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Family structure and posttraumatic stress reactions: a longitudinal study using multilevel analyses

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Abstract

Background: There is limited research on the relevance of family structures to the development and maintenance of posttraumatic stress following disasters. We longitudinally studied the effects of marital and parental statuses on posttraumatic stress reactions after the 2004 Southeast Asian tsunami and whether persons in the same households had more shared stress reactions than others.

Method: The study included a tourist population of 641 Norwegian adult citizens, many of them from families with children. We measured posttraumatic stress symptoms with the Impact of Event Scale-Revised at 6 months and 2 years post-disaster. Analyses included multilevel methods with mixed effects models.

Results: Results showed that neither marital nor parental status was significantly related to posttraumatic stress. At both assessments, adults living in the same household reported levels of posttraumatic stress that were more similar to one another than adults who were not living together. Between households, disaster experiences were closely related to the variance in posttraumatic stress symptom levels at both assessments. Within households, however, disaster experiences were less related to the variance in symptom level at 2 years than at 6 months.

Conclusions: These results indicate that adult household members may influence one another's posttraumatic stress reactions as well as their interpretations of the disaster experiences over time. Our findings suggest that multilevel methods may provide important information about family processes after disasters.

Keywords: family structure, multilevel analyses, posttraumatic stress reactions, PTSD, tsunami

Background

There has been increasing interest in the relevance of family factors to the development of posttraumatic stress disorder (PTSD). In particular, family functioning and intrafamily support have been considered important [1-7]. Singles may receive less family support than married persons due to lack of partner [8]. However, the impact of marital status on posttraumatic stress is ambiguous. Some studies have found married individuals to have less posttraumatic stress reactions than unmarried individuals [4,9,10], while others have found the opposite effect [11] or no relationship between the variables [12-14]. Whereas one study found that

divorced, separated, or widowed adults are at higher risk for PTSD than people who are presently married [15], another study found that this risk disappeared when controlling for other sociodemographic factors and trauma categories [16].

Few post-disaster studies have examined the effect of parental status on the development of PTSD. Parenthood may influence the risk of developing posttraumatic stress reactions through processes occurring both in the acute disaster situation [17] and post-disaster. Such an effect would be in accordance with classical developmental theories of bidirectional processes between parents and children [18,19] as well as with more contemporary developmental theories [20,21]. However, whereas several studies have found parental factors to be related to children's development of PTSD after disasters [22-25], relatively few longitudinal

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studies have investigated how parents are influenced by their children's level of posttraumatic stress reactions, and these studies have yielded discrepant results [26-29]. Furthermore, few studies have investigated whether having children relates to levels of posttraumatic stress. Studies have found that parents had higher levels of posttraumatic stress than nonparents after the Chernobyl disaster [30], after floods [8,14], and after the 9/11 attacks [31]. The effect was particularly pronounced for single parents impacted by the 9/11 attacks [32]. However, other work suggest that parenthood or being in the company of children were not risk factors for posttraumatic stress reactions after the 2004 tsunami [10,12].

An alternative method of investigating the relevance of family factors to posttraumatic stress reactions is by examining similarities in reactions within the family. We found only three studies that looked at the similarities of couples' reactions to disasters [14,33,34]. All three studies found general mental health or depression to be more similar within couples than for nonrelated adults but did not measure specific posttraumatic stress reactions. Two other studies found child siblings' posttraumatic stress reactions not to be more similar than other children's reactions [35,36], thus it is unclear if family members do actually have more similar reactions after disaster than other disaster victims. If more than one person from a family is included in a study, the participants' responses are not independent of each other. Such grouping effects may influence results [37]; therefore, it has been suggested that disaster research should take grouping into account [38]. Multilevel analysis, including mixed effect models, is such a statistical method. It takes into account that some participants come from same subgroup, and thus for example analyze both the variability between individuals and between families [37]. However, very few disaster studies have taken into account the mutual experiences and shared reactions of families when analyzing predictors of posttraumatic stress reactions [10,14,39,40]. Some resolve the problem by investigating only one participant from each household [7,31] or by using sampling weights to correct for selection bias related to number of household members [32]. Others make no adjustments to account for participants from the same household [12,33]. Thus, the question remains to what extent adult participants living in same household do have more similar reactions than other participants, and thereby are not independent observations, and how such possible grouping effects should be taken into account. This is important because the assumption of independent observations is one of the basic assumptions in standard statistical analyses.

