

A Longitudinal Study of Posttraumatic Stress Reactions in Norwegian Children and Adolescents Exposed to the 2004 Tsunami

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Objective: To investigate the prevalence of symptoms of posttraumatic stress disorder (PTSD) and factors related to level of these in children who experienced a catastrophe as tourists and were therefore able to return to the safety of their homeland.

Design: Face-to-face semistructured interviews and assessments.

Setting: Children and adults were interviewed in their homes 10 months and 2½ years after the tsunami.

Participants: A volunteer sample of adults and children aged 6 to 17 years who were exposed to the 2004 tsunami (at 10 months, 133 children and 84 parents; at 2½ years, 104 children and 68 parents).

Main Exposure: The tsunami in Southeast Asia on December 26, 2004.

Outcome Measures: University of California, Los Angeles (UCLA) PTSD Reaction Index.

Results: Two children had scores indicative of PTSD at 10 months. There was a significant decrease in symptoms after 2½ years, and no children had scores exceeding the clinical cutoff at this time. Only the death of a family member and subjective distress were independently and significantly associated with PTSD scores at 10 months, whereas sex, need for professional mental health services prior to the tsunami, and parental sick leave owing to the tsunami were independent predictors of PTSD symptoms at follow-up.

Conclusions: The children reported fewer symptoms of PTSD compared with children in other disaster studies. Predictor variables changed from disaster-related subjective distress to factors related to general mental health at follow-up. The findings indicate the importance of secondary adversities and pretrauma functioning in the maintenance of posttraumatic stress reactions.

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THE TIDAL WAVE THAT HIT the coastlines of Indonesia, Sri Lanka, and Thailand in December 2004 was devastating and caused approximately 230 000 casualties.¹ Although most of the deceased were citizens, several thousand tourists died and even more were in immediately life-threatening situations. Some of those exposed to the tsunami were children traveling with their families on Christmas vacation. It is estimated that close to 4000 Norwegian citizens were in the affected countries. Approximately one-fourth of these were children. The Norwegian death toll was 58 adults and 26 children.

The effect of trauma on children and adolescents has been studied in a wide range of situations.² There are presumed to be fewer posttraumatic stress reactions after natural disasters than after interpersonal traumas. However, the prevalence rates vary widely, with general prevalence rates for a full posttraumatic stress disorder (PTSD)

diagnosis ranging from 5% to 70%.^{3,4} Six recent studies have described children's mental health after the Southeast Asian tsunami.⁵⁻¹⁰ In all of these studies, the children were exposed to extreme circumstances, but the levels of PTSD scores varied between 6% and 57%. These studies examined posttraumatic stress reactions in children who remained in the afflicted areas or were relocated within the same country, and where the children endured hardships and life disruption long after the tsunami was over.

This article explores Norwegian children's posttraumatic stress reactions 10 months and 2½ years after the 2004 tsunami. The study was guided by an integrated conceptual model for predicting posttraumatic stress reactions in children, assuming that the factors influencing children's postdisaster stress reactions are multiple and complex.¹¹⁻¹³ The model includes characteristics of the stressor, the child, and the postdisaster environment. Based on previous research, the stressor is the first predicting factor in the model, assuming that

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Table 1. Descriptive Statistics of Participants

Characteristic	T ₁		T ₂	
	No. (%)	Mean (SD)	No. (%)	Mean (SD)
Age at time of tsunami, y	133	12.9 (3.4)	104	12.9 (3.4)
Sex				
Girl	72 (54)	...	57 (55)	...
Boy	61 (46)	...	47 (45)	...
Professional help before tsunami				
Yes	12 (10)	...	10 (11)	...
No	106 (90)	...	81 (89)	...
Parental educational level				
≤12 y	22 (28)	...	19 (30)	...
Between 12 and 16 y	30 (39)	...	20 (31)	...
>16 y	26 (33)	...	25 (39)	...
Other life events of children before tsunami	130	0.8 (0.9)	102	0.8 (0.9)
Other life events of parents before tsunami	76	1.7 (1.5)	61	1.7 (1.6)

