Research Article

GENDER DIFFERENCES IN THE LONG-TERM ASSOCIATIONS BETWEEN POSTTRAUMATIC STRESS DISORDER AND DEPRESSION SYMPTOMS: FINDINGS FROM THE DETROIT NEIGHBORHOOD HEALTH STUDY

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Objective: *Posttraumatic stress disorder (PTSD) and depression are known to be highly comorbid. However, previous findings regarding the nature of this comorbidity have been inconclusive. This study prospectively examined whether PTSD and depression are distinct constructs in an epidemiologic sample, as well as assessed the directionality of the PTSD-depression association across time.* **Methods:** *Nine hundred and forty-two Detroit residents (males: n = 387; females: n = 555) were interviewed by phone at three time points, 1 year apart. At each time point, they were assessed for PTSD (using the PCL-C), depression (PHQ-9), trauma exposure, and stressful life events.* **Results:** *First, a confirmatory factor analysis showed PTSD and depression to be two distinct factors at all three waves of assessments (W1, W2, and W3). Second, chi-square analysis detected significant differences between observed and expected rates of comorbidity at each time point, with significantly more no-disorder and comorbid cases, and significantly fewer PTSD only and depression only cases, than would be expected by chance alone. Finally, a cross-lagged analysis revealed a bidirectional association between PTSD and depression symptoms across time for the entire sample, as well as for women separately, wherein PTSD symptoms at an early wave predicted later depression symptoms, and vice versa. For men, however, only the paths from PTSD symptoms to subsequent depression symptoms were significant.* **Conclusions:** *Across time, PTSD and depression are distinct, but correlated, constructs among a highly-exposed epidemiologic sample. Women and men differ in both the risk of these conditions, and the nature of the long-term associations between them. Depression and Anxiety 00:1–11, 2014.*

Key words: *PTSD; trauma; depression; comorbidity; gender*

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INTRODUCTION

Exposure to traumatic stress is often followed by severe and debilitating psychiatric symptoms. The two most common and widely studied psychopathological outcomes of traumatic stress are posttraumatic stress disorder (PTSD) and depression.[1] PTSD and depression have also been shown to be highly comorbid. As part of the National Comorbidity Survey, Kessler et al.[2] found that 48% of those reporting lifetime PTSD also suffered from at least one lifetime episode of major depression. A relatively high prevalence of PTSD-depression comorbidity, both lifetime (43–56%) and current (16–37%), was also found in other studies.[3–6] Although the PTSD-depression association is well-established, there is ongoing debate about whether both disorders represent distinct constructs among traumatized populations. While some have found symptoms of PTSD and depression to be part of the same general posttraumatic stress construct,[7] others have shown them to represent separate factors.[8]

In addition, the underlying mechanisms of the PTSD-depression association are not yet fully understood. There are several possible explanations for this high comorbidity. One explanation is that PTSD symptoms are risk factors for the onset of depression. According to this view, PTSD is the most direct psychopathological reaction to a traumatic event, while depression is a subsequent, indirect, complication of this reaction. This explanation was supported by findings that early PTSD predicted later onset of depression, but not vice versa.[9] A second explanation suggests that depression increases vulnerability to PTSD following trauma.[10] Finally, both depression and PTSD may independently develop in response to trauma exposure. According to this view, a third factor or group of factors may increase the risk for both disorders.[11–14]

To date, efforts to understand PTSD-depression comorbidity have been constrained by several limitations. First, most of the studies assessing this association have been cross-sectional, and therefore offered very limited information regarding the temporal relationships between the two disorders. Second, the very few longitudinal studies assessing PTSD-depression associations either covered a short time period[15] or have focused on clinical populations,[9] where rates of PTSD and depression may be particularly high[16,17] and estimates of PTSD-depression comorbidity inflated. The probability that an individual will seek treatment is higher among those with two or more comorbid diagnoses.[18] Thus, findings from clinical samples cannot be used to make inferences about the relation between disorders in the general population. Third, most studies have not examined factors that may moderate the relation between PTSD and depression, such as gender. It has been well-established that females are at greater risk than males of suffering from PTSD[19] and depression[20] alone, yet gender differences in comorbidity remain relatively unexplored. Cross-sectional studies have documented higher rates of PTSD-depression comorbidity in females,[4] but no study, to our knowledge, has longitudinally assessed gender differences in this comorbidity over time.

The present study aims to fill these gaps in knowledge by capitalizing on a 3-year longitudinal follow-up of a large, mixed-gender, urban epidemiologic sample of Detroit residents. More specifically, we attempt to answer the following questions:

1. Do probable PTSD and depression represent distinct constructs over time in an epidemiologic sample?
2. Are symptoms of PTSD and depression significantly correlated over time?
3. If so, what is the nature of this association (bidirectional, unidirectional)?
4. Is the pattern of long-term associations between symptoms of PTSD and depression similar for women and men?

MATERIALS AND METHODS

PARTICIPANTS AND PROCEDURE

Data were collected as part of the Detroit Neighborhood Health Study (DNHS).[21,22] The DNHS is a study of adults, 18 years or older, from the Detroit population. A probability sample of 1,547 households within the city limits of Detroit was initially chosen and one individual per household was then randomly selected for interview. Participants were administered a 40-min assessment that included questions on exposure to traumatic events, sociodemographic characteristics, and measures of psychopathology. A two-tailed chi square test was performed to compare key sociodemographic characteristics of the Detroit population, obtained from the 2005–2007 American Community survey, and our complete weighted sample, and found no significant differences in terms of age, gender, race, income, and educational attainment.