Present study

This longitudinal study investigated posttraumatic stress reactions in Norwegian adults who experienced the tsunami as tourists in Southeast Asia on December 26, 2004. To our knowledge, this is the first longitudinal study of posttraumatic stress reactions to account for the multilevel effect of mutual households or families within the sample. We aimed to examine the relevance of family structures for adults' risk of posttraumatic stress reactions using two strategies: (1) by analyzing family structures as predictors for posttraumatic stress reactions and (2) by investigating possible similarities in reactions within families. The specific aims of the study were as follows:

To investigate differences in posttraumatic stress reactions between married participants and non-married participants

To investigate differences in posttraumatic stress reactions between parents and adults without children

To investigate, via multilevel analyses, whether adults within shared households had more similar posttraumatic stress reactions than adults from different households

Methods
Procedure
Shortly after the 2004 tsunami in Southeast Asia, Norwegian nationals who were evacuated from the disaster-stricken area were registered upon arrival in Norway. A postal questionnaire was sent to all registered persons 18 years or older ($N = 2468$) at 6 (T_1) and 24 (T_2) months post-tsunami. The questionnaire at T_1 included questions concerning exposure, posttraumatic stress reactions, marital and parental status, and other background variables [41]. The questionnaire at T_2 included questions about posttraumatic stress reactions [42]. Participants with the same address were assumed to be living in a common household. The study was approved by the Norwegian Social Science Data Services and The Regional Committee for Medical Research Ethics.

Participants
While 868 and 1170 responded at T_1 or T_2 respectively, we received questionnaires for both T_1 and T_2 from 657 respondents. Five of these were excluded due to high levels of missing data on measures of posttraumatic stress reactions, and eleven more were excluded due to missing addresses. Therefore, the final sample included 641 participants.

At T_1, 61.8% of the 641 participants had more than 12 years of education, and 75.5% were employed. There were multiple participants from the same household in 221 cases (34.5%). A total of 48.4% of the participants reported that they had traveled with a spouse or

cohabitating partner. A total of 247 (38.5%) participants reported having children under the age of 18 years at T_1; 240 participants (40.7%) reported to have responsibility for a child at time of the disaster, including 25 (4.2%) who had sole responsibility; and 310 (48.4%) reported to have traveled together with their own child, stepchild or foster child. At T_1, 70.5% were married or cohabitating, 9.4% were no longer married and 20.1% were single. A total of 50 participants changed marital status from T_1 to T_2, 27 of which were no longer married or cohabitating, and 23 participants became married/cohabiter. More descriptive information about the participants is included in Table 1.

Non-responders at T_1 were more likely than responders to have resided in less severely affected locations in Southeast Asia [41] and were more often men; however, they were similar in age to responders [43]. The most frequently reported reasons for not participating were lack of interest or time, followed by lack of relevant experiences [44]. The final sample did not differ from responders who were excluded from the analyses in family features (marital status, proportion who had children at T_1, or proportion of participants from same household) or posttraumatic stress reactions at T_1. However, the excluded responders reported a lower average level of posttraumatic stress reactions at T_2

Table 1 Descriptive statistics of the major study variables (N = 641)

