Stability of Posttraumatic Stress Reaction Factors and Their Relation to General Mental Health Problems in Children: A Longitudinal Study

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The aim of this study was to evaluate the structure of posttraumatic stress reaction factors and their relation to general mental health problems in Norwegian children exposed to the tsunami on December 26, 2004. A total of 133 children and adolescents (ages 6–17) were interviewed 10 months posttsunami using the UCLA PTSD Reaction Index, and 104 were interviewed again 2.5 years after the tsunami. Confirmatory factor analyses supported the theory of a four-factor model of intrusion, active avoidance, numbing, and arousal as a better division of symptoms than the three-factor model used in the present diagnostic criteria. The factors of intrusion and active avoidance were highly correlated 2.5 years posttsunami. This association may be due to nonspecificity in these trauma-related factors as posttraumatic stress reaction levels diminish over time. General mental health problems were highly related to arousal at both assessments, supporting the theory that some symptoms of posttraumatic stress reactions overlap with other, concurrent mental problems.

Most research on posttraumatic stress disorder (PTSD) in children has focused on increasing our understanding of what contributes to the development and maintenance of PTSD, as defined by the revised fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM–IV–TR; American Psychiatric Association [APA], 2000). However, a number of studies have raised concerns that the current definition of PTSD does not adequately describe important elements of the concept (Anthony, Lonigan, & Hecht, 1999; Kassam-Adams, Marsac, & Cirilli, 2010; Spitzer, First, & Wakefield, 2007). In addition, results from studies of child trauma victims strongly suggest that child reactions may differ in important ways from adult reactions (Carrion, Weems, Ray, & Reiss, 2002; Fletcher, 2003; Scheeringa, Zeanah, Myers, & Putman, 2003). Therefore, many researchers welcome the debate about how to define PTSD in the forthcoming DSM–5.

In the DSM–IV–TR, PTSD refers to a set of 17 symptoms that develop after exposure to an unusually severe stressor or event. Three symptom clusters are defined: intrusion (e.g., flashbacks, nightmares), avoidance/numbing (e.g., trying not to talk about the event, restricted range of affect), and hyperarousal (e.g., difficulty...
concentrating, exaggerated startle response). The current clustering of symptoms is a major concern in the ongoing debate about how to redefine PTSD. How well do the clusters differentiate between features of posttraumatic stress? More specifically, questions have been raised about whether actively avoiding stimuli associated with the trauma is part of the same PTSD features as other symptoms (e.g., intrusion or numbing) or whether active avoidance should be viewed as a separate cluster (Anthony et al., 1999; King, Leskin, King, & Weathers, 1998; Saul, Grant, & Carter, 2008).

Most studies of posttrauma stress reactions have been conducted on adult survivors of trauma. Although children demonstrate many of the same PTSD reactions as adults (Fletcher, 2003), there are developmentally related differences (Salmon & Bryant, 2002). However, studies of childhood PTSD symptoms have so far been inconclusive. For instance, differences have been reported in factor structure between younger and older adolescents (Saul et al., 2008), whereas others have found the same factor structure across age groups (Anthony et al., 1999). Another debate about diagnostic validity has been whether different diagnostic criteria are needed for children of different age groups (Carrión et al., 2002). Scheeringa and colleagues (e.g., Scheeringa et al., 2003) have argued for the need to have specific criteria for preschool children. Others have found that the current diagnostic criteria may be too rigid for children (Carrión et al., 2002; Lonigan, Anthony, & Shannon, 1998).

A literature search revealed 29 studies of PTSD’s factor structure in children or adolescents, of which 12 used confirmatory methods, 13 used exploratory methods, and four used a combination of methods (an overview of the studies is available at request). All studies comparing the present DSM–IV–TR three-factor model to other models find that alternative ways of clustering symptoms are just as well suited or better suited than the three-factor model in DSM–IV–TR (Anthony et al., 1999; Elhai, Ford, Ruggiero, & Christopher Frueh, 2009; Ford, Elhai, Ruggiero, & Frueh, 2009; Hukkelberg & Jensen, 2011; Kassam-Adams et al., 2010; Saul et al., 2008; Stewart et al., 2004), whereas absence of confirmatory comparisons of alternative models are a methodological shortcoming in most factor studies confirming the validity of the DSM–IV–TR model (Bal & Jensen, 2007; Bean, Derluyn, Eureling-Bontekoe, Broekaert, & Spinhoven, 2006; Foy, Wood, King, King, & Resnick, 1997; Hamada, Kameoka, Yanagida, & Chemtob, 2003; Wu, Chan, Hung, & Cho, 2008).

The most comprehensive study of PTSD diagnostic models in children was presented by Anthony et al. (1999). They found that an alternative three-factor model of intrusion/active avoidance, numbing, and arousal provided the best fit for their data related to PTSD in 5,664 children exposed to Hurricane Hugo. These findings were replicated in a study of 396 children who experienced hurricanes (Anthony et al., 2005). However, Anthony’s conclusions have been challenged by more recent studies of a four-factor model that separates active avoidance from numbing (hereafter called the numbing model). This four-factor model of intrusion, active avoidance, numbing, and arousal has gained support from several studies (Ford et al., 2009; Kassam-Adams et al., 2010; Saul et al., 2008; Stewart et al., 2004).