Abbreviations: Ellipses, data not applicable; T₁, visit 10 months after tsunami; T₂, 2½ years after tsunami.

the proximity to the disaster³ and the child's subjective experience of the event^{14,15} are the most critical factors for development of posttraumatic stress reactions. The second factor in the model, preexisting child characteristics, included demographic variables of age and sex, the child's prior life events,⁵ and prior psychosocial problems. These factors do not lead to posttraumatic stress reactions, but their presence may influence risk. Higher distress scores have been reported for girls,¹⁶ and age differences have been found in some studies.^{14,16,17} The third factor was the concept of postdisaster environment. Parental posttraumatic distress, lack of perceived support from significant others, and a family environment characterized by a lack of cohesion and expressiveness was assumed to contribute to ongoing symptomatology.^{6,16,18-23}

The children in this study were evacuated soon after the catastrophe and were able to return to the safety of their country and resume normal daily living routines in school and at home. The study provides, therefore, a unique vantage point for assessing the effect of trauma caused by a natural disaster in a situation where the secondary stressors are thought to be minimal.²⁴

METHODS

PARTICIPANTS

This is a longitudinal study using interview data from 2 time periods. The children and their parents were recruited from respondents to a questionnaire sent 6 months after the tsunami to parents traveling with children aged 6 to 17 years and who arrived at Oslo International Airport from one of the tsunami-affected countries (n=781 children). Parents of 142 children consented to participate in the first interview study (T₁). Three of the children were excluded from the analysis owing to missing data, and 6 of the children were excluded because they did not fulfill exposure requirements for PTSD (objective exposure and immediate subjective distress), making 133 children and 84 parents available for analysis. The mean (SD) age of the children was 12.9 (3.4) years; 54% were girls; and there was no significant age difference between boys and girls. The children lived in all parts of the country. Of the 84 parents participating in the interviews, 75% were mothers.

In the follow-up interview (T₂) approximately 2½ years after the tsunami, 104 (78%) of the children and 68 (81%) parents participated. The demographic characteristics are shown in **Table 1**. Analyses of the dropout group compared with participants at follow-up showed no significant differences in any of the dependent or independent variables except parental education ($\chi^2=8.6$; $P=.01$).

PROCEDURE

Children (n=133) and 1 of their parents (n=84) were interviewed face-to-face separately in their homes 10 months after the tsunami (T₁), and again approximately 2½ years after the tsunami (T₂). Both interviews were semistructured and conducted by trained psychologists, psychiatrists, and educators. The interviews included open-ended questions in addition to standardized measures. The study was approved by the Norwegian Regional Ethical Committee. All parents and children signed a written consent form.

At the first interview (T₁), the children were asked questions about their subjective distress during the tsunami and questions regarding family environment. They also were asked whether they felt understood by their mother, father, siblings, other close relatives, and friends (yes=0; no=1). The parents were asked for background information and whether they or their children had experienced other major life events before the tsunami such as sudden death of close family members, their own serious physical or psychological illness, serious physical or psychological illness in a person close to the family, divorce with a high level of conflict, serious accident, violence or witnessing violence, or any other events. The questions were answered with a yes/no response and were summed to a total score of other (nontsunami) serious life events. The total score for the parent had a Cronbach α of .67. For the children, the Cronbach α was .29. The parents were also questioned about whether they had tsunami-related sick leave that lasted more than 14 days. Responses were given as yes or no (yes=0; no=1).

MEASURES

Exposure

Information on the children's level of exposure was taken from the questionnaire. Based on information about the critical events experienced during the tsunami, the following list of events re-

Table 2. Descriptive Statistics of Independent Variables Measured at T₁

Variable	No. (%)	Mean (SD)
Sum of exposure ^a	133	3.7 (2.0)
Family member(s) died in tsunami ^b	4 (3)	
Sum of subjective distress ^b	133	5.4 (2.3)
Family environment scale, cohesion ^b	131	7.5 (1.4)
Family environment scale, expressiveness ^b	130	6.1 (1.6)
Child feeling understood ^b		
Yes	113 (88)	...
No	16 (12)	...
Parental sick leave ^b		
Yes	15 (19)	...
No	64 (81)	...
Parental stress reactions (IES-R) ^b	77	26.8 (20.4)

Abbreviations: Ellipses, data not applicable; IES-R, Impact of Event Scale-Revised; T₁, visit 10 months after tsunami.

