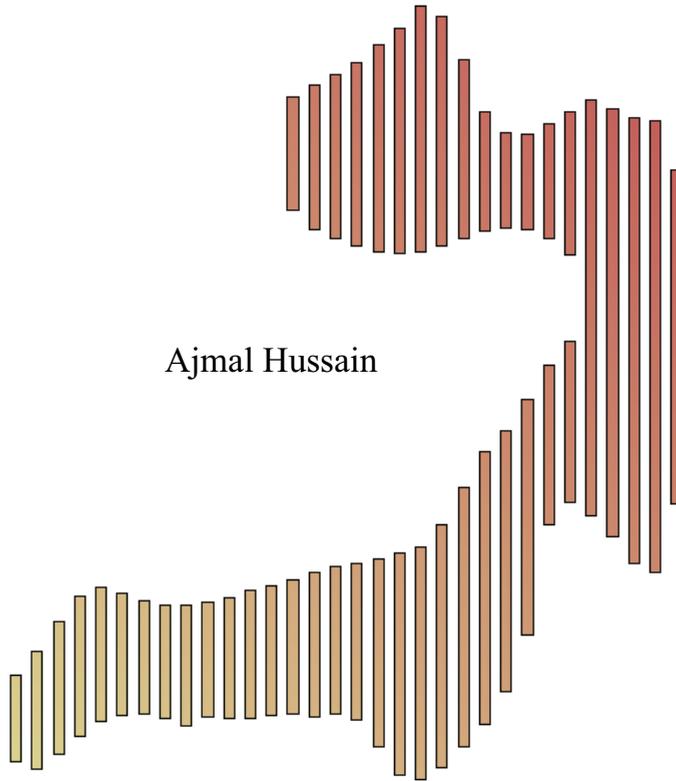


Long term mental health effects of the 2004 tsunami

A prospective study of Norwegian tourists exposed to the
disaster



Norwegian Centre for Violence and Traumatic Stress Studies

Thesis for the degree of Ph.D.
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Ajmal Hussain

Oslo, December 2011

List of papers

- I. Hussain A, Weisæth L, Heir T (submitted). Posttraumatic stress and symptom improvement in Norwegian tourists exposed to the 2004 tsunami – a longitudinal study.
- II. Hussain A, Weisæth L, Heir T (2011). Psychiatric disorders and functional impairment among disaster victims after exposure to a natural disaster: a population based study. *J Affect Disord*, 128:135-141.
- III. Hussain A, Weisæth L, Heir T (2011). Changes in religious beliefs and the relation of religiosity to posttraumatic stress and life satisfaction after a natural disaster. *Soc Psychiatry Psychiatr Epidemiol*, 46:1027-1032 [Epub ahead of print, 2010 Jul 31].
- IV. Hussain A, Weisæth L, Heir T (2009). Nonresponse to a population-based postdisaster postal questionnaire study. *J Trauma Stress*, 22:324-328.

Summary

The aim of the study was to investigate long term mental health consequences of disaster exposure and identify predictors for severe mental health problems in the aftermath of the 2004 tsunami. In addition we wanted to study post-disaster changes in religious beliefs.

All Norwegians aged ≥ 18 yrs. ($n=2468$) who were repatriated from tsunami affected countries were invited to participate in our study; 899 returned a questionnaire at 6 months (T1), 1180 responded at 24 months (T2), and 674 responded at both assessments. A random sample of non-participants at T2 was telephone interviewed.

Sixty three highly exposed individuals, the normative tourist population at Khao Lak in Thailand, were in-depth interviewed 2.5 years after the disaster.

Disaster exposure i.e. witnessing death or suffering, being chased or caught by the waves and loss of loved ones, peritraumatic fear, neuroticism and low levels of social support were the strongest predictors of posttraumatic stress 6 months post-disaster. Symptom improvement from T1 to T2 was related to high symptom level at T1 and emotional stability, but not to perceived social support. Being referred to a mental health specialist did not facilitate symptom improvement.

Non-participants were less exposed and had lower levels of posttraumatic stress. Most likely reasons for non-response were lack of relevance and lack of interest or time.

The post-tsunami 2.5 year incidence of PTSD and Major Depression was 36.5% and 28.6% respectively among Norwegian tourists who survived in Khao Lak. Also the recovery rate was high in this group leading to fewer participants with chronic symptoms. About half of those who fulfilled the PTSD criteria after the tsunami recovered within the first year. Psychiatric disorders other than PTSD, i.e. phobias, social anxiety disorder, dysthymia and depression, were common, but only PTSD and depressive disorders were independently related to functional impairment. Individuals who were directly exposed and had lost close family member in the tsunami had the highest level of psychopathology.

Religion did not play an important role in the lives of Norwegian tsunami survivors. Respondents who had the greatest disaster exposure were more likely to report changes in religious beliefs, strengthened as well as weakened. There were no differences in posttraumatic stress, general psychopathology or life satisfaction between religious and non-religious persons.

Sammendrag (Norwegian summary)

Hovedmålet med studien var å kartlegge langvarige psykiske helsekonsekvenser etter katastrofeeksponering og finne variabler som kunne predikere alvorlige psykiske problemer i etterkant av tsunamien i 2004. I tillegg ønsket vi å studere endringer i religiøs overbevisning i etterkant av en naturkatastrofe.

Alle nordmenn som var ≥ 18 år ($n=2468$) og som ble evakuert fra de tsunamirammede landene, ble invitert til å delta i vår studie; 899 svarte på et spørreskjema etter 6 måneder (T1), 1180 deltok etter 24 måneder (T2) mens 674 personer deltok begge gangene. Et tilfeldig utvalg av de som ikke svarte ved T2 ble telefonintervjuet.

Alle voksne som hadde vært i det hardt rammede området Khao Lak i Thailand, ble dybdeintervjuet 2.5 år etter katastrofen. 63 personer av de 75 vi fikk kontakt med deltok.

Katastrofeeksponering som f.eks. vært vitne til død og lidelse, blitt tatt eller nesten tatt av vannet og mistet nærstående, peritraumatisk trusselopplevelse, nevrotisme og lite sosial støtte var de sterkeste prediktorene for posttraumatisk stress 6 måneder etter katastrofen. Bedring i posttraumatisk stress fra T1 til T2 var relatert til høyt symptomnivå ved T1 og emosjonell stabilitet, men ikke til sosial støtte. Å bli henvist til spesialisthelsetjenesten førte ikke til høyere fall i symptomnivået.

De som ikke deltok i studien var mindre eksponert og hadde lavere nivå av posttraumatisk stress. De vanligste årsakene til manglende deltakelse var at studien ikke føltes relevant og generell mangel på tid og interesse.

2.5-års insidensen av PTSD og depresjon etter tsunamien var henholdsvis 36.5 % og 28.6 % blant overlevende fra Khao Lak. Betydelig bedring i denne gruppen førte til at det var få deltakere med kroniske symptomer. Omkring halvparten av de som utviklet PTSD, ble bedre i løpet av det første året. Forekomsten av psykiatriske lidelser i tillegg til PTSD som for eksempel fobier, sosial angst, dystymi og depresjon var vanlig. Imidlertid var det kun PTSD og depressive lidelser som var relatert til funksjonsnedsettelse. Nivået av psykopatologi var høyest blant individer som var mer direkte eksponert og hadde mistet nærstående.

Religion spilte en mindre viktig rolle i livene til norske tsunamioverlevende. Personer med høy grad av eksponering var mer tilbøyelig til å rapportere endringer i religiøs overbevisning, styrket likeså svekket. Det var ingen forskjell i posttraumatisk stress, generell psykopatologi eller tilfredshet med livet mellom religiøse og ikke-religiøse personer.

Abbreviations and acronyms

APA	American Psychiatric Association
BFI	Big Five Inventory
CRED	Centre for Research on the Epidemiology of Disasters
CSS	Crisis Support Scale
DSM-IV	Diagnostic Statistical manual of Mental disorders, fourth edition
GAF-F	Global Assessment of Functioning – Function part
GHQ-28	General Health Questionnaire, 28 items
ICD-10	International Classification of Diseases, revision 10
IES	Impact of Event Scale
IES-R	Impact of Event Scale Revised
KZ syndrome	Concentration camp syndrome
LoL	Cantril's Ladder of Life
MDD/MD	Major Depressive Disorder/Major Depression
NKVTS	Nasjonalt Kunnskapscenter om Vold og Traumatisk Stress (Norwegian Centre for Violence and Traumatic Stress studies)
PTE	Potentially Traumatic Event
SCID-I	Structured Clinical Interview for DSM-IV, Axis I disorders
PTSD	Post-traumatic Stress Disorder
T1	6 months questionnaire follow-up
T2	24 months questionnaire follow up
UN	United Nations
WHO	World Health Organization
WSAS	Work and Social Adjustment Scale
α	Cronbach's alpha
B	Unstandardized beta
β	Standardized beta
CI	Confidence interval
M	Mean
ns	Not significant
r	Pearson's correlation coefficient
ρ	Spearman's rho
SD	Standard deviation
χ^2	Chi-square

Introduction

The tsunami disaster of 2004

Case report I

Young female tsunami survivor, travelled with two other friends. She was in Thailand at the time of tsunami: *“We were in our bungalow, which was close to the beach. I was asleep and was awakened by a rumbling sound. Before I could understand what was going on I was helplessly tossed around by the water. The bungalow got filled with water and the whole structure kind of exploded. I was then in complete mercy of the water. I was dragged under water for a short period, and could feel the enormous power of the water. I saw debris, cars, and trees floating in the water. I managed to grab a little girl who was floating in the water. Suddenly a second wave came and I lost the girl. Shortly after, I was sucked under water deeper and deeper. I remember that I thought that this was the end, and began to swallow water. After a short time I suddenly found myself on the surface again. I held on to a plank and started floating with the water. Then I got hold on to a tree and climbed up. It was a strange feeling to sit there and wait, it was quite silent and I felt extremely lonely. I could see dead bodies floating in the water beneath. Occasionally I felt that all this was a bad dream.*

After some time I was joined by some other survivors and we went to search for a safe place. I later found out that I had driven about 4-5 km from the lodge. I was united with my friends in a small house. Thai people looked anxious and many screamed something about a bigger wave that was coming. We got ride to a nearby hospital in a pick-up truck. The environment at the hospital was quite chaotic, many had lost loved ones and some were seriously injured. From there we were sent to a bigger hospital as I was severely injured, had a punctured lung. After staying at the hospital for some days we managed to arrange for transport to Phuket. We were helped by our travel agency to get in contact with the Norwegian Embassy. There was a long wait at the airport. The situation there was chaotic as many persons were angry, irritated and arguing. The flight home was quite long, but I did not mind it as I just wanted to go home. I did not pay much attention to my injuries.