Another concern in the debate about how to define PTSD is the high comorbidity between PTSD and other mental health problems. Some features of PTSD may represent a nonspecific syndrome of psychiatric distress rather than a distinct syndrome linked to trauma exposure (Spitzer et al., 2007). For instance, recurrent and intrusive distressing recollections of the traumatic event relates more directly to the traumatic incident. In fact, some studies of children exposed to a range of possibly traumatic events have found the magnitude of the traumatic experience to be more related to symptoms of intrusion than to other PTSD symptoms (Dyregrov, Kuterovac, & Barath, 1996; Giannopoulou et al., 2006; Lonigan, Shannon, Taylor, Finch, & Salle, 1994; Najarian, Goenjian, Pelcovitz, Mandel, & Najarian, 1996). Other studies support the notion that PTSD measures nonspecific psychopathology. Some have found that symptoms of arousal are difficult to distinguish from anxiety and depression (Kolaitis et al., 2003; Lonigan et al., 1994), and others that symptoms of both intrusion and arousal are closely related to depression and general mental health problems (Goenjian et al., 1995; Kassam-Adams et al., 2010). Therefore, it has been suggested that symptom criteria that are less trauma specific should be removed from the DSM diagnosis (Ford et al., 2009; Spitzer et al., 2007).

Spitzer et al. (2007), for instance, suggested removing some of the numbing and arousal criteria that overlap with major depression and general anxiety disorder (e.g., loss of interest, difficulty sleeping, irritability, and concentration problems) in addition to one item thought to have questionable clinical validity (“Inability to recall an important aspect of the trauma”). This suggestion is supported by findings in a study by Ford et al. (2009). Others have suggested a dysphoria model, with a separate factor that includes numbing and arousal criteria that are related to depression and general anxiety in both adults (Simms, Watson, & Doebbell, 2002) and children (Elhai, Ford, et al., 2009; Hukkelberg & Jensen, 2011; Kassam-Adams et al., 2010).

In conclusion, some posttraumatic stress reaction symptoms, particularly within the increased arousal factor, may substantially overlap with other psychiatric disorders, such as depression, anxiety, and general mental...
health problems. Such nonspecificity may decrease the criteria’s validity and their ability to help clinicians to select proper treatment (Spitzer et al., 2007).

Because most studies have found that the level of posttrauma reactions diminish over time (Kronenberg et al., 2010; Silverman & La Greca, 2002), it may be reasonable to assume that the structure of reactions may also change over time, warranting studies that assess such changes. However, to our knowledge, no studies have investigated whether the factor structure of posttraumatic stress reactions in children is stable over time. In addition, clusters of symptoms may relate to trauma exposure and nonspecific psychopathology differently in the immediate aftermath of the traumatic event than in later, recovery phases. The lack of knowledge about these issues may result in incorrect diagnosis and suboptimal treatment of children with posttraumatic stress reactions. Therefore, there is a need for additional research, particularly longitudinal studies, examining the expression of posttraumatic distress.

CURRENT STUDY

The tsunami in Southeast Asia on December 26, 2004, was the deadliest in recorded history, with a death toll of approximately 230,000 people (NGDC, 2010). It is estimated that 4,000 Norwegian citizens were in the affected areas during the tsunami, most of them as tourists on Christmas vacation. The Norwegian death toll included 58 adults and 26 children. The surviving Norwegian children and families were evacuated back to their homes and communities soon after the disaster. This situation thereby provides a unique vantage point for assessing the effects of trauma after a disaster when the postdisaster environment included a minimum of secondary stressors.

After the tsunami, the Norwegian authorities initiated a research program that included the present study. One of the main findings was that the Norwegian children had relatively low levels of posttraumatic stress reactions, possibly because the secondary stressors that normally play an important role in maintaining posttrauma reactions were minimal (Jensen, Dyb, & Nygaard, 2009). The level of stress reactions also decreased over time. Whereas the initial levels of posttraumatic stress reactions were related to the magnitude of the trauma experiences, the traumatic stress reactions measured 2.5 years after the disaster were more clearly related to the children’s prior mental health problems. This interesting shift in what seemed to be important predictors for recovery from posttraumatic stress symptoms led us to examine how children’s trauma experiences and general mental health problems may be involved in posttrauma functioning and how children’s symptom patterns may change over time.

The aim of the current study was twofold. The first aim was to compare the factor structure of posttraumatic stress reactions as defined by the DSM–IV–TR (APA 2000) to two other models in a longitudinal perspective. The two alternative models used were those found to be most relevant from the review of studies of children. These were a three-factor model of intrusion/active avoidance, numbing, and arousal (Anthony et al., 1999) and a four-factor model of intrusion, active avoidance, numbing, and arousal (numbing model). The alternative models were expected to be superior to the DSM–IV–TR model. However, we did not have any preconceptions as to which one of the alternative models would be best and whether there would be differences over time.