Wave 1 (W1) was conducted between 2008 and 2009, and 1,547 participants completed the survey. Approximately a year after W1, 1,054 participants from W1 completed the Wave 2 (W2) survey. Wave 3 (W3) occurred approximately a year after W2, and 965 participants from W1 participated. A total of 847 participants completed all three waves, yielding an overall retention rate of 54.8%. At each wave, participants completed a structured telephone survey using standardized instruments. Informed consent was obtained at the beginning of each survey, and participants were offered $25 for their participation. The Institutional Review Board of the University of Michigan approved the study. The current study included participants who reported at least one lifetime traumatic event at W1, and completed the PCL-C and PHQ-9 at W1, and either or both W2 and W3 ($N = 942$; males: $n = 387$; females: $n = 555$). Bonferroni-corrected independent samples t-tests and chi-square tests showed that retained participants had significantly more lifetime traumatic events and stressors, significantly higher W1 and W2 depression, and were significantly more likely to be divorced or separated and less likely to be single and never married than dropped participants. In addition, participants with complete data ($n = 296$) reported significantly higher posttraumatic stress and depression at each wave compared to participants with missing data on any variables ($n = 646$).

MEASURES

Lifetime Traumatic Events and Stressors. At W1, participants completed a 20-item trauma inventory, where they indicated whether they had experienced 19 traumatic events (e.g., rape, serious car or motor vehicle crash) in their lifetime,[23] as well as an additional item allowing participants to report another traumatic event not on the inventory. A count of affirmative responses was created as an index of lifetime traumatic event exposure. Participants also indicated whether they experienced 10 stressors (e.g., serious financial problem, divorce) in their lifetime,[23] and a count of affirmative responses was included as an index of lifetime stressors.

Posttraumatic stress. A modified interview version of the PTSD Checklist-Civilian Version (PCL-C),[24] validated by the Clinician Administered PTSD Scale (CAPS),[25] assessed PTSD symptoms at each wave. The PCL-C includes 17 items, representing PTSD symptoms included in DSM-IV.[26] At each assessment, participants were asked to respond based on the event reported as the "worst" at W1. Participants indicated the degree to which they had been bothered by each symptom as a result of the event since the last interview, from 1 = *Not at all* to 5 = *Extremely*. Responses were summed to yield a total severity score for posttraumatic stress, ranging from 17 to 85. Two methods were used to provide an indicator of probable PTSD using the PCL-C. First, a cut-off score of 44 has been established for normative samples, such that scores exceeding this threshold are indicative of probable PTSD.[27,28] Second, probable PTSD status can be determined from the PCL-C based on the DSM-IV criteria A–F. To be coded as a PTSD case, a participant must have rated as "moderately" or above at least one reexperiencing item (B), three avoidance items (C), and two hyperarousal items (D). Additional questions assessed whether the participant felt helpless or hopeless during the event (A), duration of symptoms for 1 month or longer (E), and significant distress or functional impairment (F). For the current study, clinical in-person interviews conducted at W1 with a random subsample of 51 DNHS participants supported the reliability and validity of diagnoses using the latter method, relative to the gold-standard Clinician-Administered PTSD Scale for *DSM-IV* (CAPS).[25] Specifically, the PCL-C had good psychometrics (sensitivity = .24, specificity = .97, positive predictive value = .80, negative predictive value = .72, and an area under the receiver-operating characteristic (ROC) curve = .76). The PCL-C has previously been shown to have excellent internal consistency and substantial agreement with PTSD diagnosis and symptom ratings.[27,29] The internal consistency of the PCL-C in this study was Cronbach's α = .93 at Wave 1, .94 at Wave 2, and .94 at Wave 3.

Depression. A modified interview version of the nine-item Patient Health Questionnaire-9 (PHQ-9),[30] assessed depression symptoms at each wave. Participants were asked to rate the frequency (from 0 = *Not at all* to 3 = *Nearly every day*) in which they were bothered by each depression symptom since the last interview, over a period of 2 weeks. The total PHQ-9 score was created by summing ratings for all symptoms, with a possible range of 0–27. A cut-off score of 10 was used as an indicator of probable major depression.[30] Previous studies have found the PHQ-9 to have excellent internal consistency, test–retest reliability, and construct validity[31,32] (W1 α = .86, W2 α = .85, W3 α = .85).

In a clinical evaluation performed on 51 random participants from the larger study, comparing the PHQ-9 to clinician-administered SCID, the measure had a sensitivity of .60, specificity of .93, positive predictive value of .67, negative predictive value of .90, and an area under the receiver operating characteristic (ROC) curve of .76;[22] these are comparable to well-established brief assessments for depression used in community-based samples such as the CIDI. Furthermore, low sensitivity values for this instrument imply that our prevalence estimates are conservative.

Since this study did not include a clinical interview to establish a formal PTSD/depression diagnosis among the entire sample, we will use the terms "probable PTSD" and "probable depression" when referring to prevalence, and "PTSD/depression symptoms" when referring to the continuous variables.

