Published in final edited form as:

Psychol Assess. 2014 June ; 26(2): 528–538. doi:10.1037/a0035871.

Using the SRQ–20 Factor Structure to Examine Changes in Mental Distress Following Typhoon Exposure

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Abstract

Empirical research is limited regarding postdisaster assessment of distress in developing nations. This study aimed to evaluate the factor structure of the 20-item Self-Reporting Questionnaire (SRQ–20) before and after an acute trauma, Typhoon Xangsane, in order to examine changes in mental health symptoms in an epidemiologic sample of Vietnamese adults. The study examined a model estimating individual item factor loadings, thresholds, and a latent change factor for the SRQ–20's single “general distress” common factor. The covariates of sex, age, and severity of typhoon exposure were used to evaluate the disaster-induced changes in SRQ–20 scores while accounting for possible differences in the relationship between individual measurement scale items and the latent mental health construct. Evidence for measurement noninvariance was found. However, allowing sex and age effects on the pre-typhoon and post-typhoon factors accounted for much of the noninvariance in the SRQ–20 measurement structure. A test of no latent change failed, indicating that the SRQ–20 detected significant individual differences in distress between pre- and post-typhoon assessment. Conditioning on age and sex, several typhoon exposure variables differentially predicted levels of distress change, including evacuation, personal injury, and peri-event fear. On average, females and older individuals reported higher levels of distress than males and younger individuals, respectively. The SRQ–20 is a valid and reasonably stable instrument that may be used in postdisaster contexts to assess emotional distress and individual changes in mental health symptoms.

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The authors declare that they have no conflict of interest.

Keywords

SRQ-20; Vietnam; natural disaster; epidemiology; factor analysis

Individuals exposed to natural disasters may experience threats to life and personal injury, bereavement and loss, social and community disruption, and prolonged physical hardships (Norris, Friedman, & Watson, 2002). Exposure to such stressors has been demonstrated to increase the risk of developing both physical and emotional problems, including increased expression of psychiatric conditions, health and lifestyle problems, and intrapersonal and psychosocial difficulties (e.g., Acierio et al., 2009; Norris et al., 2002). Given that disasters often affect large segments of a population, and given that the prevalence of natural disasters has increased over the past several years (Guha-Sapir, Vos, Below, & Ponslerre, 2011), postdisaster mental health has become a salient public health issue. Several large-scale epidemiological studies have demonstrated the high prevalence and significant burden to individuals, families, and larger society from mental health disorders in general (Bijl et al., 2003; Kessler et al., 2007; Ormel et al., 1994), and thus the immediate and long-term consequences of postdisaster functioning represent important areas of mental health research.

Compared with Western nations, less is known about postdisaster distress in developing nations with emerging mental health infrastructures (Amstadter et al., 2009; Norris, Friedman, & Watson, 2002; Norris, Friedman, Watson, Byrne, et al., 2002). Vietnam is a particularly disaster-prone region of Southeast Asia (United Nations Economic and Social Commission for Asia and the Pacific/United Nations International Strategy for Disaster Reduction, 2010), and yet psychiatric distress has been historically understudied in this country. Despite the government's recent efforts to address mental health as an important public health issue, countries such as Vietnam are further burdened by culturally influenced lower help-seeking behaviors, impoverishment, and a paucity of mental health treatment resources (Giang, Allebeck, Kullgren, & Nguyen, 2006; Lauber & Rössler, 2007; Maramis, Van Tuan, & Minas, 2011; Niemi, Thanh, Tuan, & Falkenberg, 2010; Saraceno et al., 2007). Thus, region-specific data on mental health burden in the community, particularly following a disaster, are important for health planning and policy making if mental health services are to be effectively provided to the Vietnamese people (Giang et al., 2006).

Postdisaster researchers have noted that cultural variables may influence the expression and reporting of posttrauma symptoms and trajectory of recovery, and psychiatric diagnostic labels such as posttraumatic stress disorder (PTSD) may be culturally irrelevant and reflect a Westernized expression of distress (Chemtob, 1996; Chen et al., 2009; Kokai, Fujii, Shinfuku, & Edwards, 2004; Scholte, Verduin, van Lammeren, Rutayisire, & Kamperman, 2011; Tang, 2007; Tuan, Harpham, & Huong, 2004; Weiss, Saraceno, Saxena, & van Ommeren, 2003). Cross-national studies of mental health have often utilized more general assessments of psychiatric distress, which can capture a range of possible culturally relevant idioms of distress. Recent work using the 20-item Self-Reporting Questionnaire (SRQ-20; Beusenberg & Orley, 1994), including work conducted in the current sample, has added to the literature suggesting unique culture-based expressions of mental distress in Vietnamese

populations (Acierno et al., 2009; Giang et al., 2006; Richardson et al., 2010; Stratton et al., 2013), but this work has not yet examined patterns of change in symptom reporting as related to trauma exposure or whether the SRQ-20 as an instrument can detect meaningful differences in levels of general distress based on pre- and posttrauma assessments. To date, psychometric studies of the SRQ-20 have relied primarily on cross-sectional analyses; indeed, there has been limited study of the longitudinal characteristics of the scale (see Scholte et al., 2011). To our knowledge, no available studies have investigated the structural stability of the SRQ-20 following a specific environmental pathogen, such as a natural disaster.