Case report II

Male tsunami survivor, travelled with wife and two kids, was in Thailand at the time of tsunami: *“We had been in Thailand for only one day before it happened. We lived in a hotel which was on a hillside. That day we woke just before 10 o’ clock and rushed in to order breakfast. Our hotel was 60-70 metres from the beach. I suddenly heard rumbling of water and looked up. I saw a big wave coming towards the shoreline. At that time I had no idea what that was. I thought about flooding, but I knew this was different; it was more like a wall of dirty water. I quickly understood that the water-wall was taller than the lower part of our hotel. I reacted first when I saw people came running from the beach. I grabbed one of the kids and shouted to my wife to grab the other one and run. Everything happened so quickly. We all ran up the hillside to get up to the height. I remember that there were a lot of screaming before everything went silent. We could see water filling the lower parts of our hotel. Suddenly there was a lot of shouting and screaming and we could hear warnings about new and bigger waves that were coming. At the time we had been really taken by surprise and had no problem to take the warnings seriously. We started to run again and came to the road. It was pretty chaotic because of the damage caused by the water. We got ride to a nature reserve and quickly ran up the hill in the jungle. It feels strange to think that we ran into the jungle with a lot of poisonous snakes. But at the moment we all just wanted to get as high up as possible.*

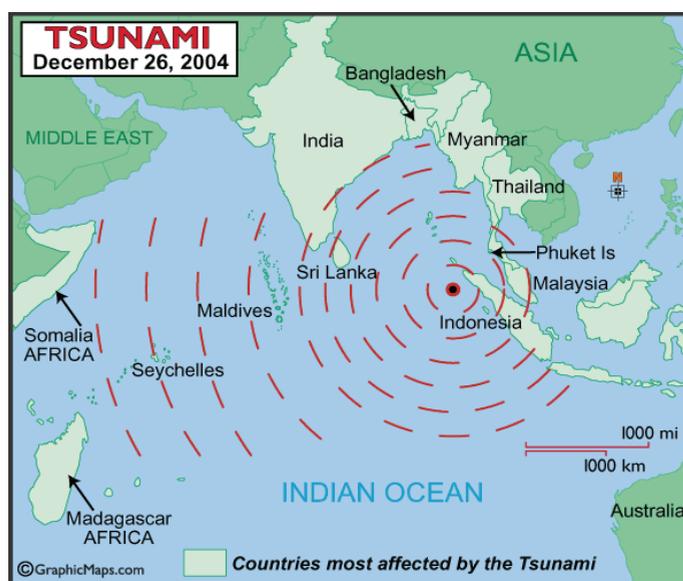
We followed others to a farm were we stayed over night. None of us could relax because of the shock. In addition there were rumours about a 100-meter wave which made everybody anxious. As I said I had no problems to accept that a 100-meter wave could come. My feeling was that if this can happen everything is possible. At the time I was not familiar with the tsunami phenomenon. From the farm we were evacuated to an assembling point in a hotel where we were exposed to lots of impressions; injured people, abandoned children and people grieving. From there we were bussed to Phuket to a new gathering point in a hotel. We were advised to go home to Norway as soon as possible as we had children with us. At the hotel we met other people who had lost their loved ones. We understood how lucky we had been.

The Event – The 2004 Indian Ocean tsunami

On December 26, 2004, 07:59, a powerful undersea earthquake (9.3 on Richter-scale) near Sumatra, Indonesia, caused a series of devastating waves up to 30 meters, or tsunami, which

crushed shorelines across the Indian Ocean (Figure 1). Waves even reached Somalia in Africa, 4,800 kilometers away (Townsend 2006). In deep ocean water, tsunami waves are barely noticeable and harmless, but generally travel at a very high speed. In shallow water near coastlines, a tsunami slows down and forms large destructive waves. Because of the distances involved, the 2004 tsunami took anywhere from fifteen minutes to seven hours (for Somalia) to reach the various coastlines. Thailand was struck about two hours after the earthquake (local time 10:25). In some areas the sea temporarily receded from the coast, while in other areas it suddenly swell without receding.

Figure 1. Countries affected by the 2004 tsunami



Map provided by: www.worldatlas.com

The 2004 tsunami caused approximately 230,000 deaths and affected millions of others, making it one of the deadliest natural disasters in recent history (EM-DAT, International Disaster Database). Indonesia was the most severely affected country, followed by Sri Lanka, India and Thailand.

Many other countries, especially those in Europe, had relatively large numbers of citizens visiting in the region on holiday. Approximately 2200 Europeans died or were presumed dead (Table 1). Both Sweden and Germany lost more than 500 citizens each in the

disaster. Approximately 3500 Norwegians were in the region at the time of disaster, mainly Thailand, and 84 persons were killed by the tsunami, among them 24 children (Table 1).

Table 1. Approximate number of tourists from some of the European countries who were in disaster affected areas and number of those who died or were presumed dead (Vymetal 2006, Wikipedia and other internet sources).

Country	No. of tourists	Presumed dead
Germany	4000	552
Sweden	20 000	543
Great Britain	10 000	247
Finland	2900	179
Switzerland	4000	121
Norway	3500	84
Denmark	2500	47

Central dimensions of disaster

The tsunami had many of the potential traumatic dimensions of a disaster: It was totally unexpected and unthinkable, especially for the tourists who mostly were from countries where natural disasters of large scale are uncommon. Tsunami as a natural phenomenon was mostly unknown for the majority of tourists who were affected. Neither the local government nor overseas governments were prepared for a disaster of this nature and magnitude. As the stricken countries had no tsunami warning system, the tidal waves struck the coastlines without a forewarning leaving no time for mental or practical preparedness. Hardly any of the Norwegian visitors interpreted the earthquake and withdrawal of the seawater as warning signs of a tsunami. Within seconds many people were caught by the waves or had to run for their lives. The devastation was huge and violent with massive losses of life. The fact that most people had no knowledge of the cause of the tsunami, probably made the situation more terrifying and threatening, i.e. some even believed that the tsunami was caused by a nuclear bomb.

The safety of loved ones was of particular concern. The situation during the tsunami and afterwards was experienced as uncontrollable. Although the exposure to the physical impact was relatively brief, the rumours of new and deadlier waves and uncertainty regarding

missing of loved ones inhibited sense of safety and getting calm during the first days after the tsunami. Also many survivors had strong witness experiences, such as seriously injured persons, dead bodies, and abandoned children. The devastation of the tsunami was mostly limited to coastal areas, so people who were far away from the disaster stricken areas, i.e. in the cities, did not have similar threatening experiences. Like other large scales natural disasters, such as earthquakes, hurricanes and floods, the tsunami disaster was total as it caused destruction of the social structures, homes and jobs, and represented a serious concern for the whole region. However, all the Norwegian tourists were repatriated to stable home communities within a short period of time, escaping these secondary stressors.

Natural disasters differ from accidental and man-made disasters as there is no one to blame. Although a few Westerners still call it an act of God, they differ from for example the Indonesian victims who largely interpret the disaster in religious terms. The magnitude of the devastation and loss of lives after a natural disaster partly depends on human factors; building structure, warning system, evacuation procedure, postdisaster management (WHO 2006). The distinction between a natural disaster and a manmade disaster is there for blurred. However, few people blamed the Thai authorities for not having a tsunami warning system and the disaster was not viewed as a result of any human failure. The Norwegian tourists were rather dissatisfied with their Governments' effort in the disaster areas, so were the Swedes and Danes (Michel et al. 2011).

The Tsunami research programme

The Norwegian Centre for Violence and Traumatic Stress Studies (NKVTS) was engaged during the early phase after the 2004 tsunami disaster in various capacities: advising decision makers, disseminating knowledge, teaching, developing preventive intervention models and planning research. Personnel from the centre had some operational responsibilities in the disaster area.

The centre was later tasked by the Norwegian Directorate of Health to conduct a comprehensive research programme of the consequences of the tsunami disaster. In all, 8 research projects were to be carried out. One of the research projects investigated the exposure, the psychological health and courses of reactions in Norwegian adults who had been in South-east Asia, and who were exposed to the disaster. The other projects within the tsunami programme were: Exposed children and parents, Disaster workers, When a disaster

strikes one's homeland - the tsunami in an exile perspective, National Support Association after the tsunami, The role of the general practitioners, The bereaved and The effects of visiting the disaster area for the bereaved and for survivors.

