Published in final edited form as:
Psychiatry Res. 2012 December 30; 200(2-3): 827–834. doi:10.1016/j.psychres.2012.04.022.

The New York PTSD Risk Score for Assessment of Psychological Trauma: Male and Female Versions

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Abstract

We previously developed a new posttraumatic stress disorder (PTSD) screening instrument – the New York PTSD Risk Score (NYPRS). Since research suggests different PTSD risk factors and outcomes for men and women, in the current study we assessed the suitability of male and female versions of this screening instrument among 3,298 adults exposed to traumatic events. Using diagnostic test methods, including receiver operating curve (ROC) and bootstrap techniques, we examined different prediction domains, including core PTSD symptoms, trauma exposures, sleep disturbances, depression symptoms, and other measures to assess PTSD prediction models for men and women. While the original NYPRS worked well in predicting PTSD, significant interaction was detected by gender, suggesting that separate models are warranted for men and women. Model comparisons suggested that while the overall results appeared robust, prediction results differed by gender. For example, for women, core PTSD symptoms contributed more to the prediction score than for men. For men, depression symptoms, sleep disturbance, and trauma exposure contributed more to the prediction score. Men also had higher cut-off scores for PTSD compared to women. There were other gender-specific differences as well. The NYPRS is a screener that appears to be effective in predicting PTSD status among at-risk populations. However, consistent with other medical research, this instrument appears to require male and female versions to be the most effective.

Keywords

Posttraumatic stress disorder; Psychological Trauma; Diagnostic testing; Patient screening

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Previous Presentation Preliminary results from this study were presented at the 31th Annual Meeting of the Anxiety Disorders Association of America, New Orleans, LA, March 26, 2011.

1. Introduction

The goal of this study is to identify effective risk assessment instruments for posttraumatic stress disorder (PTSD) screening, including assessing the utility of gender-specific instruments. To meet this objective, we used a study of the World Trade Center disaster (WTCD) in New York City (NYC) (Boscarino et al., 2004; Boscarino et al., 2011a), together with data collected in a chronic pain and in a trauma study (Boscarino et al., 2011b).

A number of brief PTSD screening tools are available, including the Primary Care PTSD Screener (PCPS), the Short Screening Scale for PTSD (SSSP), the abbreviated PTSD Checklist (APCL), and the Short PTSD Rating Interview (SPRINT), among others (Breslau et al., 1999b; Winston et al., 2003; Brewin, 2005; Lang and Stein, 2005; Norris et al., 2006; Bliese et al., 2008; Calhoun et al., 2010). These instruments are relatively short, have been shown to have reasonable specificity and sensitivity, and are focused on screening for core PTSD symptoms. At this time the PCPS is the most widely used PTSD screener, as it is currently being utilized among both military and civilian populations (Bliese et al., 2008; Calhoun et al., 2010; van Dam et al., 2010; Freedy et al., 2010).

The briefness of the PCPS (4 PTSD items) and its widespread use are clearly the strengths of this instrument. However, these features are also potential weaknesses. The PCPS is a simple, one-dimensional screener focused on key PTSD symptoms, including re-experiencing, avoidance, and arousal symptoms. The PCPS measure has the potential limitation of misclassifying persons whose PTSD symptoms might be expressed somewhat differently, such as among men and among those from different ethnic/racial groups (Adams and Boscarino, 2005; Boscarino and Adams, 2009; Felmingham and Bryant, 2012). When the New York PTSD Risk Score (NYPRS) was originally developed, the goal was to create a screening instrument that was practical and effective in different clinical settings and among different populations (Boscarino et al., 2011b). To achieve this we examined multiple risk factors that went beyond the one-dimensional PTSD screeners in current use (Brewin, 2005). This multi-factorial approach was consistent with the method recently used by Marx et al. in a study designed to predict PTSD among Vietnam veterans (Marx et al., 2008).

Based on previous research, the specific focus of the current study is to assess the suitability of PTSD diagnostic screening scores for men and women. Women are known to have higher rates of PTSD than men (Kessler et al., 1995), different trauma histories (Bromet et al., 1998; Tolin and Foa, 2006), and different PTSD-related risk factors (Yehuda, 1999). At this time, evidence related to the causes of these gender differences in PTSD is limited. Nevertheless, research suggests that these differences cannot be explained by the occurrence of sexual assault, preexisting depression or anxiety disorder, or by gender-related reporting bias (Breslau, 2009). It has been suggested that gender differences in neuroticism, depression, and the effects of stressful experiences might partly explain the higher vulnerability of women to PTSD (Breslau, 2009), but this is unclear at this time.

