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World assumptions, posttraumatic stress and quality of life after a natural disaster: A longitudinal study

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Abstract

Background: Changes in world assumptions are a fundamental concept within theories that explain posttraumatic stress disorder. The objective of the present study was to gain a greater understanding of how changes in world assumptions are related to quality of life and posttraumatic stress symptoms after a natural disaster.

Methods: A longitudinal study of 574 Norwegian adults who survived the Southeast Asian tsunami in 2004 was undertaken. Multilevel analyses were used to identify which factors at six months post-tsunami predicted quality of life and posttraumatic stress symptoms two years post-tsunami.

Results: Good quality of life and posttraumatic stress symptoms were negatively related. However, major differences in the predictors of these outcomes were found. Females reported significantly higher quality of life and more posttraumatic stress than men. The association between level of exposure to the tsunami and quality of life seemed to be mediated by posttraumatic stress. Negative perceived changes in the assumption “the world is just” were related to adverse outcome in both quality of life and posttraumatic stress. Positive perceived changes in the assumptions “life is meaningful” and “feeling that I am a valuable human” were associated with higher levels of quality of life but not with posttraumatic stress.

Conclusions: Quality of life and posttraumatic stress symptoms demonstrate differences in their etiology. World assumptions may be less specifically related to posttraumatic stress than has been postulated in some cognitive theories.

Keywords: Natural disaster, Posttraumatic stress, PTSD, Quality of life, World assumptions

Background

Natural disasters have a negative impact on individuals' mental health. Not only do disaster survivors have an increased risk of developing posttraumatic stress disorder (PTSD) [1] and other mental ailments [2], but their quality of life may also be curtailed [3-5]. Factors that increase the risk of developing PTSD include being female [6] and the severity and proximity to the disaster [1]. Social support has been identified as a protective factor [7,8]. Findings concerning the effect of age have been inconsistent [1]. Quality of life and PTSD are highly negatively related in the aftermath of natural disasters [5,9,10]. However, it is unknown whether there

are different risk factors for PTSD and decreased quality of life after natural disasters. Findings from the few studies conducted following other traumatic experiences, such as females' experience with breast cancer [11] and children's experience with traffic injuries [12], indicate that the risk and protective factors may be quite similar. However, to our knowledge, no study has compared risk factors for PTSD and decreased quality of life after natural disasters. In addition, there is a lack of investigations on changes in world assumptions after a disaster. Such changes are a fundamental concept within theories that explain PTSD.

Several theories have been presented to explain the development of and recovery from PTSD. Cognitive-oriented theories are most commonly referenced in the clinical literature and are the most fully developed and

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studied e.g., [13]. Ronnie Janoff-Bulman [14-16] has been a major theoretical contributor to the area of PTSD. She concentrated on the nature of trauma victims' pre-existing assumptions about the world and themselves that she predicted would be shattered during a traumatic event. Similar terms and concepts have been central in cognitive theories for a long time, e.g. "assumptive world" by Parkes [17], "working models" by Bowlby [18], "self-theory/world-theory" by Epstein [19] and Beck's "Cognitive Triad" with negative thoughts about the self, the world, and the future [20]. Thus, Janoff-Bulman's theories of world assumptions have a solid theoretical background. The shattering of world assumptions remains a central perspective in cognitive theories of mental health following traumatic experiences e.g., [21].

Many studies have found that people with posttraumatic stress symptoms have more negative world assumptions than people without such reactions e.g., [22-24]. For example, low self-worth has been strongly related to high levels of posttraumatic stress symptoms across different types of traumatic experiences e.g., [22,23,25-27]. Low levels of assumption of benevolence of the world or other people have been related to greater posttraumatic stress symptoms e.g., [22-26,28]. Assumptions such as meaningfulness, justice, luck, randomness, controllability, and self-control have, to a lesser degree, been related to posttraumatic stress symptoms e.g., [25-30].

According to Janoff-Bulman [14], the assumption that is most influenced by natural disasters is that of the meaningfulness of the world, followed by the assumptions of randomness and controllability. In contrast, benevolence of the world, benevolence of persons, and self-worth are more vulnerable after human-induced victimization. However, the few small studies conducted after natural disasters found that self-worth and benevolence of the world were related to the levels of posttraumatic stress symptoms [31-33].