The second aim of the study was to understand more about the relationship between factors of posttraumatic stress reactions, the levels of trauma exposure, and general mental health problems. Do some criteria measure specific trauma related reactions, whereas other criteria are nonspecific and measure general mental health problems? We hypothesized that intrusion and active avoidance symptoms would be more closely related to the magnitude of the trauma experiences than numbing and arousal, and that numbing and arousal would be more related to earlier or concurrent general mental health problems.

METHOD

Participants

This longitudinal study recruited children and their parents who responded to a questionnaire study conducted 6 to 8 months after the tsunami (Dyb, Jensen, & Nygaard, 2011). The questionnaire was sent to parents traveling with children aged 6 to 17 years who arrived at Oslo International Airport from one of the tsunami-affected countries in the first days after the disaster (N = 781 children).

The children and a parent were interviewed 10 to 11 months (T1) and 2.5 years (T2) after the tsunami. Eighty-seven parents and 142 children participated at T1, and 68 parents and 107 children participated at T2. Five of the children were excluded from the analyses due to extensive missing information about posttraumatic stress reactions, and four were excluded because they did not fulfill the exposure requirements for PTSD (diagnostic criteria A1 and A2). Hence, 133 and 104 (78.2%) children were available for analyses at T1 and T2, respectively. The mean age at T1 was 12.9 years (SD = 3.4; range = 6.5–17.5 years), and there were 72
(54.1%) girls and 61 (45.9%) boys. There was no significant age difference between genders. In 41 families, only one child participated in the study; in 35 families, two children participated; in six families, three children participated; and in one family, four children participated. Of the 84 parents participating in the interviews at T1, 75% were mothers.

Parents reported that, on average, the children were exposed to more than three of 10 exposure variables (Table 1). Most children had been in an area exposed to the tsunami (99%), had been in physical danger because of the wave (65%), or witnessed the physical injuries of others (59%). Four children (3%) had friends who died in the tsunami, and four children (3%) had family members who died. Most of the children reported that they experienced the tsunami as very frightening, with a mean above 5 on the nine items that asked about immediate subjective distress (Table 1). Many of the children reported that this was one of the most frightening experiences they had ever had (83%), that they were afraid that friends or someone in their family would die (77%), or that they were afraid that friends or someone in their family would get seriously injured (71%). Even though the children had high levels of exposure and immediate subjective distress (Table 1), only two children had scores of posttraumatic stress reactions above clinical cutoff indicative of PTSD at T1, and none did at T2. The children reported on average no more general mental health problems than what has been found in a population-based study of adolescents in Norway (Table 1, and Van Roy, Grøholt, Heyerdahl, & Clench-Aas, 2006). Analyses of the dropout group compared to participants at T2 revealed no significant differences in age, gender, exposure, immediate subjective distress, general mental health problems, or total level of posttraumatic stress reactions at T1.

**Procedure**

The Norwegian Regional Ethical Committee approved the study procedures. All parents and children signed written consent and assent forms. At 10 to 11 months after the tsunami (T1) and 2.5 years after the tsunami (T2), the children were interviewed face-to-face and alone in their homes. The interviews were semistructured and conducted by psychologists, psychiatrists, and educators trained and supervised by a doctoral-level psychologist. Children answered questions about their immediate subjective distress at T1 and about their general mental health and posttraumatic stress reactions at both T1 and T2. Information about the children's exposure and background was gathered from the parents in a questionnaire study conducted 6 to 8 months posttsunami. More comprehensive information about the study population has been previously published (Jensen et al., 2009).

**Measures**

**Tsunami exposure.** An exposure scale was developed based on information about the critical events experienced during the tsunami. The scale included the following 10 items: present in the area where the tsunami hit; in physical danger because of the wave; caught by the water; physically injured; separated from parents; witnessed injuries of others; exposed to dead bodies; exposed to other dangers; suffered from lack of water, food, or medication; and death of a close friend during the tsunami. All items were rated as yes (1) or no (0). The 10

| TABLE 1 |
|---|
| **Descriptive Statistics for the Major Study Variables at T1 and T2** |
| |
| **T1** | **T2** |
| n (%) | M | SD | Range | x | n (%) | M | SD | Range | x |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Age at Time of Tsunami** | 133 | 12.9 | (3.4) | (6.5–17.5) | .66 | 104 | 12.9 | (3.4) | (6.5–17.5) | .61 |
| **Gender** | | | | | | | | | | |
| Boy | 61 (45.9%) | 3.7 | (2.0) | (1–9) | .66 | 104 | 3.8 | (1.9) | (1–9) | .65 |
| Girl | 72 (54.1%) | 5.5 | (2.2) | (1–9) | .69 | 57 (54.8%) | 5.5 | (2.2) | (1–9) | .66 |
| **Exposure** | 133 | 14.6 | (10.1) | (0–51) | .87 | 104 | 8.8 | (7.1) | (0–33) | .82 |
| **Immediate Subjective Distress** | 133 | 10.2 | (5.0) | (0–23) | .76 | 85 | 8.9 | (5.1) | (0–31) | .61 |
| **Posttraumatic Stress Reactions** | 95 | 8.9 | (5.1) | (0–31) | .61 | 84 | 8.9 | (5.1) | (0–31) | .61 |
| **General Mental Health Problems** | 84 | 10.2 | (5.0) | (0–23) | .76 | 84 | 8.9 | (5.1) | (0–31) | .61 |
| **No. of Parents** | 84 | 68 | | | | | | | | |

*Note: Exposure was reported by the parents in the questionnaire 6 to 8 months posttsunami. Immediate subjective distress was reported by the children at T1. Posttraumatic stress reactions were measured by the total scores from children’s reports on the University of California, Los Angeles PTSD Reaction Index at T1 and T2. General mental health problems category reflects the adolescents’ answers to the Strength and Difficulty Questionnaire at T1 and T2.*

*N = 133.