To date, one study suggests that the PTSD Checklist used among veterans seen in primary care clinics should have a lower cutoff score for female veterans (Lang et al., 2003), but few PTSD screening studies have reported differences by gender (Yeager et al., 2007). Our hypothesis was that the NYPRS would detect a significant difference by gender, given the scale's multi-dimensional structure. As suggested, most PTSD screeners are not gender-specific (Lang et al., 2003). However, these instruments typically focus only on core PTSD symptoms (Bliese et al., 2008; Calhoun et al., 2010; van Dam et al., 2010). There is also indirect evidence that gender-specific PTSD screeners would be more effective, given the

differences found for men and women as this relates to trauma exposures, PTSD risk factors, and responses to traumatic stressors (Kessler et al., 1995; Bromet et al., 1998; Tolin and Foa, 2006; Breslau, 2009; Maguen et al., 2012). As discussed below, the NYPRS includes core PTSD symptoms, as well as depression symptoms, trauma history, sleep disturbance, access to care measures, and demographic variables. If differences were found by gender for the NYPRS, this would mean different risk scores may be warranted for men and women with this instrument. In the current study we specifically assess the predictive value of different NYPRS models for men and for women.

2. Data and methods

2.1. Conceptual Approach

Although level of exposure and trauma-related loss are typically associated with the impact of traumatic events (Brewin et al., 2000; Norris et al., 2002), there are other mediating factors. Research suggests that increased PTSD vulnerability occurs among those with a history of mental health disorders, child adversity, and a history of previous traumas (Kessler et al., 1995; Yehuda, 1999; Breslau et al., 1999a). Socioeconomic and racial/ethnic factors are also known to affect these experiences (Adams and Boscarino, 2005; Galea et al., 2008). Research has also identified the key role of social support among those exposed to traumatic events (Hobfoll et al., 2009; Adams and Boscarino, 2011). The psychobiological bases of this syndrome have also become more apparent (Ursano et al., 2010). Given these different psychogenic factors, we anticipate a number of health-related problems to emerge among traumatized persons, including sleep disturbances, substance misuse, and alterations in functional health status, among others.

Our study was in specific response to the National Institute of Mental Health's (NIMH) request for applications related to conducting research with existing datasets to develop new PTSD assessment tools (RFA-MH-09-060). To meet this request, as discussed elsewhere, the NYPRS project team used a multi-factorial approach to guide model building combined with agnostic (i.e., atheoretical) examinations of statistical results (Boscarino et al., 2011b). Noteworthy is that the data used by the NYPRS research team utilized data that contained 3,298 persons, including 270 individuals identified as PTSD-positive cases from three separate studies (Table 1).

2.2. Measurements Used in the NYPRS

The NYPRS consists of 5 clinical measures plus 5 demographic measures (Boscarino et al., 2011b). The core PTSD screening measure used in the NYPRS is the 4-item Primary Care PTSD Screener (PCPS) (Kimerling et al., 2006; Ouimette et al., 2008; van Dam et al., 2010). As suggested, currently this instrument is widely utilized among both military and civilian populations (Bliese et al., 2008; Calhoun et al., 2010; van Dam et al., 2010). The cut-point we used for PTSD with the PCPS was 3 positive items, which is the recommended PCPS score to predict PTSD (Calhoun et al., 2010). To assess depression symptoms in the NYPRS we used the PHQ-2 scale, a commonly used 2-item depression screener (Whooley et al., 1997). For lifetime trauma exposure we used a simple count of the number of traumatic events (e.g., combat exposure, sexual assault, major disasters, etc.) experienced in the person's lifetime. For sleep disturbance we use a single-item measure of sleeping problems experienced in the past year. For access to healthcare we used a single-item report of access to a regular doctor or to healthcare services. Demographic measures were based on self report and included age, gender, race, Hispanic ethnicity, and college status. Additional information on these measures is presented in Table 1 and in the study appendix, as well as published elsewhere (Boscarino et al., 2011b).

2.3. Statistical Approach

We used a process of moving candidate variables in and out of the prediction models to allow for the manipulation of specificity and sensitivity (Pepe, 2003). We used methods designed for diagnostic test development, including sensitivity, specificity, receiver operator characteristic (ROC) curves, and bootstrapping (Pepe, 2003). An initial model was developed using variables thought to predict PTSD. This model was then extended to include other candidate measures. These variables initially included mental health status, substance misuse, stress exposures, social/community resources, and functional status measures, among others (Boscarino et al., 2011b). The goal of this model building was to estimate the area under the ROC curve (AUC), while using the fewest number of parameters and the simplest measures to reduce the administrative burden of the final instrument. The AUC was estimated at each step to quantify the prediction accuracy (Hanley and McNeil, 1982). The sequential addition of variables to the base model was evaluated in terms of increasing the AUC (Pepe, 2003).