Variable	n (%)/M (SD)
Number of participants from household at T_1	
One	420 (65.5%)
Two	196 (30.6%)
Three	21 (3.3%)
Four	4 (0.6%)
Mean age at time of tsunami (*SD*)	43.4 (12.9)
Sex	
Men	288 (44.9%)
Women	353 (55.1%)
Marital status at T_1	
Married or cohabitating	434 (70.5%)
Divorced, separated, or widowed	58 (9.4%)
Single	124 (20.1%)
Missing	25
Had children under 18 years of age at T_1	
No	394 (61.5%)
Yes	247 (38.5%)
Witnessed abandoned children	
No	415 (70.2%)
Yes	176 (29.8%)
Missing	50
Witnessed multiple dead bodies	
No	463 (78.9%)
Yes	124 (21.1%)
Missing	54
Caught, touched or chased by waves	
No	404 (64.0%)
Yes	227 (36.0%)
Missing	10
Death of family member or friend	
No	585 (91.3%)
Yes	56 (8.7%)
Mean immediate response of fear during tsunami (*SD*)	2.5 (1.4)[a]
Mean immediate response of helplessness during tsunami (*SD*)	2.6 (1.4)[b]
Mean posttraumatic stress reactions at T_1 (*SD*)	1.1 (0.8)
Mean posttraumatic stress reactions at T_2 (*SD*)	1.0 (0.8)

[a] *n* = 596. [b] *n* = 597.

than the analyzed sample ($M(SD)_{excluded}$ = 0.85 (0.82), $M_{included}$ = 1.05 (0.83), $t(1396)$ = 2.89, p = .004).

Measures

Exposure and immediate response to the disaster

Based on earlier work [45], questions regarding a broad spectrum of tsunami experiences were assessed in the questionnaire 6-months post-tsunami. Based on earlier evaluations of the exposure experiences as risk factors [41], four questions were included in the present study to measure exposure: whether a participant had witnessed multiple dead bodies, had witnessed abandoned children, had been caught, touched or chased by waves, or had experienced the death of a family member or friend. Each question was answered *no* (0) or *yes* (1). Two questions were used to assess immediate subjective response to the disaster: fear, and feelings of helplessness, with both items rated on a five-point scale (0 = *not at all*, 1 = *little*, 2 = *moderate*, 3 = *intense*, 4 = *extreme*). These two items represented immediate response to the disaster, corresponding to the A2 criterion for PTSD from the DSM-IV [46].

Posttraumatic stress reactions

The Impact of Event Scale - Revised (IES-R) [47] was included at both assessments to measure the level of posttraumatic stress reactions during the previous two weeks. The IES-R includes 22 items with five response alternatives (0 = *not at all*, 1 = *little*, 2 = *moderately*, 3 = *quite a bit*, 4 = *extremely*). Total mean scores were based on all items. The psychometric properties of the IES-R have been extensively evaluated and deemed acceptable, with internal consistency within subscales reported to be between .81 and .91, test-retest reliability to be between .52 and .86, and correlation with other measures of posttraumatic stress reactions to be between .53 and .57 [48]. Similar acceptable measures or reliability have been found in a Norwegian non-clinical sample [49]. The internal consistency was high in the present sample (Cronbach's α = .96 and .95 at T_1 and T_2, respectively).

Data analysis

We excluded participants who were missing more than four replies to questions about posttraumatic stress reactions. For the remaining participants, missing values for these variables were replaced using expectation maximization algorithms (EM algorithms), which took into account a participant's scores on items within the same symptom cluster, the scores of the other respondents, and the correlations between items [50]. Dropout analyses were done using χ^2-tests for categorical data and student t-tests for continuous data.

Chi-square tests were used for bivariate analyses of grouped variables. The effects of marital status and parental status on posttraumatic stress reactions were first tested with univariate mixed effects models adjusted for exposure and immediate subjective distress during the disaster. The effect of single parenthood was tested with a mixed effects model with random effects for differences between household and for individuals within household. There were no random effects regressors. Fixed effects regressors included both marital status and parental status, and also adjustment for the six questions concerning exposure and immediate subjective distress during the disaster. Mixed effects models were also used to analyze whether household members reported more similar posttraumatic stress reactions than participants from different households. The effect of household was tested with two mixed effects models, first an unadjusted model without predictors and next with a model adjusted for exposure and immediate subjective distress during the disaster. In this way, all models controlled for participants who lived in the same household. This multilevel approach means that the regression model has error terms at two levels, the individual level and the household level.