How I came into this project

In June 2005 a questionnaire study was conducted of Norwegian citizens who had been in the disaster region when the tsunami struck. It was later decided to do a follow-up study of the same population along with clinical interviews among selected individuals and a study of non-responders. The project leader Trond Heir, MD PhD, with whom I previously had worked with in the Acute Psychiatric Department at Ullevål University Hospital, offered me to conduct the follow-up study. At the time, winter of 2006, I had two years left to complete my five year specialisation in psychiatry. I accepted the offer as the study was related to my field of specialisation, it provided me an opportunity to learn more about research methodology and besides that I felt privileged to have the opportunity to work with professor Lars Weisæth, who is an authority in disaster psychiatry. My interest for disaster research increased as I observed a change among people in Pakistan (my homeland) during my visit in March 2006. This change was especially related to social and religious behaviour which according to my relatives in Pakistan was triggered by the devastating Earthquake in October 2005 in Northern Pakistan. I started on the follow-up study in April 2006. The follow-up study gained financial support from the Research Council of Norway and was accepted for doctoral thesis at the University of Oslo, Faculty of Medicine.

Background

Historical perspective on trauma related disorders

The pioneers in psychiatry portrayed cases of patients where trauma was involved in the disease history already at the end of the 19th century (Weisæth 2002). Kraepelin described a disorder he called "fright neurosis" that developed after serious accidents and injuries resulting in severe emotional upheaval and sudden fright (Van der Kolk et al. 1997, Van der Kolk 2007). Freud, working with Charcot in Paris, noted that in cases of traumatic stress "the

memory acts like a foreign body that have been denied the normal wearing-away process of abreaction and reproduction in states of uninhibited association” (Breuer & Freud 1893-95).

As a consequence of the World Wars a renewed interest for traumatic stress emerged and in 1941 Kardiner wrote in his book *The Traumatic Neurosis of War* that sufferers from traumatic neurosis develop enduring vigilance with extreme physiological arousal and constant readiness for fright reactions (Kardiner 1941). Kardiner identified the connection between the startle response and combat stress and war neurosis which shows similarities with the modern definition of the concept of PTSD. According to Kardiner the central issue in “PTSD” was that “the subject acts as if the original traumatic situation was still in existence and engages in protective devices which failed on the original occasion”.

The Vietnam War significantly influenced the current concept of PTSD. Studies of traumatic stress gained increasing momentum after the recognition that acute and post traumatic stress reactions were specific disease entities in 1980 and Post Traumatic Stress Disorder (PTSD) was included in the Diagnostic and Statistical Manual of Mental Disorders, 3d ed (DSM-III). Modifications were made in subsequent editions.

Trauma research in Norway

Norway has a relatively long tradition in conducting trauma and disaster research. In a review by Malt and Weisæth (1989) the breakthrough has been ascribed to the international works on World War II concentration camp survivors by Leo Eitinger and Axel Strøm (Eitinger 1964, Eitinger & Strøm 1973). Eitinger documented in his work the long term consequences of trauma, such as higher morbidity and mortality. Eitinger and Strøm described *The KZ syndrome* which included persisting symptoms like fatigue, irritability, depressed mood, headache, restlessness and concentration problems. Another condition with similar symptoms, labeled *The war sailor syndrome*, was described later among World War II sailors who had experienced constant threat of or actual torpedo attacks by the German submarines (Askevold 1976/77, Egede-Nissen 1978). Both the *KZ syndrome* and the *War sailor syndrome* were European forerunners of the PTSD diagnosis.

By the collaboration between the Joint Norwegian Armed forces and the University of Oslo the world’s first Chair of Disaster Psychiatry was established (Malt & Weisæth 1989). Arne Sund was the Chief Psychiatrist of the Armed Forces. He was also the first professor in disaster psychiatry. The research focus was on civilians’ responses to adverse events like an

industrial disaster (Weisæth 1984), motor vehicle accidents (Malt 1987) and North Sea oil-rig disaster (Holen 1990).

In Bergen, the Centre for Crisis psychology was founded in 1988, the center's primary focus has been to study impact of stressful events in children and adolescents. Also, at the University of Bergen, the Trauma Psychology Research Group have conducted studies investigating long term mental health consequences of among survivors from a bus accident in Western Norway (e.g., Winje 1996, Winje & Ulvik 1998). The mental health of traumatized refugees has been another active field of PTSD related research in Norway (e.g. Hauff & Vaglum 1994).

As we can see, disaster studies have long traditions in Norway. The establishment of the National Centre for Violence and Traumatic Stress Studies (NKVTS) in 2004 in Oslo, investigation of mental health effects of combat deployment (Department of Defense 2010, personal communication) and recently two dissertations on long-term follow-up of the survivors from the capsized oil-rig in the North Sea (Bøe 2011, Holgersen 2011), indicate that studies on traumatic stress are likely to be continued by new generations of researchers.

Traumatic events

An event must have certain qualities to be considered traumatic. Some of the core features of trauma are listed below:

1. Injury
2. Danger
3. Witness
4. Threat to integrity
5. Loss

In the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders, a traumatic event is defined as any event in which the individual “experienced, witnessed, or was confronted with an event or events that involved actual or threatened death or serious injury, or a threat to the physical integrity of self or others.” In addition, this event must elicit very strong emotional reactions, including fear, helplessness or horror (APA 1994).

The experience of traumatic events is associated with risk for the development of several psychiatric disorders, including PTSD. The use of the term potentially traumatic event

(PTE) is increasing internationally. It has long been recognized that people exposed to the same PTE are affected differently including persons who do not seem to be affected by such exposure. While the term traumatic is often used in daily language to refer to events that are moderately distressing, in psychology the term is used to describe catastrophic and severely distressing events. Sexual assault, natural disasters, serious accidents, and combat are all examples of experiences that are considered potentially traumatic.

The lifetime prevalence of traumatic events shows great variation depending on definitions and sample selection (Kessler 2000). However, epidemiological studies show that exposure to trauma is quite common (Alonso et al. 2004, Creamer et al. 2001, Kessler et al. 1995, Stein et al. 1997). The National Comorbidity Survey in USA found a lifetime prevalence of 61 % for men and 51 % for women (Kessler et al. 1995a).

Effects of trauma

The risk for psychological traumatization increases with the degree of human involvement in the causation of danger. As nature often is not viewed as evil, natural disasters are not experienced as being as insulting as interpersonal violence. Human failure to prevent and even more so, human negligence cause more psychological harm, than natural dangers. A very decisive dimension in the psychic trauma is to what degree it threatens the individual's sense of worth. This aspect of humiliation and insult may represent an attack on the individual's integrity. The combination of exposure to life-threatening danger and/or loss of loved one and a blow to one's self esteem seem to represent a massive risk for psychic traumatization (Weisæth 2006).

Posttraumatic Stress Disorder (PTSD)

PTSD is one of the few psychiatric disorders where the causal element is part of the illness definition. The trauma necessary to diagnose PTSD must be outside the range of normal human experience and be a real life threatening incident. The three core elements of PTSD are repeated memories of the traumatic event, avoidance of trauma reminders and increased arousal (see DSM-IV definition in appendix).

Prospective studies of stress exposed individuals' show that the exposure to disease rate varies depending on type of exposure. Approximately 25 to 30 percent of victims of traumatic events develop symptoms of PTSD. In population studies lifetime prevalence of PTSD varies from 2-8% (Alonso et al. 2004, Kessler et al. 2005) and the condition is roughly twice as

common in women compared to men (Bromet & Dev 1995). In general, trauma caused by interpersonal violence is considered the type of trauma which most likely lead to PTSD compared to traumas caused by accidents or natural disasters (Galea et al. 2005a, Norris et al. 2002, Weisæth 1989a). In cases of serious rape, torture and kidnapping up to 50 % go on to develop PTSD diagnosed one month after the event (Yehuda 2002) and 30% may still have severe PTSD symptoms after one year (Dahl 1993). In parts of the world where war and serious diseases are endemic the prevalence is substantially higher than in prosperous and peaceful societies (APA Guidelines 2004).

Environmental dangers such as radiation, toxins, viruses, cannot be perceived by human senses and are therefore sometimes called “silent trauma”. The stress develops when the individual is made aware of his exposure. Silent traumas seldom cause PTSD as they do not have the invasive quality needed. Instead, the reactions are increased awareness of one’s own physical health and subsequent diffuse symptoms of psychosomatic nature (Tønnessen 2002).

Collective trauma – Disasters

The disaster concept is a very complex, multidimensional phenomenon (Korver 1987). The definition adopted usually reflects the role of the particular organization, but it may also depend upon the event itself or solely on the consequence of the event. Within medicine and the rescue service, a disaster is defined as an event where the destruction is so extensive that the acute need for help by far exceeds the resources i.e. the need for rescue efforts and emergency medical interventions are much greater than the immediately available resources. Disasters have in common a collective social suffering that requires an effort by individuals as well as communities and even entire societies to overcome (Davidson & McFarlane 2006). Most of the worst disasters, including technological accidents, have occurred in developing countries (Lima et al. 1990, Weisæth 1993).

Disasters are often divided into two categories: natural disasters and human induced or man-made disasters. Table 2 shows the traditional attitudes to the nature of the disastrous event and the likely effect the exposure has on a person’s self-esteem (Weisæth 2006).