A non-parametric approach was used to compare the added effects of other variables above the contribution of the base model (DeLong et al., 1988). The results of the model were then used to construct risk scores for PTSD. The properties of the risk scores were examined in terms of sensitivity, specificity, AUC, and by use of a nomogram (Harrell, 2001). A nomogram is a graphical tool used to represent the model and assign regression weights. These weights are the equivalent of standardized beta coefficients in linear regression and are developed from the final prediction models (Harrell, 2001). One problem in estimating diagnostic ability is in using the same dataset from which the model was derived, which can result in overestimation (Efron, 1986). This problem was addressed by estimating a bias-corrected version that used a 1,000-sample bootstrap procedure to provide a more accurate estimate of the AUC (Harrell, 2001). Specifically, bootstrap 95% confidence intervals (CIs) for the bias-corrected AUC were calculated for the ROC curves reported for the WTCD development sample. This procedure has been shown to be statistically superior to the method of cross-validation and the use of training and validation datasets (Harrell, 2001). In addition to estimating the AUC, we also used Youden's Index (Pepe, 2003). The Youden Index is a summary measure of the ROC curve, as it provides a criterion for choosing a cutoff value for which both sensitivity and specificity are maximized (DeLong et al., 1988; Fluss et al., 2005).

Our earlier analyses suggested that while our overall predictions were good, the NYPRS results appeared to be different for men and women (Boscarino et al., 2011b). Based on this preliminary finding and other gender research reviewed, in the current study our prediction model was tested for an interaction effect by gender. This was done by comparing the model with gender interaction effects for all the parameters in the model to those without these interaction terms included (Harrell, 2001). If this difference was statistically significant, gender-specific prediction models would be warranted. Originally we assessed sensitivity and specificity as functions of participants' core PTSD symptom, psychosocial status, and demographic variables. A model was subsequently developed to create a risk score from resultant logistic regression weights. The final NYPRS was based on a prediction model that included the PCPS, depression, trauma exposure, sleep disturbance, access to care, and several demographic measures (Table 1). If statistical interaction was detected by gender, separate models for men and for women would be recommended. The statistical software used in our current study included, SAS, version 9.2 (SAS Institute Inc., 2010), Stata, version 11.2 (Stata Corporation, 2011), and Pepi, version 4.0 (Abramson and Gahlinger, 2001).

2.4. Study Subjects

2.4.1. The World Trade Center Disaster (WTCD) Study—To study the impact of the WTCD event, using random-digit dialing, baseline diagnostic interviews were conducted among NYC adults (18 and older) by telephone one-year after the attacks. For the baseline survey, 2,368 residents completed the interview from October, 2002 through December, 2002. This survey was administered using a computer-assisted telephone interviewing (CATI) system. In this study, PTSD was diagnosed based on the full Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) (American Psychiatric Association, 1994). The PTSD measure used was developed for telephone administration and used in previous mental health surveys (Resnick et al., 1993; Acierno et al., 2000; Galea et al., 2002). To meet criteria for PTSD in this study, the person had to meet the full diagnostic criteria for PTSD (Boscarino and Adams, 2008). The validity of this PTSD diagnostic scale was reported to be good compared to the SCID (Kilpatrick et al., 1998). Versions of this scale have been used in mental health surveys involving over 15,000 telephone interviews, including several WTCD surveys (Resnick et al., 1993; Galea et al., 2002; Boscarino et al., 2004). The WTCD study served as both a developmental and a validation sample. The survey cooperation rate for this survey was estimated to be approximately 63% (American Association for Public Opinion Research, 2008). Additional information on the WTCD study has been published elsewhere (Boscarino and Adams, 2009; Boscarino et al., 2011a; Adams and Boscarino, 2011).

2.4.2. Chronic Pain Study—The chronic pain study included adult subjects (18+ years old) selected from non-malignant chronic pain patients (Boscarino et al., 2010). These individuals were selected from primary and specialty care patients seen in the Geisinger Clinic, a large integrated healthcare system that serves 2.5 million residents within 40 central and northeastern Pennsylvania counties (Boscarino et al., 2010). The majority of these pain patients had a history of physical injury, a condition often associated with PTSD (Shipherd et al., 2007; McFarlane, 2010). Diagnostic telephone interviews that included assessment of PTSD and psychological trauma were completed from August, 2007 through November, 2008. This interview was adopted from the WTCD Study described above and used the same PTSD diagnostic scale. This survey was also administered using a computer-assisted telephone interviewing (CATI) system. Altogether, 705 patients were surveyed. The chronic pain study served as a validation sample in this study. The survey cooperation rate for this survey was estimated to be approximately 60% (American Association for Public Opinion Research, 2008). Additional information related to the pain study has been published elsewhere (Boscarino et al., 2010).