Similarity between household members is presented by intra-class correlations (ICC) computed from the random effects between and within household in the mixed effects models. ICC was calculated by dividing unexplained variance between households by the sum of unexplained variance between households and between individuals within same household. ICC can vary between 0 and 1. An ICC close to 0 indicates that household members are no more similar than other participants, whereas an ICC of 1 indicates that household members have identical responses. Confidence intervals for ICC were based on parametric bootstrapping and computed as bootstrap percentile intervals using 10,000 bootstrap replications. Bootstrapping is a general procedure that e. g. makes it possible to compute confidence intervals in cases where other methods are not easily available [51].

All tests were two-tailed, with a significance level of p ≤ .05. Statistical analyses were performed using PASW Statistics, version 18, and R, version 2.10.1, with packages nlme and boot.

Results

Marital status and parenthood

Marital status at T_1 was not related to the level of posttraumatic stress reactions at T_1 or at T_2. The mean values (SD) of IES-R at T_1 and T_2, respectively, were 1.1 (0.8) and 1.0 (0.8) for married/cohabiters, 1.1 (0.8) and 1.1 (1.0) for single persons who had been previously married, and 1.1 (0.9) and 1.0 (0.8) for single persons who had not been previously married, corresponding to an average response close to *little* on the 0-4 scale ($F(2, 515.2)$ = 0.02, p = .98 at T_1 and $F(2, 512.5)$ = 1.74, p = .18 at T_2).

Furthermore, parents at T_1 did not differ from non-parents in their level of posttraumatic stress reactions at T_1 or at T_2. The mean values (SD) of IES-R at T_1 and T_2, respectively, were 1.2 (0.9) and 1.1 (0.8) for non-parents and 1.1 (0.8) and 1.0 (0.8) for parents ($t(503.8) = 1.77$, $p = .08$, $b(95\% \text{ CI}) = 0.10 (-0.01, 0.22)$ at T_1 and $t(469.4) = 0.91$, $p = .36$, $b(95\% \text{ CI}) = -0.06 (-0.07, 0.18)$ at T_2).

To examine whether posttraumatic stress reactions differed between single parents and couples with children, marital status (single, divorced, separated, or widowed versus couple), parenthood (having a child versus not having a child), and the interaction effect between marital status and parenthood, were entered simultaneously into mixed effects models. No significant main effects or interaction effects on posttraumatic stress reactions were found at either of the two study times.

Further analyses were conducted to investigate whether parents and non-parents differed in their exposure or immediate emotional reactions during the tsunami. Compared to non-parents, parents did not witness more abandoned children, were not taken more often by the waves, and did not feel more helplessness during the tsunami. However, parents were less likely to have witnessed multiple dead bodies ($\chi^2(1, N = 587) = 5.38$, $p = .02$), were more likely to have lost family or friends in the tsunami ($\chi^2(1, N = 641) = 8.97$, $p = .003$), and felt more fear during the tsunami ($t(505.2) = 2.39$, p = .02, $b(95\% \text{ CI}) = 0.28 (0.05, 0.52)$).

Mutual household

At both time points, adults from the same household reported more similar levels of posttraumatic stress reactions than adults from different households. The unadjusted intra-class correlation (ICC) for posttraumatic stress reactions in the mixed effects model was .53 at T_1 and .47 at T_2 (Table 2). The confidence intervals for ICC at both times were sufficiently far from zero to indicate a considerable effect of mutual household. To examine whether similarities between members of the same household could be due to a greater number of shared experiences during the tsunami, we performed mixed effects models adjusted for the six questions concerning exposure and immediate emotional responses. Similar results were found, with ICC of .56 and .35 at T_1 and T_2, respectively (Table 2).

