p < 0.001$.**

[d]**Full PTSD > comparison group, $p < 0.05$.**

[e]**Full PTSD > partial PTSD, $p < 0.01$.**

[f]**Full PTSD > comparison group, $p < 0.001$.**

[g]**Full PTSD < partial PTSD, $p < 0.05$.**

[h]**Full PTSD < comparison group, $p < 0.001$.**

[i]**Partial PTSD < comparison group, $p < 0.001$.**

[j]**Full PTSD < comparison group, $p < 0.05$.**

[k]**Full PTSD > partial PTSD, $p < 0.05$.**

[l]**Partial PTSD < comparison group, $p < 0.05$.**

[m]**Partial PTSD > comparison group, $p < 0.05$.**

[n]**Partial PTSD < comparison group, $p < 0.01$.**

[o]**Full PTSD < comparison group, $p < 0.01$.**

[p] **Full PTSD > partial PTSD, _p_ < 0.001.**

[q] **Full PTSD < partial PTSD, _p_ < 0.01.**

Table 2

SF-12v2 measures of functioning among NESARC respondents by PTSD status

	No PTSD (Comparison group)[a]	Partial PTSD[b]	Full PTSD	F (df)	P
	(n=26,716)	(n=2,471)	(n=2,463)		
	mean (SE)	mean (SE)	mean (SE)		
Functioning (SF-12v2)[c]					
Physical component summary[d,e,f]	50.6 (0.08)	48.9 (0.27)	46.9 (0.33)	73.67 (2,65)	<.001
Physical functioning[d,e,f]	51.2 (0.08)	49.3 (0.28)	47.2 (0.30)	98.48 (2,65)	<.001
Role-physical limitations[d,e,f]	50.5 (0.08)	48.2 (0.27)	45.7 (0.28)	149.94 (2,65)	<.001
Bodily pain[d,e,f]	51.2 (0.08)	48.3 (0.30)	45.6 (0.36)	153.88 (2,65)	<.001
General health[d,e,f]	50.4 (0.09)	47.9 (0.28)	45.8 (0.31)	144.99 (2,65)	<.001
Mental component summary[d,e,f]	52.1 (0.08)	48.3 (0.26)	45.7 (0.27)	359.19 (2,65)	<.001
Vitality[d,e,f]	52.7 (0.09)	50.2 (0.24)	48.4 (0.29)	139.91 (2,65)	<.001
Social functioning[d,e,f]	52.3 (0.07)	48.9 (0.28)	45.9 (0.33)	233.45 (2,65)	<.001
Role-emotional limitations[d,e,f]	50.1 (0.09)	46.8 (0.28)	44.1 (0.29)	262.60 (2,65)	<.001
Mental health[d,e,f]	52.6 (0.09)	48.6 (0.28)	46.0 (0.27)	356.17 (2,65)	<.001

[a] **Respondents in this group reported experiencing a traumatic event but had neither full nor partial PTSD.**

[b] **Defined as experiencing a traumatic event; helplessness, horror, or fear of death or severe injury or disability; and at least one symptom each from Criteria B, C, and D and duration of at least one month (Criterion E).**

[c] **Mean scores on the SF-12v2 are adjusted for sociodemographic characteristics.**

[d] **Full PTSD < partial PTSD, p <.001.**

[e] **Full PTSD < comparison group, p <.001.**

[f] **Partial PTSD < comparison group, p <.001.**

Table 3

Past-year health care professional-diagnosed general medical conditions among NESARC respondents by PTSD status

	No PTSD (Comparison Group)[a] (n=26,716) % (SE)	Partial PTSD[b] (n=2,471) % (SE)	Full PTSD (n=2,463) % (SE)	Partial PTSD vs. No PTSD AOR[c,d] (95%CI)	PTSD vs. No PTSD AOR[c,d] (95%CI)
Arteriosclerosis	2.0 (0.11)	2.2 (0.35)	2.4 (0.36)	1.2 (0.84-1.71)	1.3 (0.88-1.84)
Hypertension	24.7 (0.42)	28.0 (1.23)	30.0 (1.25)	Men **1.6 (1.22-1.98)** | Women 1.0 (0.87-1.21)	Men **1.6 (1.30-2.00)** | Women 1.1 (0.90-1.24)
Diabetes mellitus	8.0 (0.20)	8.0 (0.63)	10.9 (0.71)	1.0 (0.82-1.18)	**1.3 (1.07-1.52)**
Cirrhosis	0.2 (0.04)	0.3 (0.14)	0.3 (0.11)	1.1 (0.44-2.78)	0.6 (0.28-1.49)
Noncirrhotic liver disease	0.6 (0.05)	1.0 (0.22)	1.9 (0.37)	1.3 (0.79-2.18)	**2.0 (1.23-3.24)**
Angina pectoris	3.6 (0.14)	6.2 (0.62)	8.9 (0.67)	**1.4 (1.08-1.75)**	**1.7 (1.38-2.07)**
Tachycardia	4.2 (0.15)	7.3 (0.67)	9.7 (0.70)	**1.4 (1.08-1.72)**	**1.6 (1.31-1.94)**
Myocardial infarction	0.8 (0.06)	1.1 (0.25)	1.4 (0.27)	1.3 (0.76-2.27)	1.6 (1.00-2.53)
Hypercholesterolemia	20.6 (0.34)	21.8 (1.06)	24.2 (1.01)	1.1 (0.93-1.23)	**1.2 (1.03-1.36)**
Other heart disease	2.6 (0.12)	3.4 (0.45)	4.3 (0.47)	1.3 (0.96-1.71)	**1.6 (1.20-2.01)**
Stomach ulcer	2.0 (0.10)	4.5 (0.50)	5.9 (0.60)	**1.6 (1.20-2.03)**	**1.7 (1.31-2.17)**
HIV seropositivity	0.2 (0.03)	0.1 (0.07)	0.6 (0.18)	0.7 (0.21-2.32)	**2.5 (1.18-5.43)**
AIDS	<0.1 (0.02)	0.1 (0.06)	0.2 (0.08)	1.7 (0.16-17.83)	3.3 (0.48-23.15)
Other sexually transmitted disease	0.5 (0.05)	1.1 (0.31)	0.7 (0.17)	1.1 (0.64-1.83)	**0.5 (0.31-0.92)**
Gastritis	4.3 (0.17)	7.3 (0.62)	9.7 (0.73)	Men **2.0 (1.39-2.91)** | Women 1.1 (0.90-1.45)	Men **1.8 (1.20-2.64)** | Women **1.6 (1.25-2.03)**
Arthritis	20.9 (0.40)	27.3 (1.11)	31.6 (1.24)	**1.3 (1.13-1.48)**	**1.5 (1.26-1.68)**
Stroke	0.7 (0.06)	0.5 (0.15)	1.3 (0.29)	0.6 (0.30-1.17)	1.5 (0.92-2.44)