2.4.3. Trauma Study—The trauma study also included adult subjects (18+ years of age) selected from trauma patients discharged from Geisinger Clinic's Level-I Trauma Center. Patients were eligible for the trauma study if they were discharged alive and not institutionalized at the time of study follow-up (Boscarino et al., 2011b). Study interviews took place from June, 2008 through December, 2008. Patients for this study were contacted approximately six months after discharge from the Trauma Center. For this study, interviewers administered structured diagnostic interviews also adopted from the WTCD study and used the same PTSD diagnostic scale. As in the WTCD and pain study described, the trauma survey was administered using a CATI system. Altogether, 225 patients were interviewed in this trauma study. The survey cooperation rate for this survey was estimated to be approximately 57% (American Association for Public Opinion Research, 2008). Additional information related to this trauma study has been published elsewhere (Boscarino et al., 2011b).

The WTCD, pain and trauma studies were all approved by the Geisinger IRB. The Geisinger Clinic IRB serves as the current IRB of record for all three of these studies.

3. Results

The studies used in our analyses, tabulated by the risk score measures and PTSD, are shown in Table 1. As seen, the WTCD study tends to differ from the pain and trauma studies in terms of race/ethnicity and level of education. However, the WTCD, pain, and trauma studies are more comparable with respect to lifetime trauma exposure and the prevalence of current PTSD (Table 1). Chi-square (χ^2) and t-tests indicated that the differences between the WTCD and the combined pain and trauma studies were statistically significant ($p < 0.05$). Consequently, in the current paper we present the results stratified by the WTCD and the combined pain and trauma studies.

Consistent with our previous work, the study results are presented by the key predictor variables identified. As seen, the Primary Care PTSD Screener (PCPS) is followed by the PCPS plus core psychosocial risk factors. This is followed by the PCPS, plus psychosocial risk factors, plus demographic variables. To formally assess a gender interaction effect, we compared the model with gender interaction terms included for the parameters in the final model (i.e., sleep × gender, trauma × gender, depression × gender, healthcare × gender, age × gender, race × gender, Hispanic × gender, and education × gender) to a model without these interactions. Since these results were statistically significant ($\chi^2 = 27.24$, df = 12, $p = 0.007$), separate gender-specific risk score models were developed and are presented below (Tables 2 and 3). For the current study, the pain and trauma studies are combined, as discussed above.

Noteworthy is that for male gender, the PCPS alone is a good predictor of PTSD (Table 2). For example, for men in the WTCD development sample, the PCPS had a specificity of 84.1% and a sensitivity of 89.8% (area under the receiver operating curve, AUC, = 0.87). Among the male pain and trauma patients, the PCPS had a specificity of 91.6% and a sensitivity of 95.5% (AUC = 0.935). In the WTCD sample, adding the psychosocial predictors (i.e., depression, trauma exposure, sleep disturbance, and healthcare access) to the model with the PCPS included resulted in a significant improvement, with a specificity of 87.7% and sensitivity of 91.5% (AUC = 0.947, $p < 0.0001$) for men. This improvement was also observed for men in the pain and trauma studies after psychosocial predictors were added to the model containing the PCPS, with a specificity of 93.4% and sensitivity of 95.5% (AUC = 0.964, $p = 0.0165$). However, for men the addition of demographic variables to the model (i.e., college status, age, race, and ethnicity) was neither statistically significant for the WTCD sample ($p = 0.089$) nor the pain and trauma studies combined ($p = 0.214$) (Table 2).

As can be seen for female gender (Table 3), the PTSD screener alone (i.e., PCPS) is also a good predictor of PTSD. In the WTCD sample, the PCPS had a specificity of 80.8% and a sensitivity of 95.6% (area under the receiver operating curve, AUC, = 0.882). Among the female pain and trauma patients, the results for the PCPS had a specificity of 92.4% and a sensitivity of 94.6% (AUC = 0.935). In the WTCD sample, adding the psychosocial predictors to the model with the PCPS resulted in a significant improvement, with a specificity of 85.5% and sensitivity of 93.0% (AUC = 0.941, $p < 0.0001$) for women. Significant improvement was also observed among women in the pain and trauma studies after psychosocial predictors were added to the model, with a specificity of 93.0% and sensitivity of 90.5% (AUC = 0.965, $p = 0.0084$). For women, the addition of demographic variables to the model was neither statistically significant for the WTCD sample ($p = 0.414$)

nor the pain and trauma samples (p = 0.814) (Table 3), similar to what was reported for men (Table 2).