The decrease in unadjusted and adjusted ICC from T_1 to T_2 was not significant. However, the decrease in adjusted ICC was close to significant (Table 2). This decrease was related to changes in how much tsunami experiences explained variance in posttraumatic stress reactions between individuals within families. Taking into account the disaster experiences, the unexplained variances at T_1 were reduced both at the individual level (36.0%) and at the household level (44.8%). At T_2, unexplained variance between households had decreased (48.4%), whereas unexplained variance between individuals within the same household had decreased less when taking into account the disaster experiences (9.0%) (Table 2). Thus, tsunami experiences were still related to posttraumatic stress reactions of families at T_2, but not as much to the reactions of individuals within families.

Discussion

In the present study, neither marital status nor parental status was related to the level of posttraumatic stress. Adults living in the same household had more similar levels of posttraumatic stress than adults not living together. The association between household members with regard to posttraumatic stress did not change from T_1 to T_2. Disaster experiences were associated with posttraumatic stress of individuals within families at T_1, but there was almost no such association at T_2. Thus, the impact of each family member's original disaster experiences on the level of posttraumatic stress decreased over time.

Neither single nor married parents had higher levels of posttraumatic stress reactions than adults without children. This is in accordance with findings in a similar study of Swedish tourists during the tsunami [10] and a study of Sri Lankan adults who were displaced after the tsunami [12]. However, other studies have found parenthood to be related to higher levels of reactions after a nuclear accident [30], floods [8,14], and the 9/11 attack [31]. One possible reason for the discrepant findings is that our study, like the Swedish tsunami study, examined disaster survivors who were repatriated to stable home societies; thus, parents had fewer post-tsunami worries about their children's wellbeing and future. The fact that parents experienced both more fear than non-parents and were less likely to have witnessed dead bodies may have influenced our results as well. While the parents may have been more anxious because they worried about the wellbeing of their children, they may also have protected their children and thus also themselves from witness experiences. Thus, the findings indicate that it is possible that having children may both be related to factors enhancing and factors decreasing the risk of posttraumatic stress reactions [17], with such effects possibly nullifying each other.

Marital status was not related to an elevated or reduced level of posttraumatic stress reactions. This was surprising as singles may get less family support, and social support has been found to be a major protective factor against posttraumatic stress reactions [52,53]. However, adults living in the same household had more similar levels of posttraumatic stress reactions than

Table 2 Intra-class correlations for posttraumatic stress reactions, with and without adjustments for predictors at 6 (T_1) and 24 (T_2) months post-tsunami, and differences between these times

	Without adjusting for predictors (95% CI)[a]			Adjusting for predictors (95% CI)[b]		
	T_1	T_2	Difference (T_2-T_1)	T_1	T_2	Difference (T_2-T_1)
Unexplained variance between households	0.38	0.33	-0.05	0.23	0.17	-0.06
Unexplained variance between individuals within households	0.33	0.37	0.04	0.18	0.32	0.14
Intra-class correlation	.53 (.36, .62)	.47 (.45, .68)	-.06 (-.24, .10)	.56 (.42, .69)	.35 (.17, .52)	-.21 (-.43, .005)
Change in unexplained variance between households when including predictors				-44.8%	-48.4%	
Change in unexplained variance between individuals within households when including predictors				-36.0%	-9.0%	
Total change in unexplained variance when including predictors				-41.3%	-28.2%	

Adjustment for mutual household is done by mixed method with mutual household as intercept. Dependent variable is mean posttraumatic stress reactions (IES). Intra-class correlation (ICC) is defined as the proportion of unexplained variance that is between groups (possible range 0-1). It is calculated as unexplained variance between households divided by the sum of unexplained variance between and within households. Predictors controlled for include witnessed abandoned children, witnessed multiple dead bodies, caught or chased by waves, death of family member or friend, immediate response of fear, and immediate response of helplessness.

Difference (T_2-T_1) is the difference between the two assessment points in unexplained variance and intra-class correlation.

Change in variance in analyses adjusted for predictors is the change in unexplained variance when taking into account the predictors in percentage of unexplained variance before taking into account any predictors. The percentages are different from what can be calculated from the first part of the table because the change in unexplained variance is based on models excluding participants with missing data on predictor variables (N = 550).