An important question for evaluating change is whether the SRQ-20 items maintain an equivalent measurement structure following trauma exposure; that is, do the items related to the latent general mental health factor function in the same way before and after a traumatic event? If the measurement structure, or invariance, of the SRQ-20 holds, analyses can focus on changes in the underlying distress factor across time, thereby providing insight into mental health status in a given sample and supporting the use of this instrument in posttrauma contexts. In general, measurement invariance testing may be used to make inferences about changes in constructs over time (e.g., Conroy, Metzler, & Hofer, 2003; Long, Harring, Brekke, Test, & Greenberg, 2007; Schaie, Maitland, Willis, & Intrieri, 1998) or about the effects of an intervention on a particular construct (e.g., Pentz & Chou, 1994; for a review, see Pitts, West, & Tein, 1996). Further, through examination of related demographic factors, measurement models can also be used to investigate latent differences and correlates of change across time and in relation to traumatic event exposure (McArdle, 2009). Due to the widespread availability, brevity, and relative ease of administration of the SRQ-20, it is vital to examine how this instrument performs as both a measure of general mental health and as a postdisaster distress screening tool.

The SRQ-20 was developed as an instrument to screen for general psychiatric disturbances (Beusenberg & Orley, 1994), and it has been found to be reliable, valid, and adaptable for screening mental disorders in many different cultural settings, especially in developing countries. In Vietnam, the SRQ-20 has demonstrated acceptable validity as a screening tool compared with in-depth psychiatric interviews, providing preliminary evidence that this instrument is an appropriate assessment of symptom expression in Vietnam (Giang et al., 2006; Tuan et al., 2004). The scale has been used to assess mental health in Vietnamese samples of female caregivers living in both urban and rural areas (Harpham, Huttly, De Silva, & Abramsky, 2005; Tuan et al., 2003; 2004), rural hospital patients and community members (Giang et al., 2006), and nontreatment-seeking online computer-gaming communities (Son, Yasuoka, Poudel, Otsuka, & Jimba, 2013). The SRQ-20 has the benefit of being a brief and easily administered measure, and further exploration of the scale's longitudinal invariance properties has the promise of supporting its use to determine symptom changes in a number of community and clinical settings.

The present study makes use of longitudinal data collected before and after a natural disaster, Typhoon Xangsane, to test whether the measurement properties of the SRQ-20 items remain consistent in how they define the underlying latent mental health construct. Further, we evaluated differences in the pre- and post-disaster reports of psychological

distress by analyzing the latent difference scores to determine how this measurement scale performs in detecting pre- and post-typhoon changes in levels of psychological distress. We examined a single-factor “General Distress” model, which is consistent with the traditional use of the SRQ–20 as a single composite variable. The primary analyses focus on models that test the invariance of the item thresholds and factor loadings pre- and post-typhoon. Our first hypothesis is that endorsement of SRQ–20 items will be higher post-typhoon compared with pre-typhoon, as evidenced by item thresholds being shifted lower (i.e., becoming more prevalent) on the latent scale. Variable changes in item thresholds (i.e., some items are endorsed more often at the second assessment period, while some items are endorsed less often) indicate inconsistencies in item functioning, whereas proportional threshold shifts (i.e., item endorsement rates that shift uniformly in the same direction) indicate one aspect of coherent item functioning. This latter condition supports unambiguous interpretations of mean differences on the latent factor, whereas the former introduces a confound when one is interpreting factor mean differences. Following exposure to a major stressor, such as a typhoon, we expected to find proportional threshold shifts wherein items are uniformly endorsed at higher rates; this condition reflects the scale's ability to measure a theoretically consistent aspect of distress. Thus, our first hypothesis examines the measurement structure of the SRQ–20 assessing the degree of invariance of the measurement model over time as well as determining the properties of “pure” individual differences in change on the general mental distress factor. Our second hypothesis is concerned with testing if changes in distress levels differentially relate to consequences of typhoon exposure when accounting for age, sex, and typhoon exposure effects. As mental health screening tools are frequently developed for use in specific populations or under specific circumstances (i.e., disaster response), it is essential to determine the robustness and integrity of an instrument's measurement properties for accurately assessing changes in mental health status and understanding how these changes relate to relevant mental health outcomes.

Method

In 2006, the Da Nang Department of Health and the Khanh Hoa Health Service, in cooperation with several nongovernmental organizations (NGOs; i.e., the Research and Training Center for Community Development, the Vietnam Veterans of America Foundation, and the Atlantic Philanthropies), conducted a mental health needs assessment of residents in their respective provinces. This epidemiological study sought to obtain prevalence data regarding general mental health problems using the SRQ–20. A full description of the data collection methods has been previously described (Acierno et al., 2009). The initial data collection occurred between August and October of 2006 (Wave 1) and was interrupted by Typhoon Xangsane, which struck Da Nang province on October 26th. Participant recruitment and interviewing were halted, and NGO study personnel consulted with the Disaster Research Education and Mentoring Center, a National Institute of Mental Health–funded research advisory group staffed by faculty from the Medical University of South Carolina and the University of Michigan to determine how the study design should be modified.