Most studies have investigated which world assumptions people have rather than changes in their assumptions. In one study, participants who had experienced a shipping disaster were retrospectively asked about change in world assumptions following the disaster. They reported strong positive changes in their outlook on life [34]. However, the only two studies we found that investigated world assumptions over time found few [30] or no [27] changes in world assumptions from a few days after trauma until more than six months post-disaster. It is therefore difficult to determine whether world assumptions change after traumatic experiences.

The temporal relations among world assumptions, posttraumatic stress symptoms, and other mental health issues remain unresolved. Two studies that asked participants about change in world assumptions reported that negative changes were related to higher levels of

posttraumatic stress symptoms, whereas positive changes in world assumptions were not related to the level of distress [34,35]. We found only six longitudinal studies that investigated the relation between world assumptions and PTSD [26-28,30,35,36], none of which investigated samples who had experienced a natural disaster. Most of the few studies that investigated world assumptions in relation to both posttraumatic stress symptoms and other mental health aspects found that similar world assumptions were related to posttraumatic stress symptoms and other measures of mental health, such as depression, anxiety, grief, quality of life, and general mental health [23,25,27,34,35,37]. However, none of these studies found that world assumptions were more highly related to posttraumatic stress symptoms than to assessments of other mental health issues. Thus, there may not be a specific causal relation between world assumptions and posttraumatic stress symptoms, as suggested by Janoff-Bulman [14] and others [21,38]; instead, the relations may be similar to, and a reflection of, a general connection between world assumptions and mental health.

Present study: Context and aims

The tsunami in Southeast Asia on December 26, 2004 was the deadliest tsunami in recorded history, with a death toll of approximately 230,000 people [39]. An estimated 4,000 Norwegian citizens were in the affected areas during the tsunami, most of whom were tourists on Christmas vacation. The Norwegian death toll included 58 adults and 26 children. The surviving Norwegians were evacuated to their homes and communities soon after the disaster. This situation thereby provided a unique vantage point for assessing the effects of trauma after a disaster when the post-disaster environment includes minimal secondary stressors.

After the tsunami, the Norwegian authorities initiated a research program that included the present study. The main aim of the present study was to gain a greater understanding of the etiology of posttraumatic stress symptoms and quality of life after natural disasters. Three research questions were investigated. First, were quality of life and posttraumatic stress symptoms negatively related over time? Second, what perceived changes in world assumptions were reported in the aftermath of the disaster? Third, were perceived changes in world assumptions similarly related to later quality of life and posttraumatic stress symptoms?

Methods

Procedure

Shortly after the 2004 tsunami in Southeast Asia, the Norwegians who were evacuated from the disaster-stricken areas were registered upon arrival in Norway. A

postal questionnaire was sent to all registered persons 18 years or older ($N = 2,468$) at six months (T_1) and two years (T_2) post-tsunami. The questionnaire at T_1 included questions concerning level of exposure, world assumptions, quality of life, posttraumatic stress symptoms, and background information [40]. The questionnaire at T_2 included questions about quality of life and posttraumatic stress symptoms [41]. The study was approved by the Norwegian Social Science Data Services and the Regional Committee for Medical Research Ethics.

Participants

A total of 868 and 1,170 subjects responded at T_1 and T_2 , respectively. We received questionnaires for both T_1 and T_2 from 657 respondents. The final analyzed sample included 574 respondents after the exclusion of 83 respondents due to missing data. At T_1 , 63.9% of the participants had more than 12 years of education, and 75.6% were employed. There were multiple participants from the same household in 181 cases (31.5%). More descriptive information about the participants is presented in Table 1.

Non-responders at T_1 were more likely than responders to have been exposed to less severely affected locations in Southeast Asia [40] and were more often men; however, they were similar in age to responders [42]. The most frequently reported reasons for not participating in the study were lack of interest or time, followed by lack of relevant experiences [43]. The final sample did not differ from responders who were excluded from the analyses on most background features (number of participants from the same household, employment, age, or exposure), quality of life, posttraumatic stress symptoms at T_1 , or most world assumptions.