^aInformation from questionnaire at 6 months.

^bInformation from interview at T₁.

lated to the tsunami was constructed and presented: did your child experience being in the area when the tsunami struck, in physical danger due to the wave, caught by the water, physically injured, separated from parents, exposed to dead bodies, or exposed to other dangers or suffered from lack of water, food, or medication; seeing seriously injured persons; or suffering the loss of close friends during the tsunami? All items were rated as yes or no (yes=1 and no=0). The 10 exposure items had an acceptable level of internal consistency ($\alpha = .66$) and were summed to a total score of objective exposures. One question about loss of a family member was analyzed separately.

Child Subjective Distress and PTSD Symptoms

The children were interviewed about their posttraumatic stress reactions (at both T₁ and T₂) using the UCLA PTSD Reaction Index (PTSD-RI).^{25,26} Although the UCLA index often is used as a self-report instrument, in this study professionals interviewed the children face-to-face to ensure valid answers. The first part of the PTSD-RI included a systematic evaluation of the children's subjective distress and consists of 9 items describing life threat (eg, feeling afraid they would die) and emotional reactions during or immediately after the tsunami (eg, feeling that this was one of the most frightening experiences they ever had had). These items were scored as present or absent, and were summed to a total score of subjective distress. The subjective experience items showed an acceptable level of internal consistency ($\alpha = .69$).

The second part of the PTSD-RI is a self-reporting 20-item scale assessing posttraumatic stress reactions in the past month. Responses are recorded on a 5-point Likert-type frequency scale ranging from 0 ("none of the time") to 4 ("most of the time"). Three of the items have 2 alternative formulations, with the highest frequency score used to calculate the total score. Hence, 17 scores make up the total symptom scale score, corresponding to the *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition) PTSD criteria. The PTSD-RI index is one of the most widely used instruments for the assessment of traumatized children and adolescents. The index has a sensitivity of 0.93 and specificity of 0.87, with a cutoff score of 38 in community-based samples,²⁷ and test-retest reliability coefficients between 0.84 and 0.94 have been reported in children after earthquake and sniper attacks.²⁶ In this study, the Cronbach α of the total scale was .87 at T₁ and .82 at T₂.

Parental Posttraumatic Stress

Parents' stress reactions were measured by the Impact of Event Scale-Revised (IES-R)²⁸ at T₁. The IES-R consists of 22 questions regarding intrusion, avoidance, and hyperarousal and is highly correlated with other measures of PTSD.²⁹ Four possible responses of frequency were used: not at all, 0; seldom, 1; sometimes, 3; and often, 5; total sum scores were used. The total IES-R score had a Cronbach α of .93.

Family Environment

Two subscales from the Family Environment Scale³⁰ regarding family cohesion and expressiveness were administered to children at T₁. Each subscale consists of 9 statements with yes/no response categories. The Cronbach α was .59 for cohesion and .35 for expressiveness.

STATISTICAL ANALYSIS

Frequencies, means, and standard deviations were calculated for descriptive data. Independent sample *t* tests were used to compare mean PTSD symptoms, and χ^2 tests were used for categorical data. Background variables and variables measured at T₁ were used as predictor variables for PTSD scores at both T₁ and T₂. Pearson correlation and 1-way analyses of variance were used for the bivariate analyses. Stepwise multivariate linear regression analyses were applied to identify independent risk factors for symptoms of PTSD. Variables correlating significantly with PTSD scores at either of the 2 interviews were entered into the multivariate model at 4 steps. Each step had variables included in prior steps, thereby taking into account prior explained variance. No variable had tolerance below 0.5, signifying acceptable collinearity. The data were also analyzed with several other multivariate analyses, for instance, with log-transformed PTSD scores as the dependent variable, to see if the found models were stable. Owing to the high stability of the found models, these results are not shown. An α of .05 was used for all statistical tests.