Following suggestions and training, the Vietnamese research team altered their original cross-sectional study design so that approximately 800 participants who were exposed to the

typhoon and who had been interviewed prior to the typhoon (Wave 1) could be reassessed following the typhoon (Wave 2), thereby making available predisaster and postdisaster data. Wave 2 was conducted between January 8th and January 15th, 2007, in the typhoon-exposed communes in Da Nang (21 of the originally included 28 communes from this province). Wave 1 and Wave 2 measures were peer reviewed by Vietnamese experts and consultants in the United States prior to administration.

Participants

Participants were recruited through a four-stage cluster sampling strategy. First, 30 communes were randomly selected from each province. Communes are administrative subdivisions of provinces, which are the highest structural management authority in Vietnam below the government. Second, three hamlets, or small communities of about 1,000 people, were randomly chosen at each selected commune (see Acierno et al., 2009, for a full description). All household members ages 11 and older were eligible for potential study. The final sample for the current study included 4,980 adults, ages 18 years or older.

A subsample ($n = 798$) of adults residing in Da Nang who participated in Wave 1 was surveyed again following the typhoon. The subsample was selected through a three-stage sampling strategy. First, a sample summary was compiled by pooling details of all persons ages 18 and over who were surveyed at Wave 1 and were living in one of the 21 selected communes. Next, 800 persons were randomly selected from this sample using computer randomization, resulting in the selection of an average of 38 persons at each commune. In addition, a list of 20 substitutes per commune was generated in case the index person was not available. These procedures yielded a total of 798 completed interviews; however, missing data for one participant resulted in a final Wave 2 sample size of 797.

Vietnamese lay interviewers from Da Nang and Khanh Hoa received 6 days of training, which included information regarding the purpose of the study, the research design, and the specific questionnaires, an interview training protocol, and education on depression, anxiety, alcohol abuse, sleep problems, chronic fatigue, and somatic symptoms. For Wave 2, lay interviewers were joined by eight physician interviewers. All interviewers and physicians in Wave 2 received the same training as the interviewers in Wave 1. Concordance analyses were conducted to determine potential differences in survey responses by interviewer status. There were no differences observed in rates of mental health classifications based on interviewer status as determined by bivariate reliability analyses, nor were differences found after controlling for demographic characteristics. The full report of these reliability analyses can be found elsewhere (Amstadter et al., 2010). All research practices were conducted under the approval of the Vietnamese government and the Da Nang Department of Health.

Variables

Demographics (Waves 1 and 2): Sex and age—For the analyses, sex was dummy coded, with male = 0 and female = 1.

Psychiatric distress (Waves 1 and 2)—The SRQ-20 is a self-report assessment instrument of mental health that can be administered via interview or as a paper/pencil

questionnaire. The SRQ–20 was developed to assess and screen for general aspects of nonpsychotic mental distress, and it has been found to be reliable, valid, and adaptable for screening mental disorders in many countries, including in Vietnam (Giang et al., 2006; Tuan et al., 2004). Item responses are recorded as binary (yes = 1, no = 0) and cover a 30-day recall period. Summing the individual items gives a maximum total score of 20, and results may be reported as a dichotomous *case* or *noncase*. Based on the recommendations of the literature (Harpham et al., 2003; Tuan et al., 2004), a cutoff of 7/8 (i.e., 7 = probable noncase; 8 = probable case) has been commonly reported in a range of studies conducted in developing countries and is recommended by the World Health Organization (Beusenberg & Orley, 1994). The SRQ–20 has been found to be a reliable and valid screening instrument in Vietnamese studies (Thanh, Tran, Jiang, Leenaars, & Wasserman, 2006; Tuan et al., 2004), and high internal reliability was found in the present sample (Cronbach's $\alpha = .84$).

Severity of typhoon exposure (Wave 2)—In line with prior research on hurricanes (Acierno, Ruggiero, Kilpatrick, Resnick, & Galea, 2006; Freedy, Resnick, & Kilpatrick, 1992; Freedy, Saladin, Kilpatrick, Resnick, & Saunders, 1994), typhoon exposure variables were assessed and recorded as yes/no responses to the following questions: (a) “Did you evacuate from the place you were living because of the storm?”; (b) “Did the storm damage the place you lived or other personal property?”; (c) “Were you injured during or after the storm?”; and (d) “Was any member of your family injured or killed during or after the storm?” Each item was dichotomously coded and analyzed separately (yes = 1, no = 0).

Peri-event fear rating (Wave 2)—Peri-traumatic fear has been found to predict mental health outcomes in studies of hurricane exposure (Acierno et al., 2007). Thus, peri-traumatic fear was included in the present study as assessed by the question: “How afraid were you during the typhoon that you might be killed or seriously injured by the storm?” Participants rated the item on a 4-point Likert scale (*not at all, a little, moderately, extremely afraid*).

Statistical Analyses

To test the hypothesis that endorsement of SRQ–20 items would be higher post-typhoon compared with pre-typhoon, a latent variable modeling approach using the common factor model was chosen to investigate the underlying dimensional structure of the SRQ–20. This approach allowed us to determine whether the item measurement properties remained invariant when comparing the full sample of participants assessed before the typhoon (Wave 1; $N = 4,980$) with a subset of participants who were reassessed following typhoon exposure (Wave 2; $n = 797$). In previous study of the SRQ–20 in Vietnam, exploratory factor analyses (EFA) and confirmatory factor analyses (CFA) indicated three plausible latent models for the SRQ–20 items (Stratton et al., 2013). In this study, we chose to evaluate a single-factor model for the SRQ–20 items since this model is consistent with the typical practice of summing the 20 items to form a single mental health composite variable. Therefore, this model may have the greatest utility for understanding potential applications of the scale in postdisaster contexts.