Measures

Exposure and immediate response to the disaster

Based on earlier work [44], questions regarding a broad spectrum of potential experiences during a tsunami were

Table 1 Descriptive statistics of the major study variables (N = 574)

Variable	n (%) / M (SD)
Number of participants from household	
One	393 (68.5%)
Two	156 (27.2%)
Three	21 (3.7%)
Four	4 (0.7%)
Sex	
Male	261 (45.5%)
Female	313 (54.5%)
Age at time of tsunami, years, mean (SD)	42.6 (12.7)
Exposure	
Not exposed	105 (18.3%)
Exposed, but no danger	262 (45.6%)
In danger	207 (36.1%)

Note: Demographic variables and exposure were assessed six months post-tsunami.

included in the questionnaire six months post-tsunami. Based on earlier evaluations of the exposure experiences as risk factors [40], the participants were classified into three groups of exposure severity. The “danger-exposed group” consisted of individuals who were directly exposed to the waves (and were caught or almost caught by the waves). The “non-danger-exposed group” included participants who experienced the tsunami but were not in an immediate life-threatening situation (was physically injured without direct contact with the waves, a close relative was injured, experienced fear for the safety of a relative, or witnessed others’ deaths and/or suffering). The “non-exposed group” consisted of participants who were present in Southeast Asia at the time of the tsunami but without the abovementioned exposure to the tsunami [45].

World assumptions

The participants were asked to rate the degree to which their following world assumptions were perceived to have changed post-tsunami: the feeling that I will always fare well; the world is just; the world is predictable; the world is controllable; the world is good and benevolent; life is meaningful; and the feeling that I am a valuable human. All seven statements had five response alternatives (*very weakened* = -2, *some weakening* = -1, *unchanged* = 0, *some strengthening* = 1, *very strengthened* = 2). The statements were developed for the present study to capture important features of the World Assumptions Scale [16].

Quality of life

Cantril’s vertical visual-analog scale Ladder of Life Satisfaction was used to measure quality of life at both assessment times [46]. The participants were asked to indicate which step on a 10-step ladder currently represented their life. The bottom step represented the *worst life* (1) the participant could imagine, whereas the top step represented the *best life* (10) imaginable. As measures of global quality of life, visual-analog scales have good validity and reliability [47]. At six months post-tsunami, the participants also retrospectively reported their location on the ladder one year before T_1 .

Posttraumatic stress symptoms

The Impact of Event Scale-Revised (IES-R) [48] was included at both assessments to measure the participants’ level of posttraumatic stress symptoms during the previous two weeks. The IES-R consists of 22 items with five response alternatives of degree of distress (0 = *not at all*, 1 = *a 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 [49]. The IES-R has also been found to have acceptable reliability in a Norwegian non-clinical sample [50]. The internal consistency of this

Table 2 Quality of life and posttraumatic stress symptoms at six months and two years post-disaster (N = 574)

	Six months M (SD)	Two years M (SD)	Change M (SD)	Correlation T ₁ *T ₂
Quality of life ^a	7.2 (1.9)	7.3 (1.8)	0.1 (1.6)	0.63***
Posttraumatic stress ^b	1.1 (0.8)	1.0 (0.8)	-0.1 (0.6)***	0.76***
Correlation	-0.43***	-0.46***	0.22***	

Note: Pearson's r was used for correlations, whereas the difference over time was analyzed with Student's *t*-test.

^a Ladder of Life Satisfaction.

^b Impact of Event Scale-Revised.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

measure was high in the present sample (Cronbach's $\alpha = .95$ and $.96$ at T₁ and T₂, respectively).

Data analysis

Participants who were missing more than four replies to questions about posttraumatic stress symptoms were excluded. For the remaining participants, missing values for posttraumatic stress symptoms were replaced using expectation maximization algorithms (EM algorithms) [51]. The procedures for handling of missing data were decided in advance according to previous procedures [52]. Dropout analyses were conducted using χ^2 -tests for categorical data and student *t*-tests for continuous data. Student *t*-tests and Pearson correlations were used to analyze the relation between quality of life and posttraumatic stress symptoms over time. One-sample *t*-test was used to analyze whether the reported perceived change in world assumptions was significantly different from the value of no perceived change (expected mean = 0).