Table 2. Natural versus man-made (technological) disasters.

Natural disasters	Accepted as accidental Nature can be dangerous, but is not evil Poses no threat to self esteem
Man-made disasters	
Human failure	Blame of loss and control and lack of preventive measures Questions self esteem
Human negligence	Strong blame, loss of trust Challenges self esteem
Human malice	Fight, flight, surrender (shame), humiliation, hatred, cycles of violence Attack on self esteem

The degree of severity of exposure in various types of disasters may be measured by combining the intensity of threat, the number of victims and material losses. The sociologist Kai Erikson described loss of community in Buffalo Creek after a dam break that killed a high proportion of the population and destroyed much of the community (Erikson 1976). Disaster trauma usually consists of multiple stressors. It often includes an acute and a chronic event (Green et al. 1990, Green 1990), the primary and the secondary disaster stressors.

The primary disaster stressors are those experienced during the impact, and they increase in severity the nearer one is to the center of impact. Such stressors include physical injuries, objective risk to life, witnessing the death and suffering of others, and having to make difficult choices between escape and rescue. Many studies have found a correlation between intensity of exposure and likelihood of psychiatric after-effects (Bromet & Dew 1995, Galea et al. 2005a, Norris et al. 2002, Weisæth 1989b). The severity of the primary stressors depends on the speed of onset, the level of preparedness and warning, duration of impact, level of control, predictability, leadership, competence, social cohesion etc. and will determine whether traumatic degree of helplessness, anxiety, hopelessness, inhibition, or conflict develop. These responses are decisive as to whether postdisaster psychiatric morbidity will develop. The main psychiatric outcome is likely to be posttraumatic stress disorder (PTSD). Thus the literature on psychic trauma and PTSD is relevant to disaster psychiatry. Most disasters also have several secondary stressors caused by the destruction,

such as loss of home or job and loss of social resources. Other secondary stressors may be troubled interpersonal relations, financial stress, environmental worry, ecological stress and continued disruption during rebuilding.

In contrast to stress research which mainly has focused on the individual, disaster studies focus on the primary group and the family. In individual studies of traumatic stress a frequent finding is the strong relationship between the degree of exposure, for example, danger to life, and the risk of developing a later mental health problem. In case of collective situations knowledge about relational aspects of the exposure may be important in order to understand human response patterns. Safety of others may be just as important as safety of one self. During the event, the disaster victim is likely to suffer multiple losses, witness mass injuries, deaths and enormous destruction, and may have to make difficult choices between ensuring personal survival and possibly helping others. The presence of others, however, also increases the opportunity for leadership and one's own rescue. Responsibility for safety of others or some form of leader role can have positive effects (Weisæth 1989c). In a study of Norwegian tsunami survivors the authors found that having responsibility for a closely related injured person had a protective effect regarding mental health complaints six months postdisaster (Heir & Weisæth 2008). In the immediate aftermath, the disaster victim is more likely to suffer from the inadequacy of emergency operation compared to an accident victim.

Some selected studies of previous Natural and man-made disasters:

1. One of the first studies of disasters was done by the Swiss psychiatrist Eduard Stierlin (1909, 1911) who investigated man-made (mining and railway) and natural disasters (earthquake). Of the 135 persons who had experienced the earthquake in Messina in 1908, he found that 25% suffered from traumatic sleep disturbance, including nightmares. Stierlin considered violent emotions and fright the most important etiological factors.
2. The Coconut Grove night club fire disaster in Boston in November 1942 claimed the lives of 491 persons. This disaster resulted in one of the first systematic civilian studies on the acute psychic reactions in trauma survivors (Adler 1943, Cobb & Lindemann 1943, Lindemann 1944). The Boston study gave impetus to the development of crisis theory and has had a great impact upon preventive and clinical psychiatry. One of the conclusions was that severe emotional problems are due to crises in human relationships involving

conflict and guilt rather than the impersonal horror of the disaster itself. In the follow-up studies of the trauma victims, researchers found high incidence of psychiatric illness.

3. The Buffalo Creek Disaster (Gleser et al. 1981, Lifton & Olson 1976, Titchner & Kapp 1976). A dam collapse in Buffalo Creek valley in West Virginia, USA, in 1972 resulted in a devastating flood wave which severely affected the whole community with 125 dead and thousands homeless. The main conclusion which can be drawn from the studies is that long-lasting and severe psychological disorders may develop in a large proportion of the survivors after this type of disasters; 68% had moderate to severe impairment 24 to 30 months postdisaster. The impairment was due to symptoms of PTSD and depression. The disaster was perceived by the survivors as caused by human neglect, the dam had not been properly constructed and controlled. Long-term follow up showed that 25 % of adults had current PTSD 14 years after the incident, as compared with 59 percent at any time in the 14 years after the incident (Green et al. 1992).
4. Mount St. Helens is most notorious for its catastrophic eruption on May 18, 1980. Fifty-seven people were killed during the eruption. This was one of the first controlled studies which utilized criteria-based interview schedule for the identification of psychiatric disorders in the aftermath of the disaster (Shore et al. 1986). The study revealed a significant morbidity for generalized anxiety, major depression, and PTSD. The three disorders were significantly associated with disaster stress and showed a dose-response pattern. Also the duration of symptoms tend to persist longer if the subject was exposed to the greatest degree of disaster stress. Female sex, older age, concern over finances, and prior physical health problem, were some of the predictors for psychopathology.
5. The Three Mile Island nuclear accident in Pennsylvania in 1979 (Bromet et al. 1982, 1990). As the primarily threat was possibility of radiation danger and no visible destruction, this study was one of the first to investigate effect of ongoing threat “silent trauma”. Using another nuclear plant in Pennsylvania as a control, different groups were examined. No significant differences were found among the workers and patients. However, adverse mental health effects, both immediate and long-term, were found among mothers of preschool children. The mothers in the threatened area had more episodes of anxiety and depressions the first year after the accident.

Two technical disasters in Norway

1. The Jotun paint factory explosion. One night in September 1976, workers at the Jotun paint factory were hit hard by a violent explosion. The fire was extinguished after 36 hours. Six people were killed instantly and 11 were injured, two seriously. The accident resulted in a detailed study of posttraumatic stress reactions and disaster behaviour (Weisæth 1989b, 1989c). Posttraumatic stress was related to intensity and duration of the risk of death, physical injury, witnessing injury and death of colleagues and necessity of making difficult decisions, e.g. between personal safety and the risk of helping others. The posttraumatic stress reactions were reduced in frequency and intensity from one week to seven months postdisaster. Disaster behaviour was largely governed by workers' previous experience of dangerous situations and/or training for such conditions. Those who reacted constructively had a low risk of developing short- and long-term PTSD symptoms. Among the cohort of factory workers the PTSD prevalence rates decreased from 36% (after 7 months) to 27% (after two years), 22% (after three years) and 19% (after four years) in the high exposure group (Weisæth 1985). In the medium exposure group the decrease was from 17% at seven months to 2% after 4 years and even lower in the low exposure group.
2. The North Sea oil rig "Alexander Kielland" capsized on the 27th March, 1980. Of the 212 men onboard, only 89 survived. Studies have been conducted of the Norwegian survivors across four waves of data collections, in 1980, 1981, 1985 and 2007 (Bøe et al. 2011, Holen 1990, Holen 1991, 1993, Holgersen et al. 2011). A matched reference group of oil-rig workers from the same field was included in 1985. Symptoms of posttraumatic stress exhibited by the survivors decreased during the first year and remained fairly stable thereafter. One third of the survivors continued to have high symptom score in the aftermath. The disaster experiences along with high alcohol consumption were significant predictors of subjective distress and occupational and psychosocial dysfunction. In addition, neuroticism explained the outcome related to subjective distress, while job stress, social support and background factors such as history of psychological suffering explained occupational dysfunction. Compared to the control group the disaster survivors clearly showed increased levels of psychiatric morbidity. After 27 years, 6% of the survivors had PTSD, while 58% never had PTSD. A minority (24%) demonstrated chronic or relapsing courses of mental health problems, which was related to initial high

level of distress and personality style with high scores on neuroticism. The survivors had more than threefold risk of having a psychiatric disorder in comparison with the control group.

Natural disasters

The United Nations recognised the increasing impact of disasters on the world's population and environment by declaring the 1990s "the International Decade for Natural Disaster Reduction" (UN 1987). Natural disasters are increasing in frequency and in terms of the number of people affected, while the numbers of deaths are declining (Guha-Sapir & Panhuis 2004).

The smallest and the poorest countries are affected most severely by natural disasters. In general, the number of deaths and injuries is closely related to the prevailing level of economic development (Berz 1989). In the majority of developing countries, disasters, because of their severity and frequency, represent a real public health priority (WHO 1992). Especially after the South-East Asian tsunami in December 2004, the need to systematically reduce the impact of disasters is gaining recognition and commitment among governments worldwide (UN 2007).

Natural disasters are divided into five sub-groups: geophysical, meteorological, hydrological, climatological and biological (Table 3).

Table 3. Natural disasters - classification and definition (EM-DAT).