Our primary analyses focused on measurement invariance (MI) testing, which was performed on the SRQ–20 items across the two waves of assessment. MI testing can be used

to determine the consistency of item functioning across known groups (e.g., age, sex), or across time for repeated assessments of the same sample. Full MI is achieved when all the item characteristic parameters of a measurement model are statistically equivalent across groups or time (Meredith, 1993). If MI holds, then individual differences on the latent constructs are defined in the “same” way and support the practice of making meaningful and informative comparisons of the latent variables. If tests of MI fail, comparisons may be confounded with group/time-specific measurement artifacts, thereby making interpretation more difficult. Thus, the foremost goal of the present study was to determine whether participants' responses to the SRQ-20 items displayed differential functioning following typhoon exposure compared with endorsement of items before the typhoon. MI allowed us to investigate differences in individual SRQ-20 item endorsement (i.e., item thresholds), as well as the relationship between individual items and the latent construct underlying the scale (i.e., factor loadings).

MI testing can proceed in several different ways. One common form of MI testing is metric or weak factorial invariance. This refers to constraining the factor loadings to be equal across groups or over time. Additional invariance tests can be performed on the item thresholds/intercepts and residual variances, which are referred to as *strong* and *strict invariance*, respectively (Meredith & Teresi, 2006). In the present study, a test of strong factorial invariance was conducted by forcing both item factor loadings and thresholds to be equal across the assessment waves (pre- and post-typhoon). This joint multivariate test of item loadings and thresholds was conducted simultaneously because the observed SRQ-20 variables were dichotomous. In contrast to the approach in which the item factor loadings and then item intercepts are tested separately when analyzing continuous variables, joint testing has been recommended for MI testing with longitudinal binary items (Millsap, 2010). We did not impose invariance restrictions on the residual variances but did allow residuals for the same items at each of the waves to correlate when testing for factor loading and threshold invariance. This methodology was selected to take into account the across time nonindependence of the samples, as the Wave 2 data represent repeated measurement of the typhoon-exposed subset of individuals assessed in Wave 1 who were exposed to the disaster. The nonindependence of observations across time is addressed by allowing nonzero correlations between the same item residuals, reflecting an association between unique and random error components. The full measurement model is presented in Figure 1.

All model fitting was done in Mplus Version 6.1 software (Muthén & Muthén, 1998–2010) using the weighted least square mean and variance estimator to obtain parameter estimates, standard errors, and adjusted chi-square test statistic. The robust chi-square difference test was used to evaluate model–data misfit comparisons for three different MI models, which are detailed in the following text. For the evaluation of model fit, standard cutoffs for several fit goodness-of-fit indexes were also used. The root-mean-square error of approximation (RMSEA) is an index of close fit. A value of .10 or greater is considered to be marginal, .08 acceptable, and .05 or below as a good fit. Two commonly reported relative fit indexes are the Tucker–Lewis index (TLI) and comparative fit index (CFI; Hu & Bentler, 1999). Values of .95 or higher are considered to indicate adequate model fit. All model estimation was

done using the weighted least squares mean and variance adjusted estimator (WLSMV) with robust standard errors for categorical observed variables.

The model fitting proceeded as follows: first, CFA measurement models were specified for the Wave 1 and Wave 2 SRQ-20 item level data (see Figure 1). Factor loadings and thresholds were estimated separately for all items at each wave. This model served as a saturated baseline. Residual correlations were allowed for the same item across assessment waves. No covariates were included in this initial model. Next, strong measurement invariance was tested by simultaneously forcing invariance on the factor loadings and the item thresholds across Wave 1 and Wave 2. The fit of this model was compared with the baseline model as a joint multivariate test of invariance. We then completed a second invariance test that included age and sex effects on the Wave 1 and Wave 2 general factors. The covariate effects were specified to operate at the latent factor level (Figure 1) given our interest in examining effects on latent change in our sample of the same individuals assessed before and after the occurrence of a natural disaster. This model was used to test our second hypothesis, which was to determine if any of the measurement noninvariant effects detected in the first MI test were related to the effects of key demographic covariates. Third, based on the MI model-fitting results, the latent change on the common general factor across waves was examined. As shown in Figure 1, the estimation of latent individual differences was parameterized by fixing the regression of the Wave 2 common factor onto the Wave 1 factor to 1.0 and regressing the Wave 2 factor onto a new latent variable with the regression coefficient fixed to 1.0. This new latent variable represents “pure” individual differences in change that are not confounded by differential item functioning when invariance holds and when the age and sex effects are removed. For example, if the consequences of the typhoon differentially impacted the individual item characteristics (i.e., factor loadings and thresholds), this would be a component of the variability of individual differences on the latent change factor. In our measurement model, the latent difference factor is allowed to correlate with the initial level of distress at Wave 1, which indicates how initial status on the general factor is associated with individual differences in change with potential sources of confounding due to differential SRQ-20 item functioning (as well as age and sex linear effects) removed. This model provides a strong reference frame from which to draw inferences about individual-level changes in item endorsement as they relate to changes in mental distress on the factor following typhoon exposure. Finally, the typhoon exposure variables were included as predictors of the latent difference factor. Additional testing was performed to determine if latent distress changes were related to severity of typhoon exposure.