RESULTS

DESCRIPTIVE STATISTICS

Exposure and Immediate Responses

On average, parents reported that the children had been exposed to approximately 4 of the 10 exposure events, as shown in **Table 2**. Most of the children had been in an area exposed to the tsunami (99%), had been in physical danger owing to the wave (65%), or had witnessed physical injuries of others (59%). Four children (3%) had relatives who died in the tsunami. All of the deceased were identified and brought home to Norway.

Most of the children reported that they experienced the tsunami as very frightening, with a mean level higher than 5 on the 9 asked items of subjective distress (Table 2). Most of the children reported that this was one of the most frightening experiences they had ever had (83%), that they were afraid that a family member or friend would die (77%), or that they were afraid that a family member or friend would be seriously injured (71%).

Table 3. Multiple Linear Regression Analysis of Factors Related to Children's PTSD Scores^a

Variable	10 mo		2½ y	
	ΔR ²	b (95% CI)	ΔR ²	b (95% CI)
Step 1: exposure	0.14 ^b		0.05	
Sum of exposure		-0.1 (-1.1 to 0.9)		0.0 (-0.9 to 0.8)
Family member died in tsunami		11.7 (0.4 to 22.9) ^c		8.4 (-0.8 to 17.6)
Sum of subjective distress		1.5 (0.7 to 2.3) ^b		0.6 (-0.1 to 1.2)
Step 2: child demographics	0.01		0.11 ^c	
Age at time of tsunami, y		-0.1 (-0.6 to 0.5)		-0.4 (-0.8 to 0.0) ^d
Sex		-3.1 (-6.7 to 0.6)		-4.5 (-7.3 to -1.6) ^c
Step 3: other preexisting characteristics	0.01		0.06 ^d	
Professional help before tsunami		-0.6 (-6.6 to 5.4)		-5.8 (-10.4 to -1.3) ^c
Other life events of children before T ₁		0.9 (-1.4 to 3.2)		0.2 (-1.5 to 1.9)
Other life events of parents before T ₁		1.0 (-0.4 to 2.5)		0.6 (-0.5 to 1.7)
Step 4: characteristics of postdisaster environment	0.02		0.11 ^c	
Family environment scale, cohesion at T ₁		-1.5 (-3.1 to 0.1)		0.3 (-0.8 to 1.5)
Family environment scale, expressiveness at T ₁		-0.5 (-1.8 to 0.8)		-0.6 (-1.5 to 0.3)
Child feeling understood at T ₁		-2.1 (-8.5 to 4.3)		3.4 (-1.1 to 7.9)
Parental sick leave at T ₁		-3.3 (-8.6 to 1.9)		-5.9 (-9.6 to -2.2) ^c
Parental stress reactions (IES-R) at T ₁		-0.0 (-0.1 to 0.1)		-0.0 (-0.1 to 0.1)

Abbreviations: CI, confidence interval; IES-R, Impact of Event Scale-Revised; PTSD, posttraumatic stress disorder; T₁, visit 10 months after tsunami.

^a Analyses were stepwise multivariate regression with pairwise deletion of missing cases. Each step included variables from prior steps, thereby taking into account variance accounted for by prior steps. The total explained variance (adjusted R²) was 17.9% at 10 months and 32.7% at 2½ years. In the final model at 10 months, including all 4 steps, the death of a family member and subjective distress were still significant. In the final model at 2½ years, the following variables were significant: death of a family member (n_{loss}=2; b=10.2; 95% CI, 1.9 to 18.5), sex (b=-4.2; 95% CI, -6.8 to -1.6), professional help before tsunami (b=-6.8; 95% CI, -11.2 to -2.5), and parental sick leave (b=-5.9; 95% CI, -9.6 to -2.2), while age was no longer significant.

^b P ≤ .001.

^c P ≤ .01.

^d P ≤ .05.

Level of PTSD Reactions

Of the 133 children, only 2 had total score higher than 38, the cut-off associated with PTSD on the PTSD-RI. The mean (SD) score was 14.6 (10.1).