There were significant similarities in mental health between individuals in the same household (intra-class correlations = .40 and .46 for quality of life and posttraumatic stress symptoms, respectively); thus, a multilevel approach was used. Mixed effects models were used to test whether quality of life and posttraumatic stress symptoms at T₂ could be predicted from information at T₁. In addition to bivariate analyses, three mixed effects models were tested for both of the dependent variables. A model without predictors (not shown) was used as the base for calculating how much variance was explained by the inclusion of the predictors. Model A included gender, age, exposure, and world assumptions as predictors. Model B included the Model A predictors and either posttraumatic stress symptoms as a predictor of later quality of life or quality of life as a predictor of later posttraumatic stress symptoms. All models controlled for participants who lived in the same household. Due to this multilevel approach, the regression model has error terms at two levels, the individual level and the household level.

All tests were two-tailed, with a significance level of $p \leq .05$. Statistical analyses were performed using PASW Statistics, version 18.

Results

The participants reported, retrospectively, that their quality of life was better prior to the tsunami (M = 7.6, SD = 1.6) than at T₁ ($t(572) = 4.12$, $p < .001$) or T₂ ($t(572) = 3.13$, $p = .002$). The quality of life and posttraumatic stress symptom reports at T₁ and T₂ are presented in Table 2. Quality of life did not change significantly from T₁ to T₂. There was a significant, although small, decrease in level of posttraumatic stress symptoms from T₁ to T₂. Concurrent quality of life and posttraumatic stress symptoms were highly related at both T₁ and T₂.

At T₁, the participants retrospectively reported a weakening in the feeling that they will always fare well. They also reported a weakening in the four assumptions about the world being just, predictable, controllable, and benevolent in the aftermath of the tsunami (each $p < .001$). On the other hand, the participants reported a strengthening of their assumptions of life as meaningful and being a valuable human (each $p < .001$) (Table 3).

Bivariate and multivariate regression analyses for the prospective prediction of quality of life and posttraumatic stress symptoms are presented in Tables 4 and 5, respectively. In general, independent variables that were positively related to better quality of life were negatively related to posttraumatic stress symptoms. Exceptions were found for gender and age. Females had both better quality of life and more posttraumatic stress symptoms than males, both in the bivariate analyses (Table 4) and in the analyses that adjusted for other variables (Table 5). Age was not significantly related to quality of life or posttraumatic stress symptoms in the bivariate analyses

Table 3 Retrospective evaluation of perceived changes in world assumptions at six months post-tsunami (N = 574)

Variable	M (SD)
Invulnerability	-0.2 (0.9)
Just world	-0.6 (0.9)
Predictable world	-0.8 (1.0)
Controllable world	-0.8 (0.9)
Good and benevolent world	-0.5 (0.9)
Meaningful life	0.4 (1.0)
Valuable person	0.3 (0.8)

Note: All means are significantly different from zero ($p \leq .001$).

Table 4 Bivariate mixed effects analyses predicting quality of life and posttraumatic stress symptoms two years post-tsunami (N = 574)

Variable	Quality of life at T ₂	Posttraumatic stress at T ₂
	b (95% CI)	b (95% CI)
Gender		
Male	-0.25 (-0.40, -0.10)***	-0.27 (-0.41, -0.12)***
Female ^a	0 (0)	0 (0)
Age	.00 (-0.00, 0.01)	.00 (-0.01, 0.01)
Exposure		
Not exposed	0.29 (0.05, 0.53)*	-1.01 (-1.24, -0.79)***
Exposed, but no danger	0.22 (0.04, 0.41)*	-0.48 (-0.67, -0.31)***
In danger ^a	0 (0)	0 (0)
Invulnerability	0.11 (0.03, 0.20)**	-0.17 (-0.26, -0.08)***
Just world	0.22 (0.12, 0.31)***	-0.29 (-0.38, -0.20)***
Predictable world	0.06 (-0.01, 0.14)	-0.11 (-0.19, -0.03)**
Controllable world	0.10 (0.02, 0.19)*	-0.24 (-0.33, -0.15)***
Good and benevolent world	0.22 (0.12, 0.31)***	-0.27 (-0.36, -0.18)***
Meaningful life	0.31 (0.23, 0.39)***	-0.09 (-0.17, -0.00)*
Valuable person	0.37 (0.27, 0.47)***	-0.04 (-0.12, 0.04)
Quality of life at T ₁	0.62 (0.55, 0.68)***	-0.40 (-0.47, 0.32)***
Posttraumatic stress T ₁	-0.34 (-0.42, -0.27)***	0.75 (0.70, 0.81)***