Results

Demographic Characteristics

The average age of participants in Wave 1 was 41.5 years ($SD = 16.3$), and the average age of participants at Wave 2 was 41.7 years ($SD = 16.5$); there were no significant differences in age between the participants assessed only in Wave 1 and the participants included at both assessment waves, $F(1, 4978) = 0.08, p = .78$. The Wave 1 sample consisted of 2,685 (53.9%) women and 2,295 (46.1%) men, and the Wave 2 sample consisted of 446 (56%)

women and 351 (44%) men; however, the pre-typhoon sample did not significantly differ from the post-typhoon sample in terms of sex, $\chi^2(1, N = 4,980) = 1.60, p = .22$. The mean SRQ-20 score at Wave 1 was 3.85 ($SD = 4.08$, range 0–20), and the mean SRQ-20 score at Wave 2 was 4.78 ($SD = 4.62$, range 0–20).

CFA of SRQ-20 Data: Pre-Typhoon and Post-Typhoon

Based on previous studies of the SRQ-20 as representing a single “general distress” factor, a CFA was conducted specifying a common factor model (hereafter referred to as the *general factor*) for the pre- and post-typhoon samples. The estimated item factor loadings at Wave 1 and Wave 2 are presented in Table 1. Items tended to be more discriminating for the post-typhoon data compared with the pre-typhoon data, as evidenced by higher post-typhoon factor loadings, on average. The Wave 1 and Wave 2 general factors correlated, $r = .63$. The residual correlations for 10 of the 20 items were significantly different from zero. The overall model fit for the baseline model (i.e., without covariates) was acceptable: CFI = .95, TLI = .94, RMSEA = .03.

Measurement Invariance Testing

Factorial invariance—Using the general common factor CFA model specified previously, we initially tested for strong factorial invariance by simultaneously forcing the item factor loadings and thresholds to be equal across the pre-typhoon and post-typhoon samples while allowing a mean and variance difference for the Wave 2 general factor. Age and sex effects were not included in these initial models. This multivariate test produced a significant robust chi-square difference test: $\chi^2 = 56.4, df = 18, p < .001$, CFI = .95, TLI = .94, RMSEA = .03. A significant test indicates that some aspects of the item-factor measurement structure of the SRQ-20 are not functioning equivalently across the two waves. However, the lack of appreciable change in the global goodness-of-fit indices suggests that the differential item functioning may be minor. A detailed summary of the items identified as being the sources of noninvariance based on the test of strong invariance are presented in Table 2.

The item thresholds indicate the location on the general factor where each item optimally discriminates among latent scores. Changes in item thresholds are largely governed by differences in the endorsement rate of the specific items. For example, decreases in item thresholds measured across time in the same sample indicate that an item is more highly endorsed at post-typhoon than at pre-typhoon (i.e., the item threshold is shifted lower on the latent scale). As seen in Table 2, for items found to be noninvariant, item thresholds tended to decrease more than expected given the expected mean change on the factor across the assessment period, reflecting disproportional increases in symptom reporting following the typhoon for these items. Notably, differences in item thresholds were most pronounced for items assessing somatic concerns, anxiety symptoms, and depressive symptoms associated with lack of interest in activities and anhedonia.

Covariate analysis—To bring in external validating information about the sample, the covariates of sex, age, and typhoon exposure variables were entered into the model to examine how conditioning the general factor on covariates influenced the MI findings. The

covariates were entered in stepwise fashion, with sex and age entered first in the model, and severity of typhoon exposure added in a second model.

Age and sex effects—When including linear age and sex effects on the Wave 1 and Wave 2 general factors, a comparison of the baseline model with the strong factorial invariant model produced a nonsignificant robust chi-square test, $\chi^2 = 16.4$, $df = 18$, $p = .57$, CFI = .93, TLI = .93, RMSEA = .03. Age and sex effects on the general factor were both significant and consistent across waves, with age showing a positive linear effect on distress levels, and females, on average, scoring approximately .25 standard deviations higher on the general distress factor compared with males. Based on these findings, it appears that age and sex covariates are impacting the MI test by way of primarily moderating the individual item threshold estimates through the general factor mean. Thus, age and sex appear to be primary features impacting misfit in the measurement models and when assessing change before and after the typhoon.

Following, we used this model with invariant factor loadings, thresholds, and age and sex effects on the Wave 1 and Wave 2 general factors to fit a latent difference score model. A latent difference score model estimates the amount of change on the general factor across the assessment waves given an equivalent measurement structure. This model produced reasonable fit indexes: CFI = .93, TLI = .93, RMSEA = .03.

There was a positive correlation ($r = .59$) between the latent difference factor and initial status at Wave 1, suggesting that individuals who were higher on the general factor at Wave 1 tended to show greater amounts of change on the general distress factor after the typhoon. The mean point estimate for the latent difference factor was a positive .26, but was not statistically different from zero when accounting for age and sex effects on the Wave 1 and Wave 2 general distress factors. We then conducted a three degree of freedom robust chi-square test in which the mean and variance of the latent difference score factor were set to zero, and the correlation with the initial level was also dropped. This test produced strong evidence of model-data misfit, $\chi^2 = 1,077.7$, $df = 3$, $p < .001$, CFI = .71, TLI = .69, RMSEA = .06, confirming the presence of significant individual differences in change on the general factor given an invariant pre- and post-typhoon measurement structure.