Tables 4 presents PTSD risk-score results (i.e., the final regression-derived weights) used to generate the gender classification results shown in Table 2 and 3, respectively. As seen in Table 4 for men (top), a positive score on the PCPS (i.e., 3 or more positive symptoms) is given a base score of 100 (otherwise = 0) and the psychosocial and demographic items are given weights (or scores) relative to this score. This scoring is based on the logistic regression analyses, whereby the b coefficients in these logistic regression models are converted to standardized weights using a nomogram, as discussed. Table 4 also shows the cut-off score for men for a PTSD classification, based on these weights: 100 for the PCPS used alone and 184 for the PCPS + psychosocial predictors. A cut-off score for the addition of demographic variables is not shown for men, since these variables were not statistically significant when added to the model.

Standardized weights and cut-off scores are also shown for women in Table 4 (bottom half). As can be seen, the PCPS alone has a cut-off score of 100 (otherwise = 0). The PCPS + psychosocial predictors result in a score of 139 for women. A cut-off score for the addition of demographic variables is also not shown for women, since this addition was not statistically significant. As can be seen, for women to be classified as a PTSD case using the NYPRS model, requires a positive score on the PCPS (score =100), exposure to two lifetime traumatic events (score = 29), and current sleep disturbance (score = 39), which sums to a total score of 168. Comparing Table 4 results suggests that men have different risk-score burdens to achieve PTSD case status than women. For example, for men, depression symptoms are a greater risk factor for PTSD than for women (2 symptoms = 83 for men vs. 32 for women). This is also true for level of trauma exposure (4+ = 42 for men vs. 26 for women). Sleep disturbance also contributes more to PTSD case status for men than it does for women (64 for men vs. 39 for women). Finally, for women core PTSD symptoms (i.e., PCPS) tend to contribute more to predicting PTSD case status than they do for men, relative to the other psychosocial predictors, as can been seen in comparison of results for men and women. The one exception is that not having a regular source of healthcare is a better predictor of PTSD status for women than it is for men (33 for women vs. 9 for men).

4. Discussion

We examined different clinical domains, including PTSD symptoms, stressor exposures, depression symptoms, sleep disturbances, and demographic variables to evaluate different PTSD prediction models by gender. As suggested, our overall study goal was to develop a prediction tool that was useable in clinical practice (Boscarino et al., 2011b). As shown in Tables 2 and 3, five prediction domains were identified, including core PTSD symptoms (i.e., the PCPS), sleep disturbance, current healthcare access, depression symptoms, and past trauma exposure. By itself, the PCPS performed relatively well for both men and women, with the area under the ROC curve (AUC) ranging from 0.870 to 0.935.

The interaction detected for the NYPRS by gender dictated that different models should be considered for men and women (p = 0.007). For men in the WTCD study, adding healthcare access, sleep disturbance, depression symptoms, and trauma exposure to this model increased the AUC from 0.870 to 0.947, a significant improvement in the prediction results (p < 0.0001). Adding demographic variables increased the AUC to 0.954 for men, which was not statistically significant (p = 0.089). As discussed, to validate these findings for men, we applied the prediction results not only to the adults in the WTCD study, but also to those in the pain and trauma studies recruited from a large healthcare system. In summary, the

results for men were essentially the same in both the WTCD and the combined pain and trauma studies (Table 2).

For women in the WTCD study, adding healthcare access, sleep disturbance, depression symptoms, and trauma exposure to the model with the PCPS increased the AUC from 0.882 to 0.941, also a significant improvement ($p < 0.0001$). Adding demographic variables increased the AUC to 0.943, which was not significant ($p = 0.414$). As with men, to validate these findings for women, we also applied the prediction results to not only the adults in the WTCD study, but to those in the pain and trauma studies. In summary, these results were essentially similar to the WTCD study results (Table 3).

Examination of the specific prediction weights reveals that men received higher weights for depression symptoms, sleeping problems, and trauma exposures, compared to women. Conversely, women received higher relative prediction weights for poorer healthcare access and for PTSD symptoms (i.e., the PCPS) compared to men (Table 4). Also, the PTSD cut-off score for men = 184, while for women the cut-off score = 139. The latter findings is consistent with a report that suggested different cut-points should be used for men and women for the PTSD Checklist (Lang et al., 2003).