DATA ANALYSIS

Among the variables included in the current study, the overall rate of missing data was 7.2%. All of the variables had less than 15% missingness, with two exceptions: W3 PCL-C (50.4%) and W3 PHQ-9 (22.9%). We conducted multiple imputation in Amelia II for R[33] to handle missing data, and five complete datasets were used for statistical analyses. Results represent an average of the five separate analyses with Rubin's correction of standard error.[34]

To test whether symptoms of PTSD and depression represented a single construct or two separate constructs in this sample, confirmatory factor analysis (CFA) was conducted in Mplus 7.0. Two CFA models were computed at each wave: (1) a one-factor model, with all items from the PCL-C and PHQ-9 loading on a single factor, and (2) a two-factor model, with items on the PCL-C loading on one factor and items from the PHQ-9 loading on a second factor. Several indicators were used to determine superior model fit: (1) smaller Akaike information criterion, (2) smaller Bayesian information criteria, (3) smaller sample sized adjusted BIC, (4) chi-square value with larger significance value, (5) smaller Root Mean Square Error of Approximation (RMSEA), and (6) larger Comparative Fit Index (CFI).

Second, cross-lagged models were conducted in MPlus 7.0 to determine the influence of PTSD symptoms on depression symptoms, and vice versa, over time. PTSD symptoms and depression symptoms were measured using continuous PCL-C and PHQ-9 scores, respectively. Cut-offs for acceptable model fit were set at <.08 for RMSEA and >.90 for CFA.[35] A model was first computed for the full sample. Demographic characteristics (e.g., age, gender, and ethnicity) and counts of lifetime traumatic events and stressors were included as predictors of W1 PCL-C and PHQ-9, and any paths with $P > .10$ were trimmed.

Lastly, a series of descriptive statistics and comparisons by gender were conducted in SPSS 19.0. Means and standard deviations for the PCL-C and PHQ-9 at each time point were computed. The percentages of participants who met criteria for probable PTSD (PCL-C > 44, and PTSD based on DSM-IV criteria A–F), probable depression (PHQ-9 > 10), and their combination, were also computed. Chi-square analysis was conducted to determine whether the observed comorbidity was significantly greater than would be expected by chance. One-way analyses of variance (ANOVA) and chi-square tests were conducted to assess gender differences. Subsequently, a multigroup model by gender, which included the trimmed set of covariates except for female gender, was conducted to explore whether cross-lagged paths differed between male and female participants. Separate models with equality constraints for each path (e.g., the path from W1 PCL-C to W2 PHQ-9 constrained to be equal for males and females) were computed, and chi-square difference tests were conducted to determine whether the constraints led to significantly worse fit.

RESULTS

Tables 1 and 2, respectively, present demographic characteristics and lifetime traumatic events and stressors reported by the 942 participants included in the final sample.

TABLE 1. Demographic characteristics of study participants at Wave 1 ($N = 942$)

Variable	*M* (SD)/%
Gender	
Male	41.1%
Female	58.9%
Race	
Non-Hispanic Black	85.3%
Non-Hispanic White	10.5%
Hispanic	1.2%
Other race/ethnicity	4.2%
Age	52.63 (16.02)
Parent of child < 18-years old	27.5%
Marital status	
Married	26.0%
Separated or divorced	25.7%
Widowed	13.4%
Single, never married	34.9%
Employment status	
Employed full time	32.0%
Employed part time	9.4%
Unemployed	58.7%
Income (1 = < $10,000 to 7 = > $75,000)	3.84 (2.00)
Education (1 = *less than high school* to 5 = *graduate degree*)	2.78 (1.08)
Lifetime trauma	5.23 (3.44)
Lifetime stressors	4.48 (2.94)

DO SYMPTOMS OF PTSD AND DEPRESSION REPRESENT DISTINCT CONSTRUCTS OVER TIME?

The CFA models suggested superior fit for the two-factor model over the one-factor model at each wave (Table 3). Although all models had a chi-square value with $P < .001$, we noted the much smaller values for the two-factor models, indicating better fit. Thus, symptoms of PTSD and depression were found to represent two distinct constructs over time in this sample.

WHAT IS THE COMORBIDITY OF PROBABLE PTSD AND DEPRESSION OVER TIME

Table 4 contains descriptive information for the PCL-C and PHQ-9, and frequencies of participants surpassing scale cut-offs for probable PTSD and depression, meeting the DSM-IV criteria for PTSD, and having comorbid probable PTSD and depression, versus a single disorder or no disorder.

Chi-square analysis detected significant differences between observed and expected values for comorbidity status at each time point (for comorbidity based on PCL-C > 44 and PHQ-9 > 10, W1: $\chi^2(1) = 166.12$; W2: $\chi^2(1) = 215.42$; W3: $\chi^2(1) = 266.25$; for comorbidity based on DSM-IV PTSD and PHQ-9 > 10, W1: $\chi^2(1) = 150.11$; W2: $\chi^2(1) = 143.43$; W3: $\chi^2(1) = 79.11$; all $P < .001$). Inspection of adjusted standardized residuals for each analysis determined that there were significantly more no disorder and comorbid cases, and significantly fewer PTSD only and depression only cases, than would be expected by chance. Descriptive data also showed that, based on both methods of determining PTSD, the rate of cases with PTSD-depression comorbidity was higher than the rate of PTSD alone at all time points.

WHAT IS THE NATURE OF THE ASSOCIATION BETWEEN PTSD AND DEPRESSION SYMPTOMS OVER TIME?

The final cross-lagged model for the full sample had acceptable fit with the data (Fig. 1). All cross-lagged paths were significant, such that more PTSD symptoms at one wave predicted a more depression symptoms at the subsequent wave, and vice versa. The individual path coefficients revealed that the association between PTSD symptoms and later depression symptoms was higher than vice versa between W1 and W2, while the coefficients were almost identical for both PTSD and depression between W2 and W3.