Natural disaster subgroup	Definition	Disaster main types
Geophysical	Events originating from solid earth	<ul style="list-style-type: none"> • Earthquake (ground shaking, <u>tsunami</u>) • Volcano • Mass movement (dry; landslide, avalanche)
Meteorological	Events caused by short-lived/small to meso scale atmospheric processes (in the spectrum from minutes to days)	<ul style="list-style-type: none"> • Storm (tropical cyclone, local storm)
Hydrological	Events caused by deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up	<ul style="list-style-type: none"> • Flood • Mass movement (wet; landslide, avalanche)
Climatological	Events caused by long-lived/meso to macro scale processes (in the spectrum from intra-seasonal to multi-decadal climate variability)	<ul style="list-style-type: none"> • Extreme emperature • Drought • Wildfire (forest fire)
Biological	Disaster caused by the exposure of living organisms to germs and toxic substances	<ul style="list-style-type: none"> • Epidemic (viral, paracitic) • Insect infestation, • Animal stampede

Tsunami

Tsunami is a Japanese word meaning “harbor wave”. A tsunami is a series of waves caused by a rapid displacement of a body of water (ocean, lake), triggered by earthquakes, volcanic eruptions, mass movements, meteorite impacts or underwater explosions. The 2004 tsunami was triggered by an undersea earthquake which caused sudden vertical rise of the seabed by several meters displacing massive volumes of water.

Psychological effects of natural disasters

2010 was one of the worst years on record for natural disasters over the past two decades, leaving 297,000 people dead and affecting more than 200 million people world wide (EM-DAT). The cost is estimated to be \$109 billion, three times more than in 2009.

It is suggested that the prevalence of psychopathology documented in studies after natural disasters is generally lower than that documented after man-made disasters (Galea et al. 2005a, Norris et al. 2002). However, in studies of natural disasters it is more difficult to explicitly identify groups of persons who can be considered direct victims. Natural disasters often affect large areas and the study samples predominantly include persons from a broader area affected by the disaster. Thus, inclusion of persons who were less directly affected are more likely and may be one of the explanations for the lower prevalence of post disaster psychopathology. Overall, studies carried out after natural disasters report a PTSD prevalence ranging from 5 (Cannio et al.1990) to 60 (Madakasira & O'brian 1987) percent in 1-2 years postdisaster. Mostly the reported prevalences are in the lower half of this range, while higher prevalences are reported in specific groups like persons who were in heavily affected areas at time of the disaster (Bodvarsdottir & Elkilt 2004, Najarian et al. 2001, Perilla et al. 2002, Suar et al. 2002). A very high prevalence of PTSD (50%) was found among firefighters during the first two years of follow-up after the 1983 bush fires in Australia (McFarlane 1988a). Due to the massive destruction often caused by large scale natural disasters, it is hard to differentiate between symptoms caused by direct exposure to the disaster and symptoms caused by the consequences of disaster damage.

A broader range of outcomes

PTSD is the most commonly studied and most likely outcome in the aftermath of disasters (Leon 2004, Neria et al. 2007). However it is not the only clinically relevant outcome of traumatic exposure. Other psychological and psychiatric disorders include depression, phobias and other anxiety disorders, dissociative disorders, alcohol and drug abuse, somatization, family disturbance and general reduced psychological well being (Bromet & Dew 1995, Brown et al. 2000, Davidson & McFarlane 2006, Foa et al. 2006, Norris et al. 2002). In fact, psychiatric comorbidity is often considered the rule rather than the exception for individuals with PTSD (Brady et al. 2000, Kessler et al. 1995a). However, little is known about the onset and course of post-disaster psychiatric disorders other than PTSD

In the National Comorbidity Study 88 % of men and 79 % of women with lifetime prevalence of PTSD met the criteria for one or more comorbid psychiatric disorder (Kessler et al. 1995a). There is also high level of comorbidity with somatic disorders, especially circulatory diseases like hypertension that might share some of the same neurobiological etiologies as PTSD (Duke & Vasterling 2005, Schnurr & Green 2003). In addition, some evidence indicates that eating disorders (Brewerton 2008, Faravelli et al. 2004), somatoform disorders (Labbate et al. 1998, Lieb et al. 2007) and psychotic disorders (Hamner et al. 2000, Seedat et al. 2003) may be part of the trauma spectrum disorders. It is uncertain whether development of other disorders than PTSD differs regarding exposure to different traumatic events. However, it is likely that the symptomatology will differ after exposure to prolonged traumatic situations i.e. repeated sexual abuse, interpersonal violence and combat experience compared to exposure to a brief single event.

The WHO estimates that in general population worldwide, the baseline prevalence of mild to moderate and severe mental disorders is around 10 % and 2-3 %, respectively (WHO 2005). These prevalence estimates are liable to double after disaster. The WHO estimated that the likely prevalence of psychological distress to be in order of 50-90% among those affected by the 2004 tsunami.

Functional impairment

Many depressive and anxiety disorders lead to considerable impairment of social and occupational functioning (Alonso et al. 2004, Kennedy et al. 2002). Major depression has also been shown to cause a pronounced reduction in psychosocial functioning on a global level (Murray & Lopez 1996). A survey of the general population has shown that impairment caused by PTSD is comparable to the impairment observed in major depression, which is considered the most impairing mental disorder (Druss et al. 2009).

Most of the studies evaluating post-disaster psychiatric morbidity at the population level have not included measures of functional impairment. In a review of Norris and colleagues each sample's results were classified on a 4-point scale (Norris et al. 2002); 1: minimal impairment, 2: moderate impairment, 3: severe impairment (rates of psychopathology between 25 and 50%), and 4: very severe impairment (psychopathology greater than 50%). Among samples experiencing natural disasters (n=88), 10.2% showed minimal impairment, 55.7% showed moderate impairment, 21.6% showed severe impairment and 12.5% showed very severe impairment. In comparison 38.9% among examples of mass violence showed

very severe impairment. However, natural disasters in developing countries yielded a higher mean aggregated severity rating (3.0) than developed countries (2.2). Thus, the modal outcomes after natural disasters were moderate in developed countries and severe in developing countries.

Long-term psychiatric morbidity after disasters

Although the course of posttraumatic stress symptoms may vary according to type of trauma, most disaster studies shows that symptoms are prominent in close proximity to the traumatic event and most often decline within the first year (Bryant 2003, Norris et al. 2002, Weisæth 1989b). However, a significant proportion of disaster victims develop chronic symptoms that last for many years (Green et al. 1992, Hull et al. 2002, Kessler et al. 1995a, McFarlane 1988a, Norris et al. 2002, Norris et al. 2004). Secondary stressors, such as loss of home or livelihood, are likely to play an important role in development of enduring posttraumatic stress. For example, the prevalence of emotional distress was 78%, fivefold higher than for the nondistressed group, among survivors living in a tent camp two years after a mudslide in Columbia had killed 80% of the town inhabitants (Lima et al. 1987, 1991). In a cohort study of firefighters after the 1983 Australian bush fire, 21% of the firefighters had persistent PTSD over a 2-year period (McFarlane 1988a). Hurricane Andrew is another natural disaster which caused severe and long-lasting symptoms among many survivors (Norris et al. 1999).

Posttraumatic stress - Symptom course

Various symptom courses are observed in studies of disasters and other trauma rather than a stable and consistent level of posttraumatic stress. (Norris et al. 2009, O'Donnel et al. 2007, Solomon & Mikulincer 2006). Symptoms may peak, then initially decline before stabilizing, or stabilize before beginning a new downward trend. Quadratic and cyclical patterns have also been reported (Davidson & McFarlane 2006, Norris et al. 2002). Bonanno (2004), hypothesized four distinct ways in which PTSD could show up in affected individuals: *Chronic pattern* (1) where the symptoms tend to persist across time, *delayed pattern* (2) where the symptoms are not very prominent or severe during the first 6 months following exposure to a PTE, but tend to increase later, *recovery pattern* (3) where symptoms are prominent following exposure to a PTE and shows gradual improvement with time and *resilience pattern* (4) where symptoms are transiting and do not cause reduced psychosocial functioning following exposure to PTE.

The National comorbidity data showed that the mean duration of symptoms in people who never received treatment was 64 months, compared with 36 months in people who received treatment for their symptoms (Kessler et al. 1995a). In more than one third of the affected individuals the symptoms consisted for many years even when treatment was given. Symptoms may be maintained and triggered by day-to-day adverse life experience (Koopman et al. 1994).

Risk factors for posttraumatic stress (PTSD-symptoms)

Although many trauma victims experience some distress after the event, which is considered a normal reaction, most persons do not develop PTSD (Kessler et al. 1995a). To identify individuals and groups at risk of developing mental disorders, one has to identify high-risk situations (severe trauma), high-risk persons (vulnerability in exposed persons) and high-risk reactions (presence of early variables that predict later illness). A number of reviews have assessed risk factors for PTSD and PTSD symptoms after disasters and other PTEs (Brewin et al. 2000, Galea et al. 1995a, Norris et al. 2002, Neria et al. 2007, Ozer et al 2003, Rubonis & Bickman 1991, Shalev et al. 2004). Risk factors can be divided into three groups including factors that were present prior to the event (pre-trauma), factors operating during and in the initial period following the traumatic event (peri-trauma) and factors operating after the traumatic event (post-trauma). The risk factors for posttraumatic stress are summarized in table 4.

Table 4. Risk factors for debilitating posttraumatic stress divided into three groups.