The use of PTSD screeners has increased recently with growing interest in the impact of traumatic stressors in primary care. Currently, the Department of Veterans Affairs and the Department of Defense are routinely using the PCPS in clinical practice to assess veterans and active duty personnel (Calhoun et al., 2010). As seen in the current study for both men and women, the PCPS screener appears to work reasonably well with non-veterans and non-active duty personnel. It is noted that ~ 8% of the adults in the combined WTCD, pain, and trauma studies, however, are US military veterans, but this group is not analyzed separately, due to the small number of female veterans and the current sample design. The addition of psychosocial predictors increases the predictive ability of the PCPS, but adding demographic variables did not. The PCPS consists of 4 PTSD symptom questions, which would require only a few minutes to administer in most cases. If the psychosocial questions are added, which include 2 depression questions, a trauma question, a sleep question, and a healthcare access question, this would still likely require fewer than 5 minutes for administration. The instrument, minus the demographic variables, would consist of 9 questions, achieving the brevity objective for this new screening scale.

Our hypothesis was that the NYPRS would detect a significant difference by gender, given the multi-dimensional structure of this scale and previous research. As discussed, there was indirect evidence that gender-specific PTSD screeners would be more effective, given the differences found for men and women as this relates to trauma exposure, PTSD risk, and response to traumatic stressors (Kessler et al., 1995; Bromet et al., 1998; Tolin and Foa, 2006; Breslau, 2009; Maguen et al., 2012). Our research suggests that male and female versions of the NYPRS may be more beneficial than simply using one-dimensional screening scales, such as the PCPS. As was seen, for both men and women adding key psychosocial screening elements to the NYPRS significantly increased the positive predictive value of this scale for both groups. The disadvantage of this is that it would add several minutes to the patient interview.

The current study has several strengths and limitations. A major strength was that our study involved a large-scale random survey among a multi-ethnic urban population and two validation studies. These validation studies included the WTCD bootstrap-validation and the combined pain/trauma validation studies. We also assessed a range of psychological and interpersonal risk factors using standardized instruments and medical test methods. In

addition, the PTSD reference standard used in our studies has been clinically validated (Resnick et al., 1993; Galea et al., 2002; Boscarino et al., 2004).

Potential study limitations include that we omitted individuals without a telephone, and those who were institutionalized, homeless, or too ill to be interviewed. In addition, non-response bias also could have affected all our survey results (Boscarino et al., 2011b). Furthermore, we did not use the predictors identified to predict PTSD beyond the first year after trauma exposure (i.e., the baseline study), which was within the same timeframe that PTSD was assessed. However, we recently investigated use of a "modified" NYPRS to forecast PTSD two years after initial exposure, which appeared to work very well (Boscarino et al., 2012). The sample sizes for the pain and trauma studies were also relatively small and these studies were also quite different from the WTCD study. These factors could have biased the results. There are other limitations that we have noted (Boscarino et al., 2011b).

Despite these limitations, our study suggests that a simple, brief screening instrument, The New York PTSD Risk Score (NYPRS), male and female versions, may be effective in PTSD screening. We developed gender-specific PTSD risk scores based on use of the PCPS, depression symptoms, sleep disturbance, trauma history, and access to healthcare. This screening instrument had good sensitivity and specificity and was effective in discriminating PTSD cases from non-cases. The NYPRS can be used based on the available patient and/or provider time, including the PCPS alone or in combination with psychosocial predictors. Important is the fact that while the PCPS alone appears to perform well in predicting PTSD cases, the addition of several brief psychosocial measures (e.g., depression symptoms, trauma history, care access, and sleep disturbance), significantly improves the prediction results for both men and women. Furthermore, the prediction weights appear to be different for men and women. We think the latter may have important clinical significance in the future. For example, research suggests that men and women have a different responses to PTSD cognitive therapy, express PTSD symptoms differently, have significant differences in the amounts and types of trauma experienced, and have different PTSD risk factors (Heim et al., 2009; Maguen et al., 2012; Felmingham and Bryant, 2012). These factors may affect treatment interventions.

The goal of our original effort was to develop risk assessment tools that were sensitive to both statistical and clinical significance in order to develop data useful for clinical decision-making. Our objective was to develop PTSD prediction tools to facilitate intervention by making it possible to identify high-risk groups from among all persons exposed to trauma. Our current study suggests that more effective PTSD screening should involve use of different screeners for men and for women, which has rarely been the case in the past. As shown, women have lower cutoff scores for PTSD than men and their PTSD score weighting is different. The latter makes sense, given the past differences reported for men and for women related to the epidemiology and etiology of PTSD and their different treatment responses (Kessler et al., 1995; Bromet et al., 1998; Tolin and Foa, 2006; Felmingham and Bryant, 2012).