Severity of typhoon exposure effects—The final MI model examined the pattern of effects of the severity of typhoon exposure variables on individual differences in the SRQ-20 latent distress change factor. This model regresses the latent difference score factor onto the binary and ordinal post-typhoon exposure variables. An overall test of no effects of the four typhoon exposure variables and the peri-traumatic fear question was statistically significant, $\chi^2 = 59.8$, $df = 5$, $p < .001$, CFI = .91, TLI = .90, RMSEA = .04. The latent difference variance accounted for by the five exposure covariates was $R^2 = .18$. All effects were positive. However, only two of the four binary typhoon exposure variables (evacuation and personal injury) were statistically significant from zero. Those reporting being evacuated ($\beta = .20$, $p < .05$), or suffering personal injury ($\beta = .36$, $p < .05$) had, on average, significantly higher levels of distress change compared with those who did not. There was a significant positive linear effect for ratings of experiencing fear during the typhoon and the magnitude of change in distress level, $\beta = .26$, $p < .001$. Also noteworthy is that the

significant sex effects on the Wave 1 and Wave 2 general factors were no longer significant when including the effects of the typhoon exposure variables that were allowed to correlate with sex and age. Age effects, however, remained unchanged. This suggests that sex differences were also present for the typhoon exposure variables. Indeed, analysis of group differences showed that women, compared with men, were more likely to report being “moderately” or “extremely” afraid during the typhoon, $\chi^2(4, N = 797) = 1.60, p < .001$, and to report being evacuated following the typhoon, $\chi^2(1, N = 795) = 4.50, p < .05$. Women and men showed no statistically significant differences in terms of typhoon-related injury to self or others, or experiencing damaged property.

Discussion

The current study had two primary aims. The first was to examine the degree of invariance of the SRQ-20 factor structure in a sample of Vietnamese adults assessed before and after exposure to an acute traumatic event. By analyzing the latent structure of the SRQ-20 items across time with a natural disaster intervening between the assessment periods, we were able to examine the SRQ-20's ability to measure differences in levels of psychiatric distress from predisaster to postdisaster contexts. Second, this unique data set allowed us the opportunity to use the structural functioning of the SRQ-20 in a novel application of latent modeling to broaden our understanding of how established psychiatric assessments may be used as screening tools in the wake of trauma. Through the estimation of a latent difference score model, we were able to evaluate how individual differences in item endorsement patterns related to the general factor pre- and posttrauma. Thus, we were able to estimate individual differences in changes in reported mental distress following exposure to a natural disaster and to show how these changes were moderated by age and sex when estimating differences for certain typhoon exposure characteristics.

We first utilized a latent variable modeling approach to examine MI using two aspects of invariance testing on the SRQ-20 data: item factor loading and threshold invariance. When testing for the invariance of the SRQ-20 item thresholds and factor loadings at Wave 1 and Wave 2, evidence for measurement noninvariance was detected. As we expected, some of the individual items were found to relate differently to the general factor at the pre-typhoon and post-typhoon assessment periods. These preliminary MI models identified differences in SRQ-20 symptom functioning from Wave 1 to Wave 2, indicating that some of the items were not measuring the general factor in the same way before and after the trauma. Due to the repeated-measures design of the study, we tentatively posited that these item-level differences in functioning could be attributed to the typhoon, which subsequently produced alterations in the nature of psychiatric distress assessment following the disaster. However, further analyses with covariates were needed to verify this hypothesis.

To test our second hypothesis that the changes in post-typhoon distress levels would be differentially related to the demographic factors of age and sex, as well as to the severity of typhoon exposure, we then examined the SRQ-20 factor structure when including covariates. In the first covariate model, the single Wave 1 and Wave 2 general factors were conditioned on the variables of participant sex and age. Here, it was found that the item measurement noninvariance detected previously was not present when allowing age and sex

effects on the Wave 1 and Wave 2 general factors. In other words, the significant noninvariant item threshold signal found in the initial full MI test was found to be associated with sex and age effects at the latent level. On average, women were more likely to be higher on the general factor than men, and there was a significant positive linear age effect. Without considering these additional covariate effects in the model, the MI test results would lead to the conclusion that the SRQ–20 was not performing comparably in Wave 1 and Wave 2, that is, that individual differences on the general factor were not being calibrated in the same way in the two assessment periods. However, findings from the first covariate model suggested that the measurement structure could be considered invariant across the two repeated assessment samples when taking into account sex and age effects at the factor level. This result suggests that demographic differences on the general factor appear to account for a portion of the differences found in the MI models across time. These covariate effects on SRQ–20 individual differences in pre- and post-typhoon latent change extend what would otherwise be a simple and more straightforward proportional shift in item endorsement due to the theorized general effects of the typhoon, as we initially hypothesized. Interestingly, results from the covariate latent difference score model suggested that individuals who were higher on the general factor at Wave 1 tended to show greater amounts of change after the typhoon. This finding may be interpreted to mean that individuals who experienced greater distress symptoms at the initial assessment showed greater reactivity and sensitivity to the impact of the typhoon.