*N = 104.*
exposure items were added to produce a total score of objective exposure (possible range = 1–10; Table 1).

**Immediate subjective distress and posttraumatic stress reactions.** Children’s immediate subjective distress was systematically evaluated using nine items from the first portion of the University of California, Los Angeles PTSD Reaction Index (PTSD-RI; Pynoos, Rodriguez, Steinberg, Stuber, & Frederick, 1998; Steinberg, Brymer, Decker, & Pynoos, 2004). These items examine life threat (e.g., the children’s fear that they would die) and emotional reactions experienced during or immediately after the tsunami (e.g., the feeling that this was one of the most frightening experiences they had ever had). The replies were scored as present or absent and were added to produce a total score of immediate subjective distress (possible range = 1–9). Further, the immediate subjective distress items displayed an acceptable level of internal consistency (Table 1).

The second part of the PTSD–RI is a self-reported 20-item scale assessing posttraumatic stress reactions in the past month. Responses are recorded on a 5-point Likert scale ranging from 0 (none of the time) to 4 (most of the time). Three of the items have two alternative formulations, with the higher frequency scores used to calculate the total score. Hence, 17 scores (corresponding to the 17 DSM–IV–TR PTSD symptom criteria) compose the total symptom scale score (possible range = 0–68). The PTSD–RI index is one of the most widely used instruments for assessing traumatized children and adolescents. The index has been reported to have a sensitivity of .93 and a specificity of .87 for predicting a diagnosis of PTSD, with a cut-off score of 38 (Rodriguez, Steinberg, Saltzman, & Pynoos, 2001), and the 17 scores had good internal consistency in the present sample (Table 1). The PTSD–RI was translated into Norwegian and back-translated, according to recommendations, with permission from the authors.

**General mental health problems.** The Strengths and Difficulties Questionnaire (SDQ) is widely used to screen mental health in children and adolescents (Goodman, 1997). It includes 30 statements measuring six sub-factors: emotional symptoms, conduct problems, hyperactivity, peer problems, prosocial behavior, and impact. Each statement can be answered with not true, somewhat true, or certainly true, rated 0 to 2 for negatively worded items and 2 to 0 for the five positively worded statements. The total self-reported difficulty scores, based on 20 statements in the four problem-oriented subfactors (possible range = 0–40) had an acceptable level of internal consistency (Table 1) and were used as the measure of general mental health problems. Only children older than 10 years of age completed the SDQ. The SDQ was previously translated and used in a comprehensive, population-based study of adolescents in Norway (Van Roy et al., 2006).

**Data Analyses**

Frequencies, means, and standard deviations were calculated for the descriptive data, whereas Pearson correlations were used for bivariate analyses. Histograms and normality statistics demonstrated that the variables were often positively skewed, with outliers consisting of children with the most severe symptoms. The outliers were included to represent the full range of posttraumatic stress reactions. Non-normality was taken into account using robust maximum likelihood (ML) estimation and bootstrap ML discrepancy. Missing answers on the PTSD–RI and SDQ were replaced with the person’s mean score for the other questions within the same factor when calculating mean or sum scores.

Factor structure was evaluated using confirmatory factor analyses with ML estimates. Goodness of fit indices included the comparative fit index (CFI), Tucker-Lewis index (TLI) and root-mean-square error of approximation (RMSEA). The Akaike information criterion (AIC) and chi-square statistic were used to compare models without taking into account non-normality, whereas bootstrapped ML discrepancy was used to account for non-normality. AIC and ML discrepancy considers both the fit and the complexity of the models, whereas the chi-square statistic considers only the models’ fit. The significance of differences in the chi-square statistic is presented. The best fit for AIC, chi-square, and ML discrepancy (lowest figure) was considered to indicate the superior model. All presented models (Table 2) had unconstrained intercorrelations between all factors.

Confirmatory factor analyses were conducted in two steps. First, the three models were tested separately for T1 and T2 to determine which model best represented the data. The second step was to compare the factor structure across time. Three confirmatory factor analyses, using all items from T1 and T2 in the same model, were performed. In all models, eight factors were included and intercorrelated, and error terms in the 17 items from T1 were correlated with similar terms from T2. In the first analysis, all factor loadings were unconstrained; in the second analysis, each of the 17 factor loadings was constrained to be equal across T1 and T2; and in the third analysis, the covariance between the factors was also constrained to be equal at T1 and T2. Stability across time was inferred if the
constrained models did not have worse fit indices (AIC, chi-square, and ML discrepancy) than the unconstrained model (Brown, 2006; Elhai, Palmieri, Biehn, Frueh, & Magruder, 2010).