	Risk factors
Pre-trauma	Female sex, middle age, low educational level, low IQ, presence of children in the home, minorities/ethnicity, poverty or low socioeconomic status prior trauma, child abuse, little previous experience or training relevant to coping with disaster, family history of psychiatric illness, own psychiatric illness, weak or deteriorating psychosocial resources, living in a highly disrupted or traumatized community, neuroticism
Peri-trauma	Nature of trauma (unpredicted, enduring or recurring), trauma proximity, trauma severity, physical injury, bereavement, peritraumatic dissociation, peritraumatic distress, peritraumatic perceived fear, feeling of being alone or isolated, threat to integrity, inner conflict/guilt, relocation
Post-trauma	Early traumatic stress responses/Acute stress disorder, psychiatric comorbidity, substance abuse, maladaptive self-appraisals, emotion focused coping, avoidant coping, guilt, lack of social support, additional life stress

The search for risk factors that can predict PTSD has been disappointing as most of the pre-trauma factors investigated such as childhood abuse and family and own psychiatric history have found to be moderately related to the development of PTSD. Peri- and posttraumatic factors like trauma severity, peritraumatic reactions and level of social support are somewhat stronger associated with a risk of subsequent PTSD. The severity of symptoms in the immediate posttrauma period tends to predict long-term symptom severity in victims of mass trauma. Lack of social support appears to be one the strongest for PTSD. Social support (psychological resources in a community) also appears to be an important factor in protecting individuals from developing PTSD after trauma exposure (Friedman et al. 2007).

Many of the risk factors of posttraumatic stress pre-trauma, especially pre-trauma risk factors may be markers of vulnerability in posttrauma survivors. A personality trait, such as neuroticism, is closely linked to vulnerability. Neuroticism is related to a variety of mental and physical disorders, partially mediated by inappropriate coping strategies (Connor-Smith

& Flachsbarth 2007, Lahey 2009). Neuroticism plays an important role in the maintenance of long term posttraumatic stress symptoms (Carr et al. 1997a, McFarlane 1988b).

It appears that the degree of exposure plays a dominating role in the onset of PTSD, while premorbid factors such as personality, history of psychiatric problems play an important role in long-term PTSD (Green et al. 1985, Holen 1990, McFarlane 1989, Weisæth 1984) but still probably less than in general psychiatric disorders. Some groups may be more prone to develop posttraumatic stress such as families with loss or families of injured survivors (Lundin 1990, Raphael 1986) and onlookers (helpless helpers) (Erslund et al. 1989).

In investigation of risk factors for PTSD, the available studies address widely different populations, including combat veterans, victims of rape, survivors of motor vehicle accidents and sufferer of interpersonal violence (Shalev et al. 2004). As development of PTSD or PTSD-symptoms depends on factors like individual vulnerability, severity of the trauma and individual responses, it is reasonable to believe that risk factors for PTSD found in other trauma-populations are also of importance in populations of man-made and natural disasters. However, in disaster settings one has to take into account possible vulnerability and resilience factors operating among both individuals and community. Prediction may be difficult in disasters followed by severe secondary stressors or ongoing threat of new disasters. Victims of low socioeconomic status exposed to devastating natural disasters followed by severe secondary stressors may lead to particularly high level of morbidity (PTSD and depression) (Lima et al. 1991). It is likely that the correlates of PTSD may also predict other types of psychological outcomes of mass trauma (Shalev et al. 2004)

Correlates of posttraumatic stress after natural disasters are comparable to correlates documented after other types of disasters (Galea et al. 2005a). These include psychological factors such as neuroticism, guilt, coping strategies, obsessive traits, and psychiatric comorbidity. Women are more likely to than men to have PTSD after natural disasters and low social support is associated with higher likelihood of PTSD. A greater exposure to disaster is consistently associated with the likelihood of PTSD. Ethnicity, relocation, and low socioeconomic status are inconsistently associated with PTSD after natural disasters.

Religious and spiritual aspects in trauma research

Religion has often been perceived as a source of comfort, meaning and purpose for individuals who experience traumatizing life events (Chen & Koenig 2006). Berger suggested

that religion might serve to integrate the seemingly incomprehensible trauma into a “sacred order,” providing a sense that even traumatizing events have a place within the order of a larger universe (Berger 1990). Wilson and Moran (1998) emphasized that traumatic events affect not only the psychological dimension of the self but also the faith system that gives meaning to life. Religious beliefs can develop through the experience of traumatic events, and religion and spiritual beliefs can be helpful in psychological recovery (Shaw et al. 2005). Traumatic experiences sometimes enhance religious beliefs (Carmil & Breznitz 1991) or lead to an increase in religious activity (Schuster et al. 2001); alternatively, such experiences can result in a weakening of religious commitment (Schwartzberg & Janoff-Bulman 1991) or even abandonment of religious faith (Drescher & Foy 1995).

Religion can act as a moderating or mediating factor which influences survivors and long-term recovery. Religious affiliations can through social bonds not only act as support system to maintain health but also may prevent physical or mental breakdown and maladjustment in times of stress (Greenblatt et al. 1982). For the majority of persons worldwide religion provides a means of coping in times of extreme stress (Hollifield et al. 2008, Niaz 2006, Pargament et al. 1990, Schuster et al. 2001, Weinrich et al. 1990). There have been many studies of religious coping (Harrison et al. 2001, Pargament 1997) and of the relationship between religiosity and mental health (Gartner et al. 1991, Hackney & Sanders 2003, Koenig & Larson 2001, Larson et al. 1992). The findings are somewhat inconclusive, although most report that religious commitment is related to better mental health (Matthews et al. 1998).

In many European countries, religion plays a secondary role in daily life activities (Halman & Draulans 2006). According to an international Gallup survey (Gallup International 2005), the Norwegians are among the least religious people in Europe. Although the majority of Norwegians are members of the State Church, religiosity does not impact the daily lives of most individuals.

Non response in epidemiological research

Postal questionnaires are often used in epidemiological research. The use of postal questionnaires is cost-effective but can result in low response rates. Asch et al. (1997) reported that most mail surveys published in American medical journals achieve response rates of 50-70%. Other studies have shown a general decrease in response rates to mail

surveys over the last few decades (Connelly et al. 2003, Kessler et al. 1995b). The declining response rates, especially in mailed epidemiological surveys of public health, have been of particular concern because low response rates can weaken the validity of the surveys.

Compared to public health studies, there is less knowledge available about non-responders in disaster research. Though some information exists from investigations of attrition in follow-up studies, it does not describe those who decline to participate in baseline or cross-sectional surveys. It has long been speculated on the dominating cause of non-response to disaster studies. Theoretically two main causes may imply; 1. The invited persons feel that they can not contribute to the research as they were not traumatised or have no ongoing posttraumatic stress symptoms. 2. A person may be unwilling to participate because of high level of posttraumatic stress resulting in avoidance against situations resembling or reminding of the traumatic experience. In a longitudinal study of employees experiencing an industrial disaster, an initial resistance to participate was strongly correlated with the severity of the post-traumatic stress reaction (Weisæth 1989d).

The present study

Within the field of traumatic research, studies of disaster trauma offer some important research advantages. In contrast to studies of single trauma, the high number of research subjects in disasters and the great quantity of relevant research data that may be gathered in a concentrated manner, should make it possible to conduct comprehensive and in-depth analyses and study complex models of the psychological processes.

A number of concerns have been raised when reviewing and evaluating the disaster literature (Benight et al. 2006, Norris 2006). Due to the nature of disastrous events, it is common to use a convenience sample that may limit generalization. Studies of whole populations are rarely conducted. The majority of the studies conducted are cross-sectional in design, which makes it difficult to draw conclusions about cause-effect relationships. In case of studies with longitudinal design, most have their last assessment within 1-year post-disaster. In addition, it is pointed out that the effect of specialized treatment for PTSD is often not taken into account when assessing outcome (posttraumatic stress). Generally there have been few published studies that have assessed the course of posttraumatic stress after natural disasters (Galea et al. 2005a).

The mental health effect after a tsunami has not been studied before the tsunami in 2004. Due to geographical location, large scale natural disasters are rare in Norway, limiting studies of traumatic impact of natural disaster in Norway.

All the Norwegian tourists who were in South East Asia at the time of tsunami were repatriated to stable home communities within short time. This unforeseen situation resulted in a unique possibility to study mental health affects of a deadly natural disaster among a whole population of tourists who escaped secondary disaster stressors. We aimed to study predictors of posttraumatic stress and identify factors that influence the long-term course of symptoms over time. In addition, we wanted to investigate the prevalence of PTSD and other psychiatric morbidity in severely exposed individuals. We wanted to evaluate the proportion of psychopathology that could be attributed to the disaster. We also wanted to estimate the association between different psychiatric disorders and functional impairment, both self-reported and clinician assessed. There were no studies available on disaster affected tourist populations, which has used interviews for diagnostic assessment or measured functional impairment.

There are many indications that natural disasters due to climatic changes will be a source for traumatic events in the future. Increased traveling also adds to the possible burden of post traumatic stress reactions among subpopulations of tourists and other travelers in the future.

It remains unclear what role, if any, religion plays in the lives of Norwegian trauma victims. We specifically addressed four questions. First, what is the prevalence of changes in the strength of religious faith following the 2004 tsunami in Norwegian tourists? Second, what factors predict these changes? Third, does religion play an important role in the lives of the tsunami survivors two years after the disaster? And finally, are there any differences regarding posttraumatic stress, general psychopathology and life satisfaction between those who report that religion is a source of strength and those who do not?

We aimed to compare non-participants and participants from a questionnaire survey of Norwegian tourists who experienced the 2004 tsunami in South East Asia. We wanted to explore whether the non-participants had been more severely affected by the tsunami and whether they experienced higher levels of tsunami-related psychological distress. We also aimed to examine self-reported reasons for not participating in the questionnaire study.