ARE THERE GENDER DIFFERENCES IN PTSD, DEPRESSION, AND THEIR ASSOCIATION OVER TIME?

The Prevalence of Probable PTSD, Depression, and their Comorbidity. As can be seen in Table 4, female participants had significantly higher scores on the PCL-C, were significantly more likely to have PCL-C scores above 44 at W1 and W3, and were significantly more likely to meet DSM-IV criteria for PTSD than male participants at W1 only. Female participants also had significantly higher scores on the PHQ-9 and were more likely to have PHQ-9 scores above 10 at all three time points. There were also significant differences in comorbidity status at W1 and W3, with comorbidity based on PCL-C > 44 and PHQ-9 > 10. In both cases, inspection of adjusted standardized residuals showed that there were fewer women and more men with no disorder, and more women and fewer men with comorbidity, than expected. With comorbidity based on DSM-IV PTSD and PHQ-9 > 10, there were significant gender differences in comorbidity at W1 only. In this case, inspection of adjusted standardized residuals found that there were fewer women and more men with no disorder, and more women and fewer men with probable PTSD only and comorbidity, than expected.

Associations Between PTSD and Depression Symptoms Over Time by Gender. The final multigroup cross-lagged model for male and female participants had acceptable fit with the data (Fig. 2). All cross-lagged paths were significant for female participants, whereas only the paths from PTSD symptoms to subsequent depression symptoms were significant for males. The association between W2 PTSD symptoms and W3 depression symptoms was also stronger for males than for females, although both were significant. We subsequently ran three separate models with equality constraints: (1) the path from W1 depression symptoms

TABLE 2. Number and frequency of participants reporting each lifetime trauma and stressors and worst trauma ($N = 942$)

	Full sample ($N = 942$)		Males ($n = 387$)		Females ($n = 555$)	
	Experienced event	Worst trauma	Experienced event	Worst trauma	Experienced event	Worst trauma
Lifetime traumatic events						
Experienced the sudden, unexpected death of a close friend or relative	769 (81.6%)	362 (38.4%)	311 (80.4%)	136 (35.1%)	458 (82.5%)	226 (40.7%)
Experienced any other extraordinarily stressful situation or event	267 (28.3%)	94 (10.0%)	84 (21.7%)	35 (9.0%)	183 (33.0%)	59 (10.6%)
Been diagnosed with a life-threatening illness or had a serious operation	315 (33.4%)	81 (8.6%)	121 (31.3%)	29 (7.5%)	194 (35.0%)	52 (9.4%)
Been in a serious car or motor vehicle crash	273 (29.0%)	49 (5.2%)	118 (30.5%)	24 (6.2%)	155 (27.9%)	25 (2.5%)
Learned that a close friend or relative was seriously injured in a motor vehicle crash	453 (48.1%)	43 (4.6%)	190 (49.1%)	20 (5.2%)	263 (47.4%)	23 (4.1%)
Been mugged, held up, or threatened with a weapon	355 (37.7%)	43 (4.6%)	192 (47.0%)	27 (7.0%)	173 (31.2%)	16 (2.9%)
Been raped	112 (11.9%)	37 (3.9%)	7 (1.8%)	0 (.0%)	105 (18.9%)	37 (6.7%)
Learned that a close friend or relative was raped or sexually assaulted	350 (37.2%)	33 (3.5%)	131 (33.9%)	15 (3.9%)	219 (39.5%)	18 (3.2%)
Experienced combat or exposure to a war zone in the military or as a civilian	112 (11.9%)	30 (3.2%)	85 (22.0%)	25 (6.5%)	27 (4.9%)	5 (.9%)
Been shot or stabbed	105 (11.1%)	24 (2.5%)	75 (19.4%)	18 (4.7%)	30 (5.4%)	6 (1.1%)
Witnessed someone being killed or seriously injured	302 (32.1%)	21 (2.2%)	166 (42.9%)	16 (4.1%)	136 (24.5%)	5 (.9%)
Had a child of yours diagnosed as having a life-threatening illness	78 (8.3%)	21 (2.2%)	24 (6.2%)	7 (1.8%)	54 (9.7%)	14 (2.5%)
Learned that a close friend or relative was seriously physically attacked	376 (39.9%)	20 (2.1%)	161 (41.6%)	4 (1.0%)	215 (38.7%)	16 (2.9%)
Been badly beaten up	136 (14.4%)	16 (1.7%)	57 (14.7%)	7 (1.8%)	79 (14.2%)	9 (1.6%)
Learned that a close friend or relative was seriously injured in any other accident	274 (29.1%)	14 (1.5%)	129 (33.3%)	5 (1.3%)	145 (26.1%)	9 (1.6%)
Experienced a natural disaster (e.g., fire, flood, earthquake) in which you were hurt or your property was damaged	183 (19.4%)	14 (1.5%)	67 (17.3%)	4 (1.0%)	116 (20.9%)	10 (1.8%)
Experienced another kind of sexual assault or unwanted sexual contact as a result of force, threat of harm, or manipulation	144 (15.3%)	13 (1.4%)	21 (5.4%)	0 (.0%)	123 (22.2%)	13 (2.3%)
Unexpectedly discovered a dead body	139 (14.8%)	11 (1.2%)	76 (19.6%)	8 (2.1%)	63 (11.4%)	3 (.5%)
Experienced any other kind of serious accident or injury	140 (14.9%)	9 (1.0%)	64 (16.5%)	5 (1.3%)	76 (13.7%)	4 (.7%)
Been held captive, tortured or kidnapped	45 (4.8%)	7 (.7%)	13 (3.4%)	2 (.5%)	32 (5.8%)	5 (.9%)
Lifetime stressors						
Had serious financial problems	547 (58.1%)	–	211 (54.5%)	–	336 (60.5%)	–
Had a family member other than a parent with a serious drug or alcohol problem	544 (57.7%)	–	221 (57.1%)	–	323 (58.2%)	–
Been through a divorce of "break up" with a partner or significant other	511 (54.2%)	–	193 (49.9%)	–	318 (57.3%)	–
Been unemployed or seeking unemployment for at least 3 months	463 (49.2%)	–	213 (55.0%)	–	250 (45.0%)	–
Experienced mental illness personally or the mental illness of someone close to you	387 (41.1%)	–	149 (38.5%)	–	238 (42.9%)	–
Lost your job	400 (42.5%)	–	185 (47.8%)	–	215 (38.7%)	–
Been emotionally mistreated—for example, shamed, embarrassed, ignored, or repeatedly told you were no good	316 (33.5%)	–	118 (30.5%)	–	198 (35.7%)	–
Experienced stressful legal problems—for example, being sued or suing someone	277 (29.4%)	–	114 (29.5%)	–	163 (29.4%)	–
Seen or heard physical fighting between your parents or caregivers	274 (29.1%)	–	102 (26.4%)	–	172 (31.0%)	–
Had problems getting access to adequate healthcare	256 (27.2%)	–	104 (26.9%)	–	152 (27.4%)	–
Had a parent with a problem with drugs or alcohol	237 (25.2%)	–	99 (25.6%)	–	138 (24.9%)	–