To analyze whether the factors of posttraumatic stress reactions were related to facets of the disaster experiences or to the children’s general mental health problems, multivariate mixed effect models were used. The dependent variables were mean scores within each of the four PTSD factors (possible range = 0–4) at T1 and T2. Exposure, immediate subjective distress and general mental health problems measured at T1 were standardized and simultaneously entered as independent variables. The model was retested, using general mental health problems measured at T2 instead of at T1, to analyze concurrent comorbidity between general mental health problems and posttraumatic stress reactions at T2. Time and the independent variables were entered as fixed effects, whereas there were random effects for the family and individual levels. The possible clustering effects of including several children from the same families were thereby taken into account.

Intraclass correlation (ICC) was defined as the proportion of unexplained variance found between families. ICC was calculated by dividing unexplained variance between families, between individuals, and between individuals within the same family. A confidence interval for ICC was calculated by parametric bootstrapping, with 10,000 replications.

A significance level of .05 was used for all statistical tests. Descriptive and bivariate analyses were conducted using PASW/SPSS Version 18.0. Confirmatory factor analyses were performed using AMOS Version 18.0. Mixed effects models were analyzed using R Version 2.12.0 with the nlme and boot packages.

RESULTS

Factor Structure of Posttraumatic Stress Reactions Over Time

Based on our literature review, three models were tested (Table 2): a three-factor model of intrusion, avoidance/numbing, and arousal (DSM–IV–TR); a three-factor model of intrusion/active avoidance, numbing, and arousal (Anthony et al., 1999); and a four-factor model of intrusion, active avoidance, numbing, and arousal (numbing model).

The first step of the confirmatory factor analyses, testing the three models for T1 and T2 separately, revealed the DSM–IV–TR three-factor model to be the least supported model at both assessments (Table 3). The four-factor numbing model represented the data best at 10 months (T1), whereas the four-factor numbing

| DSM-IV–TR Criterion (Item No.) | PTSD-RI Item | Three-Factor Model (DSM–IV–TR) | Three-Factor Model (Anthony et al., 1999) | Four-Factor Model (Numbing Model) |
|-------------------------------|--------------|-------------------------------|------------------------------------------|----------------------------------|
| B1 (3) Upsetting thoughts, pictures or sounds of what happened | I | I/AA | I |
| B2 (5) Bad dreams about what happened or other bad dreams | I | I/AA | I |
| B3 (6) Living through it again | I | I/AA | I |
| B4 (2) Upset, afraid or sad in response to reminders | I | I/AA | I |
| B5 (18) Physiological reactions to reminders | I | I/AA | I |
| C1 (9) Avoiding talking, thinking or feeling about the event | AV | I/AA | AA |
| C2 (17) Staying away from people, places or things that arouse recollections of what happened | AV | I/AA | AA |
| C3 (15) Trouble remembering important parts of what happened | AV | N | N |
| C4 (7) Staying alone and not being with friends | AV | N | N |
| C5 (8) Feeling alone inside and not close to other people | AV | N | N |
| C6 (10/11) Trouble feeling happiness, love, sadness or anger | AV | N | N |
| C7 (19/21) Thinking I will not live a long life, feeling pessimistic or negative about future | AV | N | N |
| D1 (13) Trouble going to sleep, or waking up often during the night | AR | AR | AR |
| D2 (4/20) Feeling grouchy, angry, mad, or having arguments or physical fights | AR | AR | AR |
| D3 (16) Trouble concentrating or paying attention | AR | AR | AR |
| D4 (1) Watching out for danger or things that I am afraid of | AR | AR | AR |
| D5 (12) Feeling jumpy or startling easily | AR | AR | AR |

Note: DSM–IV–TR = Diagnostic and Statistical Manual of Mental Disorders (4th ed., text rev.); PTSD–RI = University of California, Los Angeles PTSD Reaction Index; AA = active avoidance; AR = arousal; AV = avoidance; I = intrusion; N = numbing.
model and the three-factor model proposed by Anthony et al. (1999) had similar fits to the data at 2.5 years (T2). Although the AIC and ML discrepancy found that the three-factor model fit the data best at T2, the chi-square statistic was slightly better for the four-factor numbing model (Table 3). All model fit indices (CFI, TLI, and RMSEA) were worse for all of the models at T2 than at T1 (Table 3). Arousal was highly correlated with intrusion (r = .84) and numbing (r = .89) at T1 in the four-factor model, and symptoms of active avoidance were increasingly more correlated with intrusive symptoms over time (r = .82 and r = .95 at T1 and T2, respectively), thus supporting the merging of these factors at T2. None of the other factors were correlated above .70 at either of the assessments.

The second step of the confirmatory analyses was to analyze changes in the preferred four-factor structure across time, using models that included items from both assessments. Invariance testing compared an unconstrained model across time with two increasingly constrained models (Table 3). However, this invariance testing across time had diverging results pertaining to invariance in factor loadings. Although the AIC and ML discrepancy indicated stability in the model factor loadings across time, the chi-square statistic indicated that the models were not stable across time. Thus, it is unclear from the invariance testing if the factor structure changed significantly from T1 to T2.