Aims and research questions

The main aim of this thesis was to investigate long term mental health effects and symptom course among Norwegian tourists who were exposed to the 2004 South East Asian tsunami. We decided to focus on broader effects of exposure to a natural disaster and not limiting our study to PTSD. The specific aims and research questions addressed in this dissertation were:

In paper I

- To identify predictors of posttraumatic stress six months post-disaster
- Study factors which influence the course of symptoms from 6 months to 24 months postdisaster.

In paper II

- To establish 2.5 years prevalence of PTSD along with other common psychiatric disorders among severely exposed individuals.
- To evaluate the proportion of psychopathology that could be attributed to the tsunami disaster.
- To examine 2.5 years incidence of major depression and PTSD post-tsunami.
- To estimate association between different psychiatric disorders and functional impairment.

In paper III

- To study whether exposure to a natural disaster evoked changes in religious beliefs among Norwegian tsunami survivors and if so, what predicted these changes?
- To investigate whether religiosity was linked to post-disaster mental distress or life satisfaction.

In paper IV

- To study whether non-participants differed from participants regarding exposure and tsunami-related psychological distress?
- To examine self-reported reasons for not participating in the study.

Methods and Materials

Design, procedure and participants

In the first three weeks after the disaster, all Norwegian nationals who had been in South-East Asia during the 2004 tsunami were registered by the Norwegian police, mainly on arrival at Norwegian airports. Lists of names, personal identification numbers, and places of residence during the disaster were registered. After application to the Norwegian Data Inspectorate and the Regional Committee for Medical Research Ethics, this information was made available for the study. We invited all the registered individuals aged ≥ 18 years ($n=2468$) to return a postal questionnaire at two time points. The first data set was collected at 6 months (T1, $n=899$) and the second data set at 24 months post-disaster (T2, $n=1180$). The study population in the follow-up study consisted of those who responded at both assessments ($n=674$).

We got 76 questionnaires in return due to missing address at T2. From the non-participating population ($n=1212$) a random sample of 330 individuals, stratified for age and gender, were contacted for a telephone interview to conduct a study of non-responders. Of these 171 individuals accepted to take part in the interview, hereafter called “interviewed non-participants”. Information was gathered by computer assisted telephone interviews using a structured questionnaire. Interviews were carried out by professional pretrained interviewers who were supervised by the author. All the interviews were carried out in a 4 week time frame and approximately 3 months after the questionnaire study ended.

We conducted an interview study of all the adult survivors who had been in Khao Lak in Thailand at the time of the disaster approximately 2.5 years postdisaster. According to the registry made by the Norwegian police, 82 adults were in Khao Lak at the time of the disaster. After minor adjustments to the list of names, all Khao Lak survivors were personally contacted by telephone and invited to participate in the interview-study. An information letter had been sent prior to the call. Participants were interviewed face to face, mostly in their homes, and the in-depth sessions lasted between 80 and 150 minutes. Interviews were carried out between June and August 2007 by either the author alone ($n=50$) or in collaboration with a specialist in clinical psychology ($n=13$).

Table 5. Overview of papers and study samples.

Paper	Method	Time point	Sample (≥18 yrs.)
Paper I Follow-up	Postal questionnaires	6 months (T1) and 24 months (T2) post- disaster	Included those who responded at both assessments, n=674 Original sample (n= 2468)
Paper II Interview	Face to face interviews	2.5 years postdisaster	63 interviewed Contacted all the Khao Lak survivors (n=75)
Paper III Religious changes	Postal questionnaire	T2	Included those who responded at T2, n=1180
Paper IV Non-responders	Telephone interviews	3 months after T2	171 interviewed Randomized selection of non- responders at T2 (n=330)

Participants

The follow-up study

The mean age in the study sample was 43.0 years (SD=13.0), 46.7% were men, 58.9% had ≥13 years of education, 73.4% were employed (before tsunami) and 71.8% were married or cohabitating (before tsunami). The reported prior tsunami lifetime prevalence of contact with a general practitioner, psychologist or psychiatrist for mental health concerns was 24.3%.

The majority of respondents experienced disaster exposure; 62.1% witnessed death or suffering of others, 35.7% were chased or caught by the waves and 7.3% reported that a close family member or friend perished in the tsunami. A vast majority (69.3%) also reported experiencing intense fear, helplessness, or horror during the disaster (A2 stressor criterion of PTSD, APA 1994). Of the respondents at T2, 34.1 % had experienced two or more adverse life event during last 12 months.

The participants were similar to the age- and gender-adjusted Norwegian population with regard to employment and marital status but had a higher than average education level (Heir et al. 2009a, 2009b).

Interview study

The age and gender of participants did not differ from non-participants. One person had suffered loss among the non participants. The most common reason for not participating was lack of time. None of the respondents were currently involved in unsettled insurance cases related to the 2004 tsunami. Approximately 62% of the study participants were married or cohabitating, 68% were employed, and 68% had higher education (≥ 13 yrs). In the sample, 49% of the respondents reported a life-time experience of at least one traumatic event prior to the 2004 tsunami. Pre-disaster physical health was generally good as only four of the respondents were under work rehabilitation or long-term sick leave due to physical illness. The life-time prevalence of major depressive disorder (MDD) prior to the tsunami was 22.2% ($n=14$). No significant difference was observed between men and women in regards to marital status, employment, education, and experiences of prior trauma.

Twelve respondents (19.0%) reported no direct exposure to the waves, 25 (39.7%) were touched or chased by the waves, and 26 (41.3%) were caught by the waves. Twenty-seven respondents (42.8%) reported tsunami-related injuries, 14 of whom were hospitalized. Fifteen respondents (23.8%) reported that a close family member perished in the tsunami. Women reported somewhat more serious injury than men (22% vs. 10%, OR 5.9, $p<0.05$). No other significant differences in disaster exposure were observed between men and women.

Twenty-three (36.5%) participants reported that they had sought professional help and received treatment for mental distress caused by the tsunami. Treatment mainly constituted psychotherapy alone or in combination with pharmacological treatment (mostly antidepressants). In addition some respondents reported that they joined grief-support groups and received pastoral counselling during the first months after the tsunami.

Study of religious changes

The average current age of respondents was 45.0 years ($SD = 12.9$), 49.2% were men, 58.2% had ≥ 13 years of education, 68.5% were currently married or cohabitating and 73% were employed. The reported lifetime prevalence of contact with a general practitioner, psychologist or psychiatrist for mental health concerns was 23.3% prior to the tsunami. The majority reported small/moderate or great/overwhelming perceived threat of death, 39.2 and 29.3% respectively. Of the respondents, 60.7% had experienced one or more adverse life event during the last year, including bereavement of a relative or friend (23.2%) or serious illness or injury to a close family member (20.4%).

Study of non-responders

Mean age of interviewed non-participants was 43.1 years (SD=13.3) and 56.7% were men. There was no statistical difference regarding age and gender between interviewed and among the rest of the non-responder population.

Measures

Previous mental health and referral

Mental health prior to the tsunami was measured by asking whether respondents had ever contacted a physician or a specialist due to mental health problems before the tsunami disaster.

At the six months follow-up participants were asked whether they had been referred to a mental health specialist by their family physician.

Assessment of exposure

At the 6-month assessment, the questionnaire included a broad spectrum of tsunami experiences (Heir & Weisæth 2008). Potential traumatic exposure were explored according to whether a participant had been caught, touched or chased by the waves (danger exposure); witnessed death and suffering of others (witnessing exposure); or had a close relative or friend die. In paper II exposures to the waves was coded in the same manner based on information extracted from the interviews. The first codings were done in collaboration with the co-interviewer to reach consensus.

Perceived threat of death was measured on a five-point Likert scale ranging from none (1) to overwhelming (5), and was merged into three categories before performing the data analyses: 1) no threat of death, 2) small or moderate threat of death, and 3) great or overwhelming threat of death. "*Threat of death*" had found to be the best predictor of health complaints in a previous study of Norwegian tourists six months following the 2004 tsunami (Heir & Weisæth L 2008). It correlated highly with other items that measured danger, such as whether individuals were caught, touched, or chased by the waves (Spearman $r = 0.67$) or suffered physical injuries ($r = 0.56$).

Participants were asked whether their immediate response were characterized by fear, helplessness or horror. The response was measured on a five-point scale: 0, not at all; 1, little;

2, moderate; 3, intense; 4, extreme. A score of 3 or 4 was considered as a positive response to Criterion A2 for PTSD in DSM-IV.

Posttraumatic stress

Impact of Event Scale-Revised (IES-R) (Weiss 2004) was included to examine the presence and intensity of post-traumatic stress symptoms. The IES-R is a 22-item self-report measure of subjective distress following exposure to traumatic events indexing the core PTSD symptoms (eight intrusion, eight avoidance and six hyperarousal items). The participants responded to each item on a five-point Likert scale (0-4) regarding their experience with the tsunami. Symptom severity was measured according to the original IES-R by five response anchors (0 = Not at all, 1 = A little bit, 2 = Moderately, 3 = Quite a bit and 4 = Extremely), as experienced in the previous seven days. The total score is the sum of all items (range 0–88). The IES-R total symptom scores were used as semi-continuous measures of symptom severity. We used the cut-off ≥ 33 to identify persons with high levels of posttraumatic stress (Creamer et al. 2003). In this study, the Cronbach alpha for the total scale ranged from 0.95-0.96.