TABLE 3. Results of confirmatory factor analysis for PCL-C and PHQ-9 items at each wave ($N = 942$)

	AIC	BIC	Adj. BIC	χ^2	RMSEA	CFI
Wave 1						
1 Factor	68358.62	68736.77	68489.04	2679.39*** ($df = 299$)	.09	.79
2 Factors	67187.55	67570.54	67319.64	1522.59*** ($df = 298$)	.07	.89
Wave 2						
1 Factor	56486.20	56864.35	56616.62	2251.31*** ($df = 299$)	.08	.80
2 Factor	55426.52	55809.51	55558.61	1404.89*** ($df = 298$)	.06	.89
Wave 3						
1 Factor	57275.28	57653.43	57405.71	1381.00*** ($df = 299$)	.06	.79
2 Factor	56367.44	56750.44	56499.54	995.94*** ($df = 298$)	.05	.86

Note: PCL-C = Posttraumatic Stress Checklist, Civilian Version; PHQ-9 = Patient Health Questionnaire-9; AIC = Akaike information criterion; BIC = Bayesian information criteria, RMSEA = Root Mean Square Error of Approximation; CFI = Comparative Fit Index.

to W2 PTSD symptoms constrained; (2) the path from W2 depression symptoms to W3 PTSD symptoms constrained; and (3) the path from W2 PTSD symptoms to W3 depression symptoms constrained. In no case did equality constraints lead to significantly worse fit [$\chi^2(1) = .62$, $P = .43$, $\chi^2(1) = 3.00$, $P = .08$, and $\chi^2(1) = .15$, $P = .70$], indicating that the general pattern of associations was not different for males and females.

DISCUSSION

This study examined the longitudinal associations between symptoms of PTSD and depression among an economically disadvantaged, population-representative sample. We had four major findings. First, a CFA showed symptoms of PTSD and depression to represent two distinct factors across time. Second, there were significantly more comorbid cases, and significantly fewer single-disorder cases, than would be expected by chance alone. Third, a cross-lagged analysis revealed bidirectional associations between PTSD and depression symptoms across time. Fourth, women reported higher depression scores than men at all three waves, and higher PTSD scores and comorbidity rates at W1 and W3. In addition, regression coefficients for the individual cross-lagged paths showed that the paths leading from PTSD symptoms to depression symptoms and vice versa were all significant among women. However, only the paths from PTSD symptoms to later depression symptoms were significant for men. Overall, our findings show that symptoms of PTSD and depression represent two distinct constructs, which are correlated over time. They also reveal that females are at higher risk for both probable PTSD and depression over time, and that there is a gender difference in the pattern of PTSD-depression associations over time.

Our results revealed a significant long-term burden of both probable PTSD and depression among Detroit residents. These results are in line with previous studies assessing psychopathology in disadvantaged neighborhoods.[36] Our findings reveal relatively high rates of probable PTSD, particularly when derived using the PCL cut-off score. As could be expected, when we applied DSM-IV criteria for PTSD, the rates were lower, as it is more difficult to meet these criteria. Nonetheless, probable PTSD rates were still quite high at W1, even when applying DSM criteria. The burden of PTSD in this sample may be attributed to the high level of exposure to assaultive violent events, in the study sample and more generally in Detroit.[37] The burden of PTSD and depression may also be attributed to other factors, such as unemployment, poverty, and general sense of threat. These factors are often associated with chronic, day-to-day stress, which is often adversely associated with mental health.[38,39]

Our results revealed that symptoms of PTSD and depression represent two separate constructs at all time points. In recent years, there have been numerous attempts to re-examine the structure of PTSD.[40] Some have argued that the dysphoric symptoms attributed to depression should be included as part of the PTSD diagnosis.[41] DSM-V implemented this suggestion with the inclusion of a new symptom cluster, "negative alterations in cognitions and mood." Our findings suggest that symptoms of PTSD and depression represent two distinct constructs, rather than two facets of one general psychopathological condition. It thus may be useful to consider Brentano's[42] distinction between symptoms that are about the trauma (e.g., flashbacks) and symptoms that are merely caused by the trauma (e.g., inability to enjoy life). It is quite possible that the association found here between probable PTSD and depression stems in large part from the overlap in "non-specific" symptoms of both disorders, which reflect distress as a result of living in a highly stressful environment.[43]