To evaluate whether questions were clustered together with other items measuring related features, factor loadings in the four-factor numbing model were evaluated. Loadings were significant (p ≤ .05) for all items at both time intervals. However, Item 15 (C3) “I have trouble remembering important parts of what happened” had factor loadings of 0.23 at T1 and 0.33 at T2 (both with p = .02). Modification indices suggest that this item was related to active avoidance at T1 (Δχ² = 6.6), whereas there were no suggested modification indices for this item at T2 (a table with factor loadings for the four-factor models is available from authors).

Child-reported posttraumatic stress reaction levels at T1 and T2 were significantly correlated (n = 104, r = .55, p < .001). All correlations between corresponding
Regression Coefficients (SE) for Predictors of Posttraumatic Stress Reaction Factors Across Time, Using Multivariate Mixed Effect Models

| Sample                  | Posttraumatic Stress Reaction Factors | Exposure   | Immediate Subjective Distress | General Mental Health Problems |
|-------------------------|--------------------------------------|------------|-------------------------------|-------------------------------|
|                         | Intrusion                            | 0.09 (0.07)| 0.22 (0.07)**                 | 0.35 (0.06)**                 |
|                         | Active avoidance                      | 0.09 (0.07)| 0.12 (0.07)                   | 0.26 (0.06)**                 |
|                         | Numbing                              | −0.04 (0.07)| 0.01 (0.07)                   | 0.28 (0.06)**                 |
|                         | Arousal                              | 0.06 (0.07)| 0.16 (0.07)**                 | 0.51 (0.06)**                 |
| Significant Difference  | None                                  | I vs. N**  |                               | I vs. Ar*                     |
|                         | Between Factors at T1                | N vs. Ar*  | AA vs. Ar***                  | N vs. Ar**                    |
|                         | Interview at T2                      | Intrusion  | 0.12 (0.08)                   | 0.11 (0.07)/0.20 (0.07)**     |
|                         | Active avoidance                      | 0.07 (0.08)| 0.03 (0.08)                   | 0.13 (0.07)/0.22 (0.07)**     |
|                         | Numbing                              | −0.10 (0.08)| 0.11 (0.08)                   | 0.11 (0.07)/0.14 (0.07)*      |
|                         | Arousal                              | 0.01 (0.08)| 0.11 (0.08)                   | 0.18 (0.07*/0.44 (0.07)**     |
| Significant Difference  | I vs. N*                             | None                                  | / I vs. Ar**                   |
|                         | Between Factors at T2                | None                                  | / AA vs. Ar***                 |
|                         | Significant Difference               | None                                  | / N vs. Ar**                   |
|                         | Within Factors Across Time           | None                                  | I**: N**: Ar***                |

Note: Dependent variables were mean scores (possible range = 0–4) within the four factors of posttraumatic stress reactions at the two assessments. Independent variables, exposure, immediate subjective distress, and general mental health problems were standardized before being simultaneously entered. Time and these independent variables were entered as fixed effects, whereas there were random effects for the family and individual levels. The figures in this table are estimates of nonstandardized regression coefficients (B) (SE in parentheses) of the predictors. I = intrusion; AA = active avoidance; N = numbing; Ar = arousal.

*General mental health problems was based on the children’s reports at T1 (n = 95) or at T2 (after slash) (n = 85).

*p ≤ .05. **p ≤ .01. ***p ≤ .001.

Factors of Posttraumatic Stress Reactions in Relation to the Levels of Traumatic Experiences and General Mental Health Problems

In accordance with the second aim of the study, the relationships between each of the four posttraumatic stress reaction factors in the preferred numbing model to the level of exposure, immediate subjective distress, and general mental health problems (SDQ) were investigated using multivariate mixed-effect models (Table 4). Posttraumatic stress reaction levels decreased for all factors over time (ΔBintrusion = −0.33, p < .001; ΔBactive avoidance = −0.38, p < .001; ΔBnumbing = −0.24, p = .001; and ΔBarousal = −0.22, p = .003). However, there were no significant differences in the degree to which each factor decreased, indicating that the factor scores tended to decrease between T1 and T2 at the same rates.

The level of exposure was not significantly related to any posttraumatic stress reaction factor at T1 or at T2 (Table 4), though the association between exposure and intrusion at T2 proved to be stronger than the association between exposure and numbing. The immediate subjective distress level was significantly related to intrusion and arousal at T1 but not related to any of the symptom clusters at T2. At T1, immediate subjective distress was related more significantly to intrusion and arousal than numbing. Exposure and immediate subjective distress were not significantly different in their relationship to any of the posttraumatic stress reaction factors at T2 compared to T1 (Table 4). Thus, the hypothesis that intrusion and active avoidance symptoms would be more related to trauma experiences than numbing and arousal was partly supported for intrusion but not for active avoidance.