At 2½ years, none of the 104 children had score higher than 38. The mean (SD) score was 8.7 (7.1), and the change in mean PTSD score was significant (95% confidence interval [CI], 3.9-7.2; df, 103; P < .001).

Variables Related to PTSD Scores at 10 Months

In the bivariate analyses, high sum of exposure to death of a family member (mean with no loss [M_{no loss}] = 14.2 vs M_{loss} = 27.8; 95% CI_{mean difference}, 3.7-23.5), high sum of subjective distress (r = 0.35; 95% CI, 0.18-0.50), parents' previous life events (r = 0.20; 95% CI, 0.03-0.37), and parental sick leave related to the tsunami (M_{sick leave} = 18.4 vs M_{not on sick leave} = 13.4; 95% CI_{mean difference}, 0.7-9.2) were significantly related to higher PTSD scores at T₁.

Only subjective distress and death of a family member were significantly related to PTSD scores at T₁ in the multivariate model (df, 110) (**Table 3**).

Variables Related to PTSD Scores at 2½ Years

In the bivariate analyses, the following factors from T₁ were found to be significantly related to higher PTSD scores for the children at T₂: a higher level of subjective distress (r = 0.20; 95% CI, 0.02-0.36), death of a family member (M_{no loss} = 8.5 vs M_{loss} = 20.0; 95% CI_{mean difference}, 1.6-21.4), being female (M_{girls} = 10.5 vs

M_{boys} = 6.6; 95% CI_{mean difference}, 1.2-6.6), receiving professional help before the tsunami (M_{received help} = 14.2 vs M_{no help} = 7.8; 95% CI_{mean difference}, 1.8-11.0), parents' previous life events (r = 0.20; 95% CI, 0.00-0.39), feeling understood (M_{felt understood} = 7.9 vs M_{felt not understood} = 13.4; 95% CI_{mean difference}, 1.5-9.5), and parental sick leave related to the tsunami (M_{parents had sick leave} = 12.8 vs M_{no parental sick leave} = 7.2; 95% CI_{mean difference}, 2.7-8.6). The PTSD scores at T₁ were highly related to PTSD scores at T₂ (r = 0.56; 95% CI, 0.41-0.68).

In the multivariate analysis, the following 3 factors from T₁ were related to higher PTSD scores for the children at T₂: being girls, receiving professional help before the tsunami, and tsunami-related parental sick leave (**Table 3**). Parental sick leave and parental stress reactions (IES-R) seemed to measure some of the same attributes of parental health (M_{parent with sick leave} = 47.4 vs M_{no parental sick leave} = 21.9; 95% CI_{mean difference in IES score}, 15.0-35.8).

COMMENT

Most of the children in this study were exposed to severe events. Approximately two-thirds were either injured, in a life-threatening situation, or had grotesque witness experiences. Some experienced traumatic bereavement. Despite the seriousness of their experiences, remarkably few were suffering from severe posttraumatic symptoms and only 2 adolescents had scores indicative of PTSD 10 months after the disaster. Not only was there quite a low level of posttraumatic stress reac-

tions at T₁, but there was a significant decrease in PTSD scores at follow-up.

The conceptual model for understanding the development and maintenance of posttraumatic stress inherent in this study included characteristics of the stressor, preexisting child characteristics, and the postdisaster environment.

The results of this study confirm the importance of the stressor in predicting PTSD. Particularly, the children's immediate subjective experience of the tsunami was a strong predictor for developing PTSD at 10 months. It appears that the fright they got during the tsunami was more important for later reactions than the actual danger of the episode. This finding is in line with other studies after the tsunami.^{5,9} However, none of these studies followed the children up for more than a short period of time. It is interesting, therefore, that in our study subjective distress did not predict PTSD levels 2½ years after the tsunami. When interpreting findings such as these it is important to keep in mind that the children's self-reports on subjective distress are always retrospective. The children's level of PTSD reactions at the time of the interview could influence how they remember their emotional reactions during the tsunami. Also, although the relationship between emotional reactions at the time of the disaster and later development of PTSD reactions seems to be clear, one must be careful not to assume a causal conclusion. It is possible that children vulnerable to exhibiting high levels of fear, panic, and confusion during a disaster also are vulnerable to developing PTSD. In our study, loss of a family member was the only objective exposure factor significantly related to PTSD scores for the children.