[a] **Respondents in this group reported experiencing a traumatic event but had neither full nor partial PTSD.**

[b] **Defined as experiencing a traumatic event; helplessness, horror, or fear of death or severe injury or disability; and at least one symptom each from Criteria B, C, and D and duration of at least one month (Criterion E),**

[c] Adjusted odds ratios, controlling for sociodemographic variables and comorbid lifetime mood, anxiety, substance use, and personality disorders, and attention-deficit/hyperactivity disorder.

[d] Sex-specific adjusted odds ratios are reported where statistically significant ($p < .05$) sex by PTSD status interactions were identified. In the absence of sex by PTSD status interactions, adjusted odds ratios are reported for the entire sample, controlling for sex and other covariates.

Table 4

Adjusted[a] Odds Ratios (95% Confidence Intervals) for Past-Year Medical Diagnoses Associated with Total Number of Event Types Ever Experienced and PTSD Status among Wave 2 NESARC Respondents with Any Potentially Traumatic Lifetime Events

Medical Diagnoses	OR (95% CI)		
	Per Event Type[b]	Partial PTSD[c] vs. Comparison Group[d]	Full PTSD vs. Comparison Group[d]
Arteriosclerosis	**1.10 (1.06-1.14)**	1.06 (0.74-1.52)	1.06 (0.73-1.55)
Hypertension	**1.05 (1.03-1.07)**	1.13 (0.97-1.31)	1.11 (0.97-1.28)
Diabetes mellitus	**1.07 (1.05-1.09)**	0.91 (0.75-1.10)	1.12 (0.94-1.35)
Cirrhosis	1.05 (0.94-1.16)	1.06 (0.42-2.66)	0.59 (0.27-1.31)
Noncirrhotic liver disease	**1.13 (1.06-1.19)**	1.14 (0.69-1.90)	1.53 (0.93-2.49)
Angina pectoris	**1.16 (1.13-1.19)**	1.16 (0.90-1.48)	**1.26 (1.02-1.56)**
Tachycardia	**1.12 (1.09-1.15)**	1.20 (0.95-1.51)	**1.28 (1.04-1.58)**
Myocardial infarction	**1.14 (1.08-1.21)**	1.11 (0.63-1.96)	1.22 (0.74-2.01)
Hypercholesterolemia	**1.04 (1.02-1.06)**	1.02 (0.89-1.18)	1.10 (0.96-1.26)
Other heart disease	**1.15 (1.11-1.19)**	1.08 (0.80-1.46)	1.19 (0.90-1.58)
Stomach ulcer	**1.08 (1.04-1.12)**	**1.42 (1.10-1.84)**	**1.44 (1.11-1.87)**
HIV seropositivity	1.03 (0.90-1.17)	0.67 (0.20-2.25)	**2.40 (1.12-5.16)**
AIDS	1.12 (1.00-1.26)	1.42 (0.14-13.88)	2.54 (0.31-20.74)
Other sexually transmitted disease	**1.12 (1.06-1.19)**	0.93 (0.54-1.62)	**0.41 (0.24-0.72)**
Gastritis	**1.09 (1.06-1.12)**	1.23 (0.99-1.53)	**1.39 (1.10-1.75)**
Arthritis	**1.11 (1.09-1.13)**	1.15 (1.00-1.32)	**1.20 (1.04-1.38)**
Stroke	**1.07 (1.01-1.13)**	0.55 (0.28-1.10)	1.33 (0.81-2.16)

[a]**Odds ratios for each medical diagnosis are derived from a multivariable logistic regression model containing total number of event types, PTSD status, and sociodemographic and comorbid mood, anxiety, substance use, and personality disorder covariates.**

[b]**Refers to total potentially traumatic event types respondents reported ever experiencing at the beginning of the AUDADIS-IV PTSD module (maximum possible: 27; each event type was counted only once, regardless of how many times it occurred).**

[c]**Defined as experiencing a traumatic event; helplessness, horror, or fear of death or severe injury or disability; and at least one symptom each from Criteria B, C, and D and duration of at least one month (Criterion E).**

[d]**Respondents in this group reported experiencing a traumatic event but had neither full nor partial PTSD.**