Finally, our second covariate model examined the effects of negative environmental outcomes on the MI model in the context of sex, age, and specific disaster characteristics (i.e., severity of typhoon exposure and level of peri-typhoon fear endorsed). In this model, age remained significantly related to factor level differences; however, sex effects were no longer significant. Some of the typhoon outcomes had significant differences on the latent change factor, such that individuals who reported evacuating from their homes due to the typhoon, sustaining personal injury, or experiencing greater peri-typhoon fear showed more change in levels of distress on the SRQ–20 at Wave 2. In fact, the typhoon exposure variables appeared to mitigate the direct effect of sex on the general common factor. Results from this final MI model highlight the importance of the impact of the typhoon characteristics on SRQ–20 latent change scores and suggest that individual differences in typhoon exposure may interact with other individual risk factors (i.e., age, sex) to influence levels of postdisaster distress. In our sample, sex and several of the typhoon exposure variables were highly correlated, wherein women, compared with men, reported greater distress following the typhoon. Thus, we were able to target the specific effects of typhoon exposure, sex, and age on the latent structure of the SRQ–20 and to identify how these exogenous variables influence the relationship between the individual items and the construct they are designed to measure.

The present investigation provides support for the structural stability of the SRQ–20 in both predisaster and postdisaster contexts when age and sex are conditioned on the factor structure. Further, the results provide evidence that experiential features (e.g., perceived fear during the disaster, evacuation from one's home, personal injury) are important to consider when identifying individuals at risk for increases in psychiatric symptoms following exposure to a disaster. Our results suggest that the relationship between individuals'

perceptions of natural disasters, pre-existing levels of distress, and demographic characteristics may be a particularly important consideration when examining changes in measurement response patterns and subsequent levels of mental health status pre- to postdisaster. This pattern of findings is largely consistent with past work in disaster samples (e.g., Briere & Elliott, 2000; Meewisse, Olff, Kleber, Kitchiner, & Gersons, 2011), as well as trauma-exposed samples more broadly (e.g., Kaysen, Rosen, Bowman, & Resick, 2010; Mollica, McInnes, Pham, Smith Fawzi, & Murphy, 1998; Shih, Schell, Hambarsoomian, Belzberg, & Marshall, 2010), in which greater degree of trauma exposure is predictive of greater post-trauma psychiatric symptoms.

The finding that increasing age was associated with greater postdisaster mental distress change in the present sample contrasts with the findings of several large-scale epidemiological studies conducted among both Western and cross-national samples, in which aging was found to be a protective factor for all psychiatric diagnoses (e.g., Kessler et al., 2005; 2007), as well as protective for the development of psychiatric disorders following trauma exposure (e.g., Acierno et al., 2006). However, our result is consistent with the work of Silove and colleagues, in which older Vietnamese adults reported greater mental illness, and in particular, PTSD (Silove, Steel, Bauman, Chey, & McFarlane, 2007). It may be possible that the older individuals in this study were more severely impacted by typhoon-related consequences; for example, they may have been less able to cope with property loss or displacement. Moreover, given the sociopolitical history of Vietnam, older adults are more likely to have been exposed to the Vietnam War and its consequences, which may indicate a particular cohort effect in the present study; indeed, history of exposure to traumatic events may increase distress to subsequent stressful events (e.g., Brewin, Andrews, & Valentine, 2000; Yehuda et al., 2010). A thorough lifetime history assessment of exposure to Criterion A traumatic events was not included in the present study, and therefore, this possible explanation cannot be ruled out. Interestingly, we also found that the individuals who reported a high number of symptoms at Wave 1 tended to show an increase in symptom reporting after the typhoon, suggesting that distress during or just prior to the typhoon may serve as a vulnerability factor for poorer postdisaster functioning; this, too, is in line with previous work suggesting a relationship between past psychiatric history and posttrauma psychiatric conditions (e.g., Brewin et al., 2000). Future work investigating the patterns of risk for increased postdisaster distress among Vietnamese adults, including the effects of age and previous psychiatric functioning, could provide a more complete understanding of assessment and treatment needs in this population.

Limitations and Future Directions

This study is limited in that the SRQ-20 does not provide specific diagnoses, and the general factor was not compared with established measures of psychopathology, such as assessments for posttraumatic stress symptoms or other culturally validated mental health diagnostic tools. It is important to note that the SRQ-20 is a tool for general screening of nonpsychotic mental distress and does not assess a full range of psychiatric conditions. In particular, the SRQ-20 does not address specific symptoms associated with Western conceptualizations of PTSD, such as reexperiencing and avoidance symptoms, that may be expected following exposure to a traumatic event. Although previous findings have

indicated that PTSD may be a valid constellation of symptoms following exposure to a trauma in samples of Vietnamese adults (Silove et al., 2007), reports of PTSD prevalence among Southeast Asian refugee samples have also shown that rates of PTSD are lower for those individuals from Vietnam than for those from countries such as Cambodia and Laos (Fazel, Wheeler, & Danesh, 2005). It is crucial to consider mental and physical health symptoms in the specific cultural context, and cross-cultural surveys such as the SRQ-20 may under- or overestimate actual rates of distress in a given population. Finally, given the widespread impact of an environmental disaster with a pre-post assessment design in the present study, we make the assumption that specific typhoon exposure characteristics were the primary source of reported changes in distress. Additional posttrauma factors, such as availability of social support or other life stress, may have important contributions to postdisaster distress, particularly with regard to long-term functioning. Ongoing longitudinal studies would be helpful in elucidating the lasting effects of exposure to natural disasters, particularly in countries like Vietnam where there is high risk for recurring disasters.