Our finding that, at all waves, probable PTSD-depression comorbidity was more common than probable PTSD alone, aligns with previous findings that PTSD in its "pure" form is quite uncommon.[44] PTSD is often described as a systemic psychiatric disorder,[45] typically accompanied by a host of psychiatric, psychological, and somatic problems.[46] While it remains one of few psychiatric disorders that require an external stressor for diagnosis, in most cases, and particularly in its more chronic forms, its effects are felt in multiple domains of health and functioning.

TABLE 4. Means, standard deviations, and frequencies for indices of probable PTSD and probable depression, and results of independent-samples and chi-square tests of gender differences ($N = 942$)

	Full sample ($N = 942$)	Males ($n = 387$)	Females ($n = 555$)	Gender differences: χ^2, t
PTSD				
PCL-C				
Wave 1	33.59 (15.09)	31.27 (13.85)	35.21 (15.70)	−4.07***,[a]
Wave 2	27.52 (11.99)	26.86 (11.69)	27.98 (12.19)	−1.40
Wave 3	27.16 (12.35)	25.68 (11.76)	28.19 (12.64)	−3.08**
PCL-C > 44				
Wave 1	21.5%	15.8%	25.6%	13.02***
Wave 2	10.5%	9.6%	11.2%	.73
Wave 3	11.4%	8.3%	13.6%	6.42*
PTSD by DSM-IV				
Wave 1	12.3%	7.9%	15.3%	11.53***
Wave 2	4.7%	3.9%	5.2%	1.02
Wave 3	4.1%	4.0%	4.1%	.28
Depression				
PHQ-9				
Wave 1	5.69 (6.30)	4.76 (6.11)	6.33 (6.36)	−3.41***
Wave 2	4.32 (5.55)	3.60 (5.33)	4.82 (5.65)	−3.35***
Wave 3	4.10 (5.53)	3.36 (5.02)	4.61 (5.80)	−3.51***,[a]
PHQ-9 > 10				
Wave 1	23.6%	19.0%	26.8%	7.85**
Wave 2	16.7%	12.9%	19.4%	6.95**
Wave 3	14.6%	11.3%	16.9%	5.76*
Comorbidity				
PCL-C > 44 and PHQ > 10				
Wave 1				15.21**,[b]
Neither	67.3%	74.2%	62.5%	
PTSD only	9.1%	6.9%	10.7%	
Depression only	11.2%	10.1%	12.0%	
Both	12.4%	8.9%	14.9%	
Wave 2				7.52
Neither	80.0%	83.3%	77.7%	
PTSD only	3.3%	3.8%	3.0%	
Depression only	9.5%	7.1%	11.2%	
Both	7.2%	5.8%	8.2%	
Wave 3				8.62*,[b]
Neither	81.6%	85.2%	79.1%	
PTSD only	3.8%	3.5%	4.0%	
Depression only	6.9%	6.5%	7.3%	
Both	7.6%	4.9%	9.6%	
PTSD by DSM-IV and PHQ > 10				
Wave 1				15.29**,[b]
Neither	72.6%	78.8%	68.3%	
PTSD only	3.8%	2.2%	4.9%	
Depression only	15.2%	13.3%	16.5%	
Both	8.5%	5.7%	10.4%	
Wave 2				7.29
Neither	82.4%	86.0%	79.9%	
PTSD only	.8%	1.0%	.7%	
Depression only	12.8%	10.0%	14.8%	
Both	3.9%	2.9%	4.6%	
Wave 3				7.05
Neither	83.9%	87.0%	81.8%	
PTSD only	1.5%	1.7%	1.3%	
Depression only	12.0%	9.0%	14.1%	
Both	2.6%	2.3%	2.8%	

Note: $^*P < .05$, $^{**}P < .01$, $^{***}P < .001$. [a]Equal variances not assumed due to significant Levene's test. In both cases, the adjusted degrees of freedom were 889. [b]Adjusted standardized residuals were inspected to determine which cells had observed values that were significantly different than expected. For Wave 1 and Wave 3 comorbidity status based on PCL-C > 44 and PHQ-9 > 10, there were significantly fewer females and more males in the "neither" category, and significantly more females and fewer males in the "both" category, than expected. For Wave 1 comorbidity status based on DSM-IV PTSD and PHQ-9 > 10, there were significantly fewer females and more males in the "neither category," and significantly more females and fewer males in the "both" and "PTSD only" categories. PCL-C = Posttraumatic Stress Checklist, Civilian Version; PHQ-9 = Patient Health Questionnaire-9.