Preexisting factors such as receiving mental health services before the tsunami were highly related to PTSD at follow-up, but were not related to the children's PTSD scores at 10 months. This indicated that the development of posttraumatic stress over time may be less related to the traumatic event (tsunami) than to the children's general mental health. La Greca et al³¹ also found that predisaster anxiety was, in addition to exposure, strongly related to children's levels of PTSD after Hurricane Andrew.

Another preexisting factor that predicted PTSD scores at follow-up was sex, with girls having a higher risk of high PTSD scores. It is proposed that girls' excess risk appears to begin at the stage of subjective interpretation of events rather than at the stage of objective exposure.²⁴ It is possible that emotional factors and communication have a greater influence for girls than boys.

There was, however, a relationship between parental health and children's PTSD scores at follow-up, indicating that parental distress may contribute to the maintenance of children's posttraumatic stress. Other studies of disasters have also found parental mental health to be related to the development of children's PTSD.^{19,22} Family environment, measured with the Family Environment Scale, and other life events for children or parents, were not independently related to the children's PTSD scores in the present study.

The children in this study had lower levels of PTSD than expected from earlier studies on disasters, and lower than those described in 6 comparable tsunami studies in-

volving children from Sri Lanka, India, and Thailand.⁵⁻¹⁰ One reason for this may be the lack of secondary adversities that often accompany natural disasters such as loss of home, schooling, and possible unemployment of parents.¹² These children were able to quickly leave the disaster area and resume their normal lives. The fact that the children who experienced bereavement continued to experience high levels of posttraumatic stress supports this notion. For these children, the secondary effects of the tsunami and the experiencing of constant loss reminders remains long after they have returned home.

Several limitations of the study must be mentioned. The sample size is relatively low and was not large enough to analyze interaction effects. However, many of the children were severely exposed, and we have no reason to believe that the children in this study are not representative of other highly exposed children. Also, the children were not interviewed during the early phases after the tsunami or before the catastrophe. Pretrauma measures are virtually nonexistent in this line of research, for obvious reasons. Except through the question of pretrauma use of professional mental health services, the children's pretrauma functioning is therefore not known. To shed more light on the possible reasons for the low level of PTSD in this study, it would be interesting to know if the Norwegian children had a lower vulnerability level before the catastrophe, and if they had the same level of acute stress reactions as the children living in the affected areas. More assessments would also have been preferred. For instance, measuring social support and degree of disability would have strengthened the results. Also, a comprehensive diagnostic instrument for assessing PTSD, for instance, the Clinician-Administered PTSD Scale for Children and Adolescents, would have added solidity to the findings. However, because the UCLA index was administered by professionals in the field of psychology as part of the face-to-face interview as opposed to self reports, we feel confident that the scores reflect a valid representation of the children's posttraumatic stress. Furthermore, the UCLA index has not been validated for Norwegian youth. The measurement of family environment had low internal consistency. This could be an explanation for the lack of identified relation between family environment and level of PTSD. For several of the families, siblings were included in the study. Parents with more than 1 child in the study do thereby statistically influence the analyses more than parents with 1 child.

The study gives reason to believe that secondary stressors after a natural disaster play an important role in the development of posttraumatic stress in children. It may, therefore, be important for health professionals to seek to alleviate secondary stressors and help families so they can resume their normal activities as quickly as possible. The child's immediate experience of danger and threat seems to be of vital importance in developing posttraumatic stress reactions. Early assessments of children's subjective experiences may help professionals determine children at risk. Furthermore, the study suggests that children who have received mental health services prior to the trauma may also be vulnerable. Early interventions for this particular group of children should be considered. To be able to target specific children at risk,

more research is needed, particularly on the effect of secondary stressors. Comprehensive longitudinal studies are needed to confirm the causal effects of postdisaster mental health determinants.

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