Note: The multilevel regression analysis was controlled for the effect of mutual address. Figures are regression coefficients (confidence intervals in parenthesis). Quality of life and posttraumatic stress symptoms were standardized (Z-values) for comparability. All predictors were measured six months post-tsunami.

^a Females and those respondents exposed to danger were set to have a mean of 0 in the mixed effect models.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

but was significantly positively associated with quality of life when other variables were taken into account.

Whereas non-exposed individuals reported better quality of life than participants who were exposed to danger (Table 4), this effect was not significant after adjusting for posttraumatic stress symptoms (Model B in Table 5). However, exposure was highly related to posttraumatic stress symptoms even after adjusting for quality of life. Thus, the effect of exposure on quality of life was potentially mediated through posttraumatic stress symptoms.

In the final models, a weakening of the world assumption “the world is just” at T₁ was related to worse quality of life and more posttraumatic stress symptoms at T₂ (Table 5). Those respondents who reported weakened assumptions about “the world as predictable” had less posttraumatic stress symptoms when controlling for other variables (Model A in Table 5). However, the change from a negative association in the bivariate model to a positive association in the multivariate analyses indicates that this effect may be an artifact from other variables entered into the model. The main difference between how posttraumatic stress symptoms and quality of life were related to world assumptions was found for the assumptions “life is meaningful” and “feeling that I am a valuable human.” Those respondents who reported more strengthening in

these two assumptions reported higher quality of life. This result was found both in the bivariate analyses and when controlling for other variables. However, there was no such association between strengthening of personal assumptions and posttraumatic stress symptoms when other variables were controlled.

Discussion

Although quality of life and posttraumatic stress symptoms were highly related, major differences in predictors were found. Gender, exposure, and world assumptions were related to quality of life in other ways than they were related to posttraumatic stress symptoms.

As reported in many other studies following natural disasters, females reported more posttraumatic stress symptoms than males [6]. However, females also reported better quality of life. This finding is similar to a population-based study in Norway [53], but contrary to studies after earthquakes in Taiwan [3,5,9] and Turkey [54], which found that females reported poorer quality of life than males. The present finding that females had better quality of life than males may be a cultural affinity rather than an effect of the tsunami experiences.

Whereas higher levels of exposure were related to more posttraumatic stress symptoms independently of quality of life, the relationship between level of exposure and quality of life seemed to be mediated through posttraumatic stress symptoms. The participants in the present study were protected against many common secondary adversities in the aftermath of disasters, such as the destruction of homes and disruption of jobs. This protection may explain why exposure was related to worse quality of life only among participants with posttraumatic stress symptoms. This finding is in contrast to studies of victims who live in a disaster-stricken area; these studies found that exposure was a risk factor for decreased quality of life, after controlling for PTSD [3,5] or depression [4].