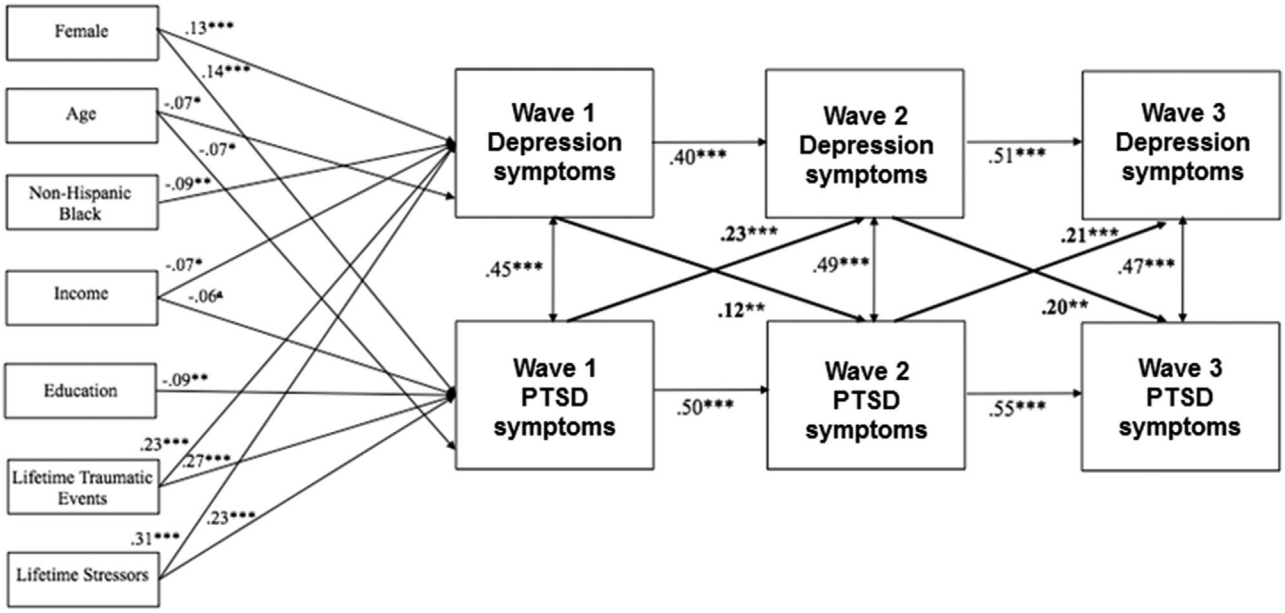

Figure 1. Results of cross-lagged model for symptoms of depression and PTSD for the full sample ($N = 942$). $^{a}P < .10$, $^{*}P < .05$, $^{**}P < .01$, $^{***}P < .001$. $\chi^2(38) = 132.85$, $P < .001$, Root mean square error of approximation (RMSEA) = .05, Comparative Fit Index (CFI) = .96. Results in the cross-lagged model are based on continuous PCL-C and PHQ-9 scores.

Our findings also reveal bidirectional relations between symptoms of PTSD and depression. While depression is often regarded as an indirect response to trauma,[47] secondary to PTSD, our findings suggest that over time depression may serve as a precursor for PTSD symptoms in trauma-exposed individuals. This is in line with other prospective studies showing that depression may fuel subsequent PTSD.[48] Several depression-related factors may impel PTSD onset. For example, depression-related helplessness and loss of mastery may prevent active coping and support-seeking, thereby facilitating the development of PTSD.[48] Other factors

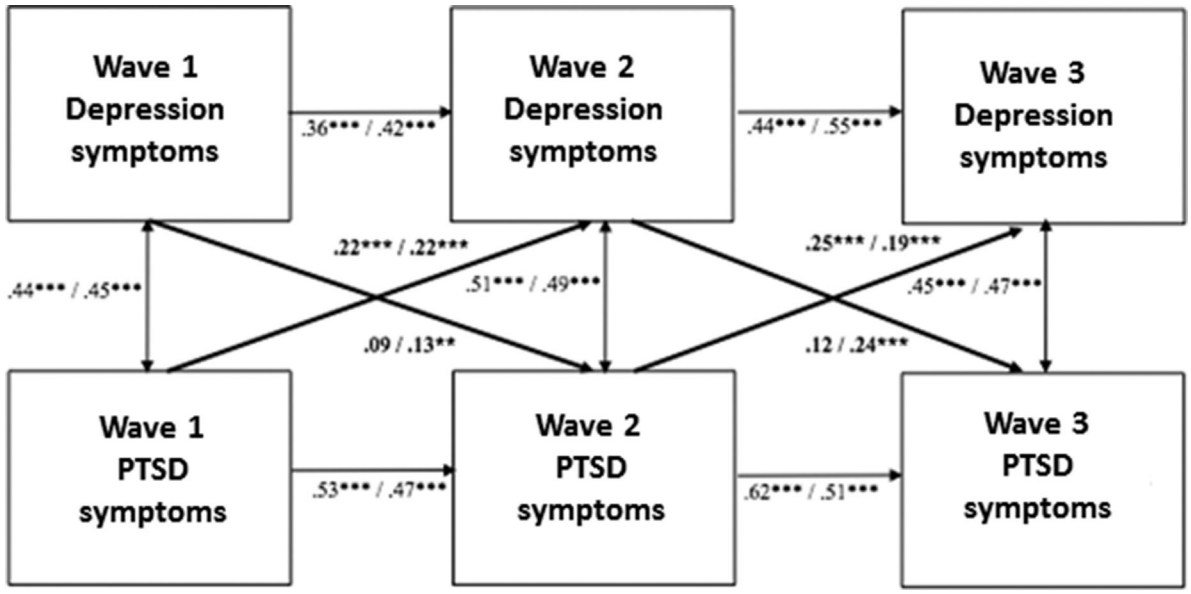

Figure 2. Results of multigroup (by gender) cross-lagged model for symptoms of depression and PTSD. Values on left are for male participants ($n = 387$), and values on left are for female participants ($n = 555$). $\chi^2(68) = 152.27$, $P < .001$, Root Mean Square Error of Approximation (RMSEA) = .05, Comparative Fit Index (CFI) = .96. The model included the same set of covariates as the model for the full sample, except for female gender. For clarity, these paths are not shown. Results in the cross-lagged model are based on continuous PCL-C and PHQ-9 scores.