General mental health problems at T1 were highly related to all posttraumatic stress reaction factors at T1 but was significantly more related to arousal than any of the other factors (Table 4). In addition, general mental health problems at T2 was significantly related to all posttraumatic stress factors at T2 but more strongly related to arousal than any of the other factors (Table 4). Using general mental health problems as a predictor of later posttraumatic stress reactions was also assessed, and general mental health problems at T1 significantly predicted levels of arousal, but not any of the other three factors, at T2 (Table 4). Thus, general mental health problems were highly related to concurrent posttraumatic stress reactions at both assessments but did not predict later posttraumatic stress reactions as well. The ICC was .10 (95% CI [.00, .26]), indicating that the effect of being from the same family was minute.
DISCUSSION

The aim of the present study was to investigate the factor structure of posttraumatic stress reactions in children, as well as the symptoms’ relation to trauma exposure and general mental health problems, from a longitudinal perspective. There were three main findings: (a) the DSM–IV–TR model was the least supported model at both time points, whereas a four-factor numbing model of intrusion, active avoidance, numbing, and arousal described the data slightly better than the other models at T1; (b) the factors of intrusion and active avoidance merged as time passed; and (c) general mental health problems were highly related to concurrent posttraumatic stress reactions, particularly arousal symptoms, at both time points.

The first finding showing a preference for a four-factor structure with intrusion, active avoidance, numbing, and arousal over other models, particularly the DSM–IV–TR model, is supported by several studies of both children (Kassam-Adams et al., 2010; Sack, Seeley, & Clarke, 1997; Saul et al., 2008; Stewart et al., 2004; Wolfe, Gentile, Michienzi, Sas, & Wolfe, 1991) and adults (Asmundson, Wright, McCreary, & Pedlar, 2003; King et al., 1998). This also lends support to a conceptual distinction between active avoidance and passive numbing. Foa, Riggs, and Gershuny (1995) suggested that victims of trauma mobilize active cognitive avoidance strategies aimed at reducing the distress associated with memories of the trauma. When such strategies fail, the affective system shuts down through a primarily automatic process, resulting in symptoms of numbing. Another explanation, which has found support in studies of adults and is starting to find support in children, is that numbing symptoms are dysphoric and related to general mental distress, and thus should not be clustered together with symptoms of active avoidance (Elhai, Ford, et al., 2009; Hukkelberg & Jensen, 2011; Simms et al., 2002). These hypotheses and the empirical findings indicate that dividing symptoms of active avoidance and numbing may be helpful when trying to understand traumatized children’s needs.

The second finding was that reactions of intrusion and active avoidance appeared to merge into one factor 2.5 years posttrauma. During the follow-up period from 10 months posttsunami to 2.5 years posttrauma, the posttraumatic stress reactions of the children in this study had diminished significantly, as expected from prior studies (Kronenberg et al., 2010; Silverman & La Greca, 2002). However, the patterns of healing from posttraumatic stress reactions may differ in regard to symptom clusters. Symptoms of intrusion and active avoidance that are more directly associated with the traumatic incident may become less pronounced and distinct over time. It is possible that the trauma victims no longer distinguish between intrusive symptoms and their strategies to actively avoid such symptoms as time passes and their level of symptoms declines. This could explain why intrusion and active avoidance merged when there were low levels of posttraumatic stress reactions at T2. This possibility is also supported by the findings of worse fit indices at T2 than at T1 (Table 3), indicating that the models of posttraumatic stress disorder do not represent the symptoms at 2.5 years after the disaster as well as at 10 to 11 months after the disaster. However, it is important to remember that the large study by Anthony et al. (1999) 3 months after Hurricane Hugo also found symptoms of intrusion and avoidance to be highly correlated in a sample that included a higher proportion of children with PTSD than in the present sample. Thus, the three-factor model of intrusion/active avoidance, numbing, and arousal may also describe samples with higher levels of reactions than found at T2 in the present sample.

Another reason for the changes in structure across time might be that the different PTSD symptoms measure different features of mental health. Thus, their relative importance may change as time passes. As suggested by Spitzer et al. (2007) and others (Simms et al., 2002), some numbing and arousal symptoms may be nonspecific and common with other mental disorders. This hypothesis was partially supported in the present study by its third finding. General mental health problems were highly related to concurrent symptoms of arousal, significantly more so than to any of the other factors. This finding supports the notion that arousal may not be a distinct feature of posttraumatic stress reactions (Ford et al., 2009; Kassam-Adams et al., 2010) and is similar to other studies’ findings that other mental health problems (e.g., trait anxiety and depression) are more related to arousal than to other factors (Kolaitis et al., 2003; Lonigan et al., 1994). As reported in other studies, characteristics of the trauma, such as immediate subjective distress, were significantly related to intrusion symptoms and to symptoms of arousal (Dyregrov et al., 1996; Giannopoulou et al., 2006; Goenjian et al., 1995; Kitayama et al., 2000; Kolaitis et al., 2003; Lonigan et al., 1994; Najarian et al., 1996; Winje & Ulvik, 1998). Thus, our findings support the hypothesis that intrusion symptoms in children are related to trauma experiences, such as immediate subjective distress, whereas arousal symptoms may overlap with symptoms of other mental ailments. However, no clear results were found for active avoidance or numbing.