Our study suggests that gender-specific PTSD screeners might be more effective for use among at-risk populations. Further research is recommended to verify our findings and to make the appropriate adjustments to the NYPRS to achieve more effective screening and treatment. At the very least the NYPRS informs the clinician that for men being screened for PTSD, depression symptoms and sleep disturbance may be the critical issues to be addressed, for women PTSD symptoms and healthcare access may be the critical issues. Additional research is advised.

Acknowledgments

This research was supported in part by grants from the National Institute of Mental Health (Grant # R01-MH-66403 and R21-MH-086317), Pennsylvania Department of Health (Contract # 4100042573), and the Geisinger Clinic Endowment (Grants # SRC-041 and # TRA-015), Boscarino PI.

Appendix: New York PTSD Risk Score (Gender Version)

Primary Care PTSD Screener (PCPS) (3 positive symptoms out of 4, past 12 months)

1. You had repeated bad dreams or nightmares or had disturbing or unpleasant memories, thoughts, or images that kept coming into your mind whether you wanted to think of them or not.
2. You deliberately tried hard not to think about something that happened to you or went out of your way to avoid certain places or activities that might remind you of something that happened in the past.
3. You felt you had to stay on guard much of the time or unexpected noises startled you more than usual.
4. You felt cut off from other people, found it difficult to feel close to other people, or you could not feel things anymore or you had much less emotion than you used to have.

Depression Symptoms (lifetime)

1. Have you ever had a period of two weeks or longer when you were feeling depressed or down most of the day or nearly everyday?
2. Have you ever had a period of two weeks or longer when you were uninterested in most things or unable to enjoy things you used to do?

Trauma Exposure (lifetime)

1. How many traumatic life events do you think you have ever experienced? These are events outside of everyday experiences and include being in combat or a war zone, being assaulted or sexually attacked, being in a major disaster, fire, or accident, experience the sudden and unexpected death of a loved one, and things like these.

Would you say you *never* experienced these events, experienced these events *once*, you experienced these events *twice*, experienced these events *three times* or you experienced these events *four times or more* in your lifetime?

Sleep Disturbance (past 12 months)

1. You had difficulty falling asleep or staying asleep?

Source of Healthcare/Regular Doctor

1. Do you have a regular doctor or a usual source of care that you can go to for routine medical care?

Demographics

1. What is the highest level of education or schooling you completed (record as college graduate vs. not college graduate)?
2. How old are you (record in years)?
3. Are you of Spanish or Hispanic origin?
4. How would you describe your racial background: White, Black/African American, Asian, or something else (record as White vs. or not White)?
5. Patient/person's gender (record by observation): Female or Male?

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Table 1

Profiles of Study Populations used in New York PTSD Risk Score Study

Study Variables*	WTCD Study (N=2368) % (n)	Geisinger Pain Study (N=705) % (n)	Geisinger Trauma Study (N=225) % (n)
PCPS *	23.4 (553)	13.3 (94)	28.0 (63)
Current PTSD	7.3 (174)	9.9 (70)	11.8(26)
PHQ-2 Depression Scale			
No Symptoms	52.7 (1248)	37.0 (261)	51.6 (116)
One Symptom	16.1 (382)	17.3 (122)	15.1 (34)
Two Symptoms	31.2 (738)	45.7 (322)	33.3 (75)
Lifetime Traumatic Events			
None	28.0 (664)	21.4 (151)	37.3 (84)
Low Exposure (< 2)	23.6 (558)	24.8 (175)	25.3 (57)
Moderate Exposure (2–3)	28.2 (667)	30.9 (218)	22.7 (51)
High Exposure (4+)	20.2 (479)	22.8 (161)	14.7 (33)
Trouble Sleeping	32.6 (772)	15.2 (107)	32.0 (72)
Access to Healthcare	88.0 (2084)	98.4 (694)	95.1 (214)
Mean Age (SD)	43.1 (15.5)	54.5 (13.7)	48.4 (16.9)
Gender			
Male	42.9 (1016)	32.9 (232)	55.1 (124)
Female	57.1 (1352)	67.1 (473)	44.9 (101)
Race			
White	42.9 (1015)	98.4 (694)	99.1 (223)
African American	25.6 (606)	0.9 (6)	0.4 (1)
Hispanic/Latino	23.6 (559)	0.4 (3)	0.0 (0)
Other	7.9 (188)	0.3 (2)	0.4 (1)
College Graduate	44.5 (1053)	19.7 (139)	26.7 (60)

*WTCD = World Trade Center Disaster; PCPS = Primary Care PTSD Screener; PHQ-2 = Patient Health Questionnaire, 2-item version; PCPS = Primary Care PTSD Screener.