associated with depression, such as enhanced negative affect,[49] may also impel the onset of PTSD. The pathway leading from initial PTSD to later depression, on the other hand, may be mediated by feelings of helplessness when attempting to cope with PTSD symptoms.[50,51]

A closer look at our cross-lagged model, however, revealed that the strength of the association between symptoms of PTSD and depression changed as a function of time. While PTSD symptoms contributed more significantly to subsequent depression symptoms than vice versa between W1 and W2, the coefficients were almost identical between W2 and W3. This may show that while both disorders are bidirectionally associated, the "entry points" into posttraumatic distress may differ over time, with PTSD symptoms being more dominant at the initial stages, and depression symptoms being almost as dominant as PTSD symptoms in later stages. Further research is needed to investigate this possibility.

Our findings also revealed several gender differences in PTS and depression. In line with numerous previous studies,[52,53] women in this study were at higher risk for both probable depression and probable PTSD than men across time. While fully elucidating the reasons for this are beyond the scope of this paper, this difference may be attributed to the different types of stressful and traumatic events to which women and men were exposed in this sample (e.g., more sexual assault reported by women). Other biological, cognitive, social, and behavioral explanations also exist for elevated levels of both disorders among women.[54–57] Interestingly, the longitudinal association between symptoms of PTSD and depression was also different for women and men. Although no significant changes in fit were found after constraining the cross-lagged model, we did find that for women all paths leading from PTSD symptoms to later depression symptoms, and vice versa, were significant. However, only the paths leading from PTSD symptoms to later depression symptoms were significant among men. Together, these findings may be taken to suggest that women have a higher, nonspecific, underlying vulnerability to traumatic stress—a vulnerability that is expressed through both depression and PTSD alone, and their comorbidity. For men, however, the implications of exposure to traumatic stress may initially remain more specific and contained, staying primarily within the realm of PTSD, and only subsequently yielding depression as a secondary disorder. While very few studies have assessed the temporal associations between depression and anxiety specifically among women, the little evidence that does exist seems to support our findings. For example, Parker and Hadzi-Pavlovic[58] have reported that, over time, the preponderance of depression among women is explained by the presence of an anxiety disorder. However, female gender was also an independent risk factor for depression, above and beyond any influence of anxiety.

This study has several methodological limitations. First, we used lay interviewer assessments of PTSD and depression, as opposed to clinician-based diagnoses. Thus, this study does not determine formal PTSD and depression diagnoses, but rather yields an approximation of PTSD and depression, as well as a measure of continuous symptoms for both disorders. In order to partly cope with this limitation, we did employ two different methods of assessing PTSD. Although these methods yielded different rates of probable PTSD, they did yield similar results regarding PTSD-depression comorbidity. Future studies are encouraged to include clinician-based measures of both PTSD and depression, which will enable to establish a formal diagnosis of both disorders. We believe that this would make future findings about PTSD-depression comorbidity even more generalizable to clinical populations. Another limitation stems from the 1-year time frame used to assess PTSD and depression, thus making it difficult to determine whether both disorders were in fact concurrent. An additional limitation is the relatively high rate of missing data in W3 PCL-C. One possibility is that some of the participants missing follow-up assessments could not recall the event they reported as the "worst" at baseline, despite being reminded of which event they had reported, and therefore could not report on PTSD symptoms linked to that event. This points to the more general limitation of having all assessments linked to the "worst" event. Although this method allowed for consistency in measurement over time, it does not fit with a conceptualization of PTSD as a set of symptoms that could be connected to multiple traumatic events. Also, retained participants in this study had significantly more lifetime traumatic events and stressors, and significantly higher W1 and W2 depression. In addition, participants with complete data reported significantly higher posttraumatic stress and depression at each wave compared to participants with missing data on any variables. Although multiple imputation was employed in order to handle missing data, it is still possible that rates of probable PTSD and depression found in our study were somehow inflated, as we may have been dealing with an initially highly symptomatic sample. It may also be that the specific pattern of associations between PTSD and depression symptoms found here is particularly relevant to individuals who are more symptomatic, and is therefore less generalizable to other populations.

Nonetheless, this study also has significant strengths. Most importantly, this is the first study to longitudinally assess the temporal relationships between symptoms of PTSD and depression in a high-risk community sample. It is also, to the best of our knowledge, the first study to include gender as a moderator of PTSD–depression associations over time. In addition, longitudinal data enabled more powerful inferences about causality. Finally, we used valid and reliable measures of PTSD and depression.

CONCLUSIONS

Our findings have implications for nosology, research, and practice. In terms of nosology, PTS and depression were found to be distinct but correlated constructs across

time among a community epidemiologic sample, with a differential pattern of associations for males and females. Thus, although symptoms of PTSD and depression facilitate each other's onset across time, they represent two separate and unique manifestations of distress among our sample. We believe these findings challenge the current DSM-V diagnostic criteria for PTSD, in which elements of depression are assimilated into the PTSD construct. With regard to research, our findings regarding gender show the importance of examining factors that may moderate comorbidity over time. In terms of practice, we observed that comorbid probable PTSD and depression was more common than either disorder alone, implying treatments need to account for both disorders, particularly among female patients.

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