There may be at least two reasons for the third finding that trauma characteristics were related to intrusion, whereas general mental health problems were related to arousal. First, the differences may reflect different psychological processes in which intrusive symptoms
and active avoidance reflect consequences of the specific trauma, whereas numbing and arousal symptoms also are mediated through and/or reflect other mental health problems. Other mental health problems (e.g., depression and anxiety) may be both a predisaster vulnerability factor for the development of PTSD (Asarnow et al., 1999; Warheit, Zimmerman, Khoury, Vega, & Gil, 1996), and/or be concurrent consequences of a disaster (O’Donnell, Creamer, & Pattison, 2004). Other mental health problems may also share some symptoms with PTSD, thus indicating a nonspecificity of the PTSD criteria (Simms et al., 2002; Spitzer et al., 2007). Low levels of posttraumatic stress reactions combined with the high correlation to general mental health problems at T2 indicate a low specificity of the diagnostic criteria. Second, the differences may reflect that the items targeting intrusion and active avoidance are phrased in relation to the traumatic incident, whereas those related to numbing and arousal are not primed to a specific event. An exception is the item “I have trouble remembering important parts of what happened” (C3), which refers directly to the possibly traumatic incident but is grouped together with items not related to the event. Other studies have defined the item as active avoidance (Sack et al., 1997) or numbing (Kassam-Adams et al., 2010; Saul et al., 2008; Stewart et al., 2004), or have excluded the item altogether (Anthony et al., 1999). It is difficult to determine if the phrasing contributes to the unclear grouping of this item, both in the present and earlier studies (Kassam-Adams et al., 2010). Few studies have studied the possible influence of differences in phrasing on the factor structure of PTSD. In a study of adults, findings were inconclusive in regard to the impact of event primers when assessing PTSD symptoms (Elhai, Engdahl, et al., 2009). To separate the effects of the psychological process from the difference in phrasing, one would need to conduct further studies using two different measurement tools on the same sample at the same time.

Limitations

This study has several limitations that must be considered when interpreting the results. First, compared to some studies of the factor structure of PTSD, we included only a small number of children. It is possible that a larger sample would have yielded more consistent results. Second, it is possible that the posttraumatic stress reaction level was too low at follow up to provide statistical validity to the factor structure. Analyses indicated that the low level of reactions at T2 was not due to dropout. This is also supported by earlier representativeness analyses of adult participants in the Norwegian tsunami research program (Hussain, Weisaeth, & Heir, 2009). Third, the study included children from the same family. Thus, clustering effects may have influenced the results from the confirmatory analyses. However, both the low ICC in the multilevel analyses and earlier findings within the present sample that siblings’ total posttraumatic stress reaction levels were unrelated (Nygaard, Jensen, & Dyb, 2010) indicate a low risk for errors due to the inclusion of more than one child per family in the present study. Fourth, victims of single traumatic events may have fewer arousal and numbing symptoms than victims of chronic or abusive stressors (Fletcher, 2003). Therefore, arousal may be more related to the trauma and thereby relatively less related to general health in children with more chronic or abusive stressors than those the children in the present study experienced. Fifth, the included children were protected against secondary adversities in a way seldom found in trauma studies, such as loss of home, schooling, displacement, and possible unemployment of parents. They probably also experienced less reminders of the disaster than children living in a disaster area. Secondary adversities (Fernando, Miller, & Berger, 2010) and reminders (Layne et al., 2010) have been found to moderate levels of posttraumatic stress reactions. It is therefore important to use caution when generalizing results from the present study to other samples.

Implications for Research, Policy, and Practice

The present study supports dividing PTSD symptoms according to a four-factor numbing model consisting of intrusion, active avoidance, numbing, and arousal, indicating that active avoidance and numbing may be two distinct features of posttraumatic stress reactions in children. This is similar to the division suggested for the DSM–5 (APA, 2011). Intrusion and active avoidance may be more highly correlated in samples with low posttraumatic stress reaction levels or as time passes after the trauma. Future research should separate the effect of time versus the effect of changes in the level of posttraumatic stress reactions.

Further research is required to examine the effects of phrasing and other priming of responders. It may be that children and adults respond differently to priming, and the effect of priming may differ depending on whether the priming occurs before all questions or as part of each question. This indicates a need for studies that examine the effect of priming on both children and adults.

Posttraumatic stress reactions, particularly arousal symptoms, were highly related to children’s concurrent general mental health problems. This finding can suggest consequences in two opposite directions. First, these results could be interpreted as supporting the removal of some of the general features, particularly arousal symptoms, from the PTSD diagnostic criteria to reduce
the overlap between PTSD and other mental ailments. However, general emotional problems may be an important clinical feature of PTSD and not primarily part of other affective disorders. Thus, instead of removing overlapping symptoms, it may be appropriate to include symptoms of general mental health problems as part of posttraumatic stress reactions, as in the current diagnostic system. Clinicians must be aware that, at present, it may be difficult to differentiate between PTSD, other diagnosable mental ailments (such as depression), and general mental health problems not specified in a diagnostic manual. Further, it may be especially difficult to understand the origin of symptoms of arousal and what they represent in children long after they have experienced a trauma. In such cases, a broader clinical assessment including an evaluation of the onset of symptoms may help differentiate between posttraumatic stress reactions and mental health problems that are not related to the traumatic experiences.

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