[a] N = 641. [b] N = 550.

adults not living in the same household, with ICC indicating that approximately half of the variation in posttraumatic stress reactions was related to differences between adults within the same household. This is consistent with theories indicating that humans in relationships influence each other and often have converging interpretations of mutual experiences [54-56]. In most natural disasters, all members of a family are exposed, and in most instances, the members of the family live together after the disaster. Therefore, not only do family members have more resemblance in their disaster experiences than unrelated people, but they will also influence each other's coping strategies, recollections, interpretations and post-disaster reactions. However, child siblings have been found to have unrelated posttraumatic stress reactions, both in the same population as the present sample and after common disaster experiences during an earthquake [35,36]. It is unclear why adult family members' reactions should be more similar than the reactions of child siblings. The difference between couples and child siblings may be age related and/or role related. Children are developmentally different from adults in how they are aware of their surroundings and their internal experiences [57]. It is also possible that couples communicate more and listen more to each other about the traumatic event and later reactions than siblings because of their cooperating role, especially their parental role. Whereas siblings may actively disagree, parents may seek cooperation and converging interpretation with their partner and co-caregiver.

We did not find any increase in household concordance of posttraumatic stress reactions from T_1 to T_2. This indicates that most of the family converging processes happened within six months of the disaster. However, the experiences during the disaster were less related to the posttraumatic stress reactions of the individuals within households at follow up than at the first assessment. These results indicate that family members influence each other's interpretations of the disaster over time. Thus, individual differences in interpretation of and reaction to the disaster diminish over time. The results thus indicate that over time, an individual's posttraumatic stress reactions may be influenced more by family members' interpretations and memories of the trauma than by actual exposure during the disaster.

Methodological considerations

This study had some methodological advantages. Almost all Norwegians who were tourists in the disaster area were invited to participate, reducing sample selection bias. The participants experienced a single, easily identifiable trauma and were largely protected from secondary adversities because they were able to quickly return to unaffected home communities. The tsunami-related processes between the persons in the household should therefore be less influenced by processes outside the household.

There was a relatively low response rate. However, due to the directionality of the dropout bias, the included participants seem to represent most of the heavily exposed Norwegian tourists in the tsunami-stricken areas [44].

The information was gathered by the use of postal questionnaires. Thus, participants from same household may have interacted during the filling out process. This may have influenced the results.

This study is limited to symptoms of posttraumatic stress. Other consequences of the disaster exposure, such as depression or functional impairment, were not analyzed or discussed. Children's levels of posttraumatic stress reactions were not controlled for in the present analyses, even though parent's and children's posttraumatic stress reactions are often related [58]. Other traumatic experiences were not taken into account [59].

The present article has evaluated marital status at first assessment as a risk factor for later posttraumatic stress reactions. Additional analyses indicated that change in marital status was not related to level of posttraumatic stress reactions (results not shown). Additional analyses (not shown) did also find that neither traveling with children nor having responsibility for children during the tsunami were related to level of posttraumatic stress reactions.

Conclusions

Adults living in the same household reported similar posttraumatic stress reactions. In addition, family members' interpretations of the disaster seemed to merge over time. This may be positive if the family moves in a favorable direction, but it indicates that for individuals who are not improving from posttraumatic stress reactions, it is important to investigate how their family interprets and perhaps contributes to the non-improving mental health. This study emphasizes the importance of a family-centered care that takes on an ecological grounded perspective when treating adults with posttraumatic stress reactions after common disaster experiences.

Methods of analysis that take into account the grouping of stress reactions within households provided valuable information about possible family processes. The study thus supports the importance of taking group levels into account when analyzing and discussing findings from studies including more than one participant from same household [38].

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Authors' contributions
EN performed the statistical analysis and drafted the manuscript. TWL performed the statistical analysis and was involved in the revision of the manuscript. AH collected data and revised the manuscript. TH participated in the conception, design, and revision of the manuscript and was the general supervisor for the project. All authors read and approved the final manuscript.

Competing interests
The authors declare that they have no competing interests.

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