Summary

The current study supplements previous cross-sectional psychometric investigations of the SRQ-20 by providing a longitudinal investigation of the factor structure following a natural disaster event. The SRQ-20 was found to retain an equivalent measurement structure pre- and post-typhoon, but only when conditioning on the key external covariates of age and sex. This suggests that general nonpsychotic mental health status changes as measured by the SRQ-20 general factor can be compared and unambiguously interpreted for the pre- and post-typhoon data. Results from this study also support the administration of the SRQ-20 in postdisaster contexts in Vietnamese samples, where it can be used to identify individuals who may be at additional risk given disaster exposure. The utility of the scale in identifying clinically significant mental distress may be further improved when responses are considered alongside a brief assessment of disaster exposure severity and age of the respondent. This finding is of significant public health relevance, particularly given that the SRQ-20 is free, publicly available, and easy to administer and score. The accurate identification of risk factors and how they may relate to changes in mental distress under postdisaster conditions can inform screening and assessment strategies in this population, particularly in situations in which rapid response and resource allocation are critical.

Acknowledgments

This research was supported by a grant from Atlantic Philanthropies to the Community Health Centers of Da Nang and Khanh Hoa, Vietnam, with personnel and technical support from the Veterans for America Foundation. Writing of this article was supported in part by the Advanced Fellowship Program in Mental Illness Research and Treatment, Office of Academic Affiliations, U.S. Department of Veterans Affairs (Kelcey J. Stratton). Special thanks to Anne Seymour for her assistance in coordinating international efforts of the research team.

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Figure 1.

Path diagram of the 20-item Self-Report Questionnaire (SRQ-20) measurement model assessing change based on pre- and post-typhoon assessment waves. Squares indicate observed variables, circles denote latent variables, one-headed arrows are regression coefficients (e.g., factor loadings, $\lambda_{1,1}$), and two-headed arrows are variances or covariances (e.g., correlation between change and initial level, $r_{1,C}$). The vertical dashed line denotes the environmental intervention in the form of Typhoon Xangsane. v = SRQ-20 items; R = item residuals: unique item variance plus random measurement error; σ^2 = variance of the latent difference scores.

Table 1

Self-Reporting Questionnaire–20 Factor Loading Estimates From a Single Common Factor Model Fit Simultaneously to the Pre-Typhoon and Post-Typhoon Samples

Item description	Wave 1 (Pre-typhoon)	Wave 2 (Post-typhoon)
1. Do you often have headaches?	0.71	0.69
2. Is your appetite poor?	0.76	0.83
3. Do you sleep badly?	0.73	0.72
4. Are you easily frightened?	0.67	0.67
5. Do your hands shake?	0.58	0.69
6. Do you feel nervous tense or worried?	0.74	0.84
7. Is your digestion poor?	0.60	0.59
8. Do you have trouble thinking clearly?	0.79	0.79
9. Do you feel unhappy?	0.77	0.74
10. Do you cry more than usual?	0.67	0.76
11. Do you find it difficult to enjoy your daily activities?	0.76	0.74
12. Do you find it difficult to make decisions?	0.76	0.80
13. Is your daily work suffering?	0.69	0.69
14. Are you unable to play a useful part in life?	0.72	0.85
15. Have you lost interest in things?	0.75	0.73
16. Do you feel that you are a worthless person?	0.79	0.81
17. Has the thought of ending your life been in your mind?	0.71	0.84
18. Do you feel tired all the time?	0.88	0.88
19. Do you have uncomfortable feelings in your stomach?	0.55	0.58
20. Are you easily tired?	0.89	0.91

Table 2

Individual Self-Reporting Questionnaire–20 Items Found to be Noninvariant Based on Strong Measurement Invariance Testing of the Pre-Typhoon and Post-Typhoon Samples

	Item description	Difference in factor loading (W1–W2)	MI factor loading	W1 threshold	W2 threshold	Difference in thresholds (W1–W2)	MI threshold	$r\chi^2$ (df) [p]
5.	Do your hands shake?	–0.11	0.59	1.25	0.98	0.27	1.21	6.5 (1) [.011]
6.	Do you feel nervous tense or worried?	–0.10	0.75	0.49	0.21	0.28	0.46	7.1 (1) [.001]
7.	Is your digestion poor?	0.01	0.59	0.69	0.67	0.02	0.71	5.7 (1) [.016]
11.	Do you find it difficult to enjoy your daily activities?	0.02	0.75	1.04	0.99	0.05	1.07	6.9 (1) [.001]
15.	Have you lost interest in things?	0.02	0.75	1.24	1.13	0.11	1.26	4.8 (1) [.029]

Note. W1 = Wave 1 sample; W2 = Wave 2 sample; MI = measurement invariance; $r\chi^2$ = robust chi-square; *df* = degrees of freedom for test; [p] = robust chi-square probability.