Table 2

Results for Men: WTCD, Pain and Trauma Studies using Different Prediction Models*

Study and Prediction Model Used	Cut-off Score	% Specificity	% Sensitivity	PV+	PV−	AUC	AUC 95% CI	P-value
PTSD Screen only								
WTCD (N = 1016)								
PCPS	100	84.1	89.8	25.8	99.3	0.870	0.829–0.910	--
Pain and Trauma Studies (N = 356)								
PCPS	100	91.6	95.5	42.9	99.7	0.935	0.882–0.989	--
PTSD Screen + Risk Factors								
WTCD (N = 1016)								
PCPS + Risk Factors	184	87.7	91.5	31.4	99.4	0.947	0.930–0.965	<0.0001
Pain and Trauma Studies (N = 356)								
PCPS + Risk Factors	184	93.4	95.5	48.9	99.7	0.964	0.936–0.993	0.0165
PTSD Screen + Risk Factors + Demographics								
WTCD (N = 1016)								
PCPS + Risk Factors + Demos	263	92.5	91.5	42.8	99.4	0.954	0.937–0.970	0.0890
Pain and Trauma Studies (N = 356)								
PCPS + Risk Factors + Demos	263	95.2	77.3	51.6	98.5	0.960	0.927–0.993	0.2137

*AUC = Area under ROC curve; PV+ = Predictive value of positive test; PV− = Predictive value of negative test; PCPS = Primary care PTSD Scale; WTCD = World Trade Center Disaster; Demos = Demographics.

Table 3

Results for Women: WTCD, Pain, Trauma Studies using Different Prediction Models*

Study and Prediction Model Used	Cut-off Score	% Specificity	% Sensitivity	PV+	PV−	AUC	AUC 95% CI	P-value
PTSD Screen only								
WTCD (N = 1352)								
PCPS	100	80.8	95.6	31.6	99.5	0.882	0.860–0.904	--
Pain and Trauma Studies (N = 574)								
PCPS	100	92.4	94.6	64.8	99.1	0.935	0.902–0.968	--
PTSD Screen + Risk Factors								
WTCD (N = 1352)								
PCPS + Risk Factors	139	85.5	93.0	37.4	99.3	0.941	0.928–0.955	<0.0001
Pain and Trauma Studies (N = 574)								
PCPS + Risk Factors	139	93.0	90.5	65.7	98.5	0.965	0.950–0.980	0.0084
PTSD Screen + Risk Factors + Demographics								
WTCD (N = 1352)								
PCPS + Risk Factors + Demos	166	87.5	91.2	40.4	99.1	0.943	0.929–0.956	0.4140
Pain and Trauma Studies (N = 574)								
PCPS + Risk Factors + Demos	166	94.0	83.8	65.4	97.5	0.965	0.951–0.980	0.8142

*AUC = Area under ROC curve; PV+ = Predictive value of positive test; PV− = Predictive value of negative test; PCPS = Primary care PTSD Scale; WTCD = World Trade Center Disaster; Demos = Demographics.

Table 4

New York PTSD Risk Scores for Primary Care Screener Plus Psychosocial Factors for Men

Predictor Variables	PC-PTSD* Screen Only	PC-PTSD Screen + Psychosocial Factors
Positive PCPS Results	100	100
PHQ-2 < 2	--	0
PHQ-2 = 2	--	83
Trauma Count = < 2	--	0
Trauma Count = 2–3	--	20
Trauma Count = 4+		42
Sleep Disturbance	--	64
No Regular Healthcare Access	--	9
PTSD Cut-off Score =	**100**	**184**

New York PTSD Risk Scores for Primary Care Screener Plus Psychosocial Factors for Women

Predictor Variables	PC-PTSD* Screen Only	PC-PTSD Screen + Psychosocial Factors
Positive PCPS Results	100	100
PHQ-2 < 2	--	0
PHQ-2 = 2	--	32
Trauma Count < 2	--	0
Trauma Count = 2–3	--	29
Trauma Count = 4+		26
Sleep Disturbance	--	39
No Regular Healthcare Access	--	33
PTSD Cut-off Score =	**100**	**139**

PHQ-2 = Patient Health Questionnaire, 2-item version.

*Primary Care PTSD Screener (PCPS) with 3 positive items equals a Risk Score = 100.