Perceived changes in world assumptions were marginally related to later posttraumatic stress symptoms but significantly related to later quality of life. There were some differences in associations between world assumptions and the two outcomes. Whereas reported negative perceived changes in the assumption “the world is just” were related to worse outcomes in both quality of life and posttraumatic stress symptoms, only quality of life was related to perceived changes in “life is meaningful” and the “feeling that I am a valuable human.” On average, these two assumptions were reinforced, whereas the five other assumptions were weakened. Thus, positive perceived changes in assumptions about personal attributes seemed to be related to better quality of life but not to posttraumatic stress symptoms. This result is in contrast to several studies that found that self-worth was related to

Table 5 Multivariate mixed effects analyses predicting quality of life and posttraumatic stress symptoms two years post-tsunami (N = 574)

	Model A		Model B	
	Quality of life	Posttraumatic stress	Quality of life	Posttraumatic stress
<i>Fixed effects</i>				
Intercept	-0.29 (-0.61, 0.22)	0.15 (-0.16, 0.46)	-0.24 (-0.54, 0.06)	0.01 (-0.28, 0.31)
Gender				
Male	-0.25 (-0.40, -0.11)***	-0.20 (-0.35, -0.06)**	-0.36 (-0.50, -0.22)***	-0.22 (-0.35, -0.08)**
Female ^a	0 (0)	0 (0)	0 (0)	0 (0)
Age	0.01 (0.00, 0.01)*	0.00 (-0.00, 0.01)	0.01 (0.00, 0.01)**	0.01 (-0.00, 0.01)
Exposure				
Not exposed	0.27 (0.05, 0.50)*	-0.94 (-1.16, -0.72)***	-0.06 (-0.29, 0.17)	-0.80 (-1.01, -0.59)***
Exposed, but no danger	0.16 (-0.02, 0.33)	-0.41 (-0.58, -0.24)***	0.02 (-0.15, 0.19)	-0.32 (-0.48, -0.16)***
In danger ^a	0 (0)	0 (0)	0 (0)	0 (0)
Invulnerability	0.03 (-0.05, 0.12)	-0.08 (-0.17, 0.00)	-0.02 (-0.10, 0.06)	-0.04 (-0.12, 0.03)
Just world	0.18 (0.08, 0.29)***	-0.17 (-0.27, -0.06)**	0.11 (0.01, 0.22)*	-0.13 (-0.23, -0.03)*
Predictable world	-0.03 (-0.13, 0.06)	0.11 (0.01, 0.20)*	-0.03 (-0.12, 0.07)	0.09 (-0.00, 0.18)
Controllable world	-0.03 (-0.15, 0.09)	-0.09 (-0.21, 0.02)	-0.04 (-0.15, 0.07)	-0.08 (-0.19, 0.03)
Good and benevolent world	0.11 (0.00, 0.22)*	-0.11 (-0.22, -0.01)*	0.07 (-0.03, 0.18)	-0.10 (-0.20, 0.01)
Meaningful life	0.15 (0.05, 0.25)**	-0.08 (-0.18, 0.02)	0.14 (0.05, 0.24)**	-0.01 (-0.11, 0.09)
Valuable person	0.23 (0.11, 0.36)***	-0.01 (-0.13, 0.11)	0.20 (0.09, 0.32)***	0.08 (-0.04, 0.19)
Quality of life at T ₁				-0.35 (-0.42, -0.27)***
Posttraumatic stress at T ₁			-0.34 (-0.42, -0.25)***	
<i>Explained variance</i>				
Between households	32.5%	52.7%	44.8%	53.4%
Within households	7.0%	-5.0%	12.3%	11.4%
Total explained variance	17.2%	21.7%	25.3%	30.8%
<i>Model fit</i>				
AIC	1,549.66	1,529.64	1,497.33	1,461.54

Note: The multilevel regression analysis was controlled for the effect of mutual address. Figures are regression coefficients (confidence intervals in parenthesis). Quality of life and posttraumatic stress symptoms were standardized (Z-values). All predictors were measured six months post-tsunami. Model A includes all control variables (age, gender, exposure) and world assumptions. Model B also includes quality of life or posttraumatic stress symptoms at six months. The explained variance is the percentage reduction in unexplained variance as compared to a model without any independent variables. The AIC for such an empty model was 1,614.32 and 1,616.05 for quality of life and posttraumatic stress symptoms, respectively.

AIC = Akaike's information criterion.

^a Females and those respondents exposed to danger were set to have a mean of 0 in the mixed effect models.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

posttraumatic stress symptoms e.g., [22,23,25-27]. This discrepancy may be due to measurement differences because the present study investigated perceived changes in world assumptions whereas the earlier studies measured level of self-worth at the time of the assessment. Thus, the level of self-worth, rather than the change in self-worth, may be related to posttraumatic stress symptoms. The type of trauma may also differentially impact self-worth. For example, human-induced traumas such as terrorist attacks or interpersonal violence may have greater consequences for the assumptions about self-worth [14]. The lack of relationship between posttraumatic stress symptoms and perceived changes in world assumptions was in contrast to Janoff-Bulman's [14] and other cognitive theories [21,38] of reactions after trauma. The current findings suggest that world assumptions may be more related to mental health in general than to a specific process after traumatic experiences.

However, the results can also be interpreted as the participants experienced posttraumatic growth (positive perceived change in sense of self-worth and meaningfulness of life), with positive consequences for their quality of life. This interpretation would be in accordance with Janoff-

Bulman's claims that posttraumatic growth is an attempt to understand the value or meaning of trauma for one's life [55]. The world assumptions of trauma survivors may be more realistic post-trauma; at the same time, the survivors may actively concentrate more on some positive aspects of life. A positive reinterpretation of the tsunami experiences may thus buffer the effect of posttraumatic stress symptoms on quality of life [11]. However, a meta-analytic study did not find a relationship between posttraumatic growth and quality of life [56].

As found in previous disaster studies, quality of life and posttraumatic stress symptoms were highly related [5,9,10]. The strength of the relationship between posttraumatic stress symptoms at six months post-tsunami and later quality of life was similar to that of the association between quality of life at six months post-tsunami and later posttraumatic stress symptoms (Table 5). Thus, no indication of the direction of causality between these two measures of mental health was found. There is likely an interactional process through which both aspects of mental health influence each other over time. This process may also include other aspects of mental health, such as depression and anxiety [4,57].

Methodological considerations

The present study had several methodological advantages and limitations. Nearly all of the Norwegians who were in the afflicted area were invited to participate, thus reducing sample selection bias. The participants experienced a single, easily identifiable trauma and were largely protected against reminders and secondary adversities due to their return to intact homes and rather unaffected communities. Thus, the confounding features that are common in research following natural disasters were reduced.

There was a relatively low response rate. However, due to the directionality of the dropout bias, the included participants seem to represent the most heavily exposed Norwegian tourists in the tsunami-stricken areas [43].

As in most posttraumatic studies, the pre-disaster information was gathered retrospectively or was lacking. Thus, reports of pre-tsunami quality of life may have been influenced by concurrent mental health. Similarly, perceived changes in world assumptions after the tsunami may have been influenced by pre-disaster level of world assumptions and concurrent mental health. The present study investigated perceived changes in world assumptions, rather than absolute levels of world assumptions. Thus, one should be careful when comparing the results with earlier studies of levels of world assumptions.

Conclusions

Most studies on the relationship between world assumptions and posttraumatic stress symptoms have used the World Assumption Scale [16]. This scale measures concurrent levels of assumptions rather than changes in assumptions. However, theories often indicate how changes in, rather than levels of, world assumptions are related to traumatic experiences. Thus, future studies should include measures of changes in world assumptions.

Quality of life and posttraumatic stress symptoms are highly related. However, there are major differences between the factors that are related to posttraumatic stress symptoms and quality of life after disaster experiences. Thus, studies should have a broader perspective than posttraumatic stress symptoms to understand mental health-related processes after traumatic experiences.

Changes in world assumptions are a fundamental concept within cognitive theories of PTSD e.g., [21]. Findings from the present study indicate that changes in world assumptions are not as specifically related to posttraumatic stress symptoms as suggested by Janoff-Bulman [14,15] but that changes in world assumptions may be even more related to quality of life. Thus, cognitive theories of the importance of changes in world assumptions after traumatic events should in the future also include how changes in world assumptions are related to quality of life.

Abbreviations

AIC: Akaike's information criterion; IES-R: Impact of event scale-revised; PTSD: Posttraumatic stress disorder.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

EN performed the literature review, conducted the statistical analysis and drafted the manuscript. TH conceived the study and its design and contributed to the manuscript. Both authors have read and approved the final manuscript.

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