This 22-item scale is based on the Horowitz's original Impact of Event Scale (IES) (Horowitz et al. 1979), one of the most widely used single self-rating scale in the world for evaluating traumatic stress symptoms (Brewin 2005). The original IES comprised 15 items measuring reexperiencing/intrusion and avoidance/numbing. The response format in the IES referring to the frequency of symptoms (not at all = 0, rarely = 1, sometimes = 3, and often = 5) was changed to measure symptom severity in the IES-R. The IES-R can be used to generate a sum score, reflecting level of posttraumatic stress reactions. Alternatively, means for each of the subscales (intrusion, avoidance/numbing and hyperarousal) can be generated. Since its original publication, the IES-R has been translated into several other languages including Norwegian and showed good psychometric properties (Eid et al. 2009, Weiss 2007).

In the study of non-responders symptoms of posttraumatic stress were measured using five items from the IES-R. These five items (hereafter called IES-5), including trouble staying asleep, intrusive thoughts and associations (two items), avoidance of feelings, and watchfulness, accounted for the maximum explained variance of the IES-R in the postal survey population. The items were selected through linear regression using forward procedure with the sum score of the IES-R as the dependent variable and all 22 IES-R items were entered as independent variables. Pearson's correlation between the IES-5 and IES-R scores

of the questionnaire study was satisfactory ($r=0.96$, $p<0.001$). Symptom severity was measured according to the original IES-R by five response anchors (0-4). The IES-mean was calculated as the average of the five items. The IES-5 was a forerunner of the IES-6, which was later developed to be used in epidemiological research and as a screening instrument in clinical practice (Thoresen et al. 2009). IES-5 had similar psychometric properties as the IES-6, which appeared to perform well as a brief measure of posttraumatic stress reactions.

Social support

The Crisis Support Scale (CSS) (Joseph et al. 1992) was used to measure received social support in the six months after the tsunami. This is a six-item scale which concern the availability of others, contact with other people in similar situation (like-minded), confiding in others, emotional and practical support, and negative response. Each item is rated on a 7-point Likert scale ranging from 1 (never) to 7 (always). The negative response is reverse scored. Items were summed for a total social support score ranging from 6 to 42, higher scores representing greater social support. An analysis of 11 studies confirms the scale's validity (Elkilt et al. 2001).

Personality traits

The Big Five Inventory (BFI) was used to measure personality (John et al. 2008). The BFI is a self-report scale which consists of 44 items that measure the five factor model for personality. The five subscales are Extraversion (8 items), Agreeableness (9 items), Conscientiousness (9 items), Neuroticism (8 items), and Openness (10 items). All items consist of short phrases (e.g., is talkative; is depressed, blue; tends to be lazy) that are based on prototypical trait adjectives related to each construct (John & Srivastava, 1999) and are rated on a 5-point scale (1 = disagree strongly, 5 = agree strongly). Subscale scores are created by reverse scoring specified items, summing the ratings for the items on each subscale, and dividing by the total number of items to obtain a mean score. Subscale characteristics:

1. Extraversion subscale (I): Includes more specific traits as talkative, energetic, and assertive.
2. Agreeableness subscale (II): Characteristics related to the prosocial and caring side of humanity. Includes traits like sympathetic, kind, and affectionate.
3. Conscientiousness subscale (III): Characteristics related to behaviour that is task- or goal-directed. Includes traits like organized, thorough, and planful.

4. Neuroticism subscale (IV): Is the only Big Five factor associated with non-desirable behaviours and therefore sometimes reversed and called Emotional Stability. This factor is related to anxiety and negative emotions and includes traits like tense, moody, and anxious.
5. Openness subscale (V): Includes traits like having wide interests, and being imaginative and insightful.

We used a Norwegian translation of BFI with a slightly different scoring scheme (Engvik 1993). Neuroticism items were reversed to assess emotional stability.

Adverse life events

The “List of Threatening Experiences, questionnaire version (LTE-Q)” (Brugha & Cragg 1990) was used to assess additional stress experienced after the tsunami. Participants completed LTE-Q at the 24-month assessment (T2). This instrument measures 12 events during the previous year that carry significant long-term threat: Serious illness or injury (self), serious illness or injury (close relative), bereavement (immediate family), bereavement (other relative or close friend), marital separation, end of relationship, problem with close friend or relative, difficulty finding a job, sacked from job, financial crisis, problems with police/law and theft/loss. We added a question about whether respondents had experienced other unpleasant and threatening events in previous 12 months. Positive responses were used to create different groups, experienced 0-1 event or ≥ 2 events.

General psychopathology

The General Health Questionnaire (GHQ-28) (Goldberg & Hiller, 1979), scored by the Likert method (0-1-2-3), was used as a measure of general psychopathology. The GHQ-28 is used widely to assess a respondent’s current state and to ask if the current state differs from the usual state. The total score ranged from 0-84 and represented the mean of participants’ item responses.

Life satisfaction

At T2 life satisfaction was measured with Cantril's Ladder of Life (LoL) (Cantril 1965) which consists of 10 steps. The top rung of the ladder (10) represents the best possible life imaginable and the bottom rung (1) represents the worst possible life. Respondents were instructed to write the number of the step on which they felt they currently stood. The face

validity of the scale has been supported by the relationship between the nature of the scale and the concept of life satisfaction (Laborde & Powers 1989).

Structured diagnostic interview

We used the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) to assess PTSD (First et al. 1995). The participants were evaluated for current and previous tsunami-related PTSD symptoms. We made a full assessment of all PTSD criteria in all participants. In addition we asked all the participants to report the length of the period in which the PTSD-symptoms had been most pronounced and disturbing. The SCID-I PTSD module was chosen because it is not restricted to current symptomatology and also assesses previous symptoms after a specific traumatic event.

To assess other psychiatric disorders, we used the Mini International Neuropsychiatric Interview (MINI), which is a brief and valid structured diagnostic interview that covers 16 axis I disorders according to DSM-IV criteria (Sheehan et al. 1997 and 1998). With some exceptions, MINI measures current psychiatric morbidity (symptoms experienced in the previous month). We used the Norwegian version of the MINI 5.0.0, which has been validated in the clinical setting and shown good psychometric properties (Leiknes et al. 2005, Mordal et al. 2010). We included modules for specific phobia and somatoform pain disorder from the MINI-plus (Sheehan et al. 1998). In case a participant reported several specific phobias, only the most disturbing phobia was taken into account when the disorder was categorized. We screened all participants for previous MDD, not just those who fulfilled the diagnostic criteria for current MDD. When respondents fulfilled the diagnostic criteria for any current psychiatric disorder, additional questions were asked to inquire about the onset of symptoms to establish whether symptoms existed before or originated after the 2004 tsunami.

Work and psychosocial functioning

We used the Global Assessment of Functioning (GAF) to assess clinician-based functional impairment. GAF is a 100-point rating scale for evaluating psychological, social, and occupational functioning and constitutes axis V of the present DSM-IV (APA 1994). The most severe current condition on any of the three dimensions (psychological, social, and occupational) constitutes the appropriate overall score. Higher scores indicate better mental health and psychosocial function. According to the DSM-IV manual, the clinician's ratings of current functioning reflect the patient's need for treatment. The split version of the GAF was

used, in which the GAF scale is divided into one symptom (GAF-S) and one function score (GAF-F) (Pedersen et al. 2007). Only the function score (GAF-F) was assessed.

We measured participant-rated functional impairment using the Work and Social Adjustment Scale (WSAS) (Mundt et al. 2002). WSAS is a validated measure which explores five domains: ability to work, home management, social leisure, private leisure and ability to form and maintain close relationships with others. The five items of the WSAS were rated from 0 (no impairment) to 8 (very severely impaired), and the scores obtained for each item were summed to obtain a total score. Increasing total score reflected lower levels of socio-occupational functioning.

Religiosity

At T2 changes in religious beliefs were measured by a question from the 'religious outcome scale' (Pargament et al. 1990): Do you feel that you have become more religious after the tsunami? Subjects were asked to answer this question using a five-point scale: 1 = Much more religious; 2 = Somewhat more religious; 3 = No change; 4 = Somewhat less religious; 5 = Much less religious. Responses 1 and 2 were considered a strengthening of religious beliefs, while responses 4 and 5 were considered a weakening of religious beliefs.

Religiosity at the time of the study ("current religiosity") was measured by a question from Zuckerman's three item Index of religiousness (Zuckerman et al. 1984): How much is religion a source of strength and comfort to you? Responses were coded on a four-point scale ranging from 1 (= "none") to 4 (= "a great deal"). Responses 1 and 2 were considered to indicate that the respondent was less religious (labelled non-religious), while responses 3 and 4 were considered to indicate that the respondent was positively religious (labelled religious).

Both questions concerning religion addressed personal feelings of religiosity rather than attachment to a religious community or participation in religious activities. Thus, the questions were applicable to all the respondents regardless of their specific belief system.

Reasons for non-participation

The interviewed non-participants were presented with a list of various possible reasons for their non-participation in the questionnaire study, grouped into three categories: A) statements related to the questionnaire being too personal or emotionally disturbing (I found the study too personal, I was skeptical of the study, the study reminded me too much of the disaster); B) statements indicating that personal experiences were of little relevance to the study (I was not

in the disaster area when the tsunami struck, I was not directly affected by the disaster, my experiences were of little importance to the study); and C) statements concerning a lack of interest or time (the study was not of any use for me personally, I usually do not reply to questionnaires, I did not have the drive or time to complete the questionnaire, the questionnaire was too long). The interviewees were asked about the importance of each of the ten statements for not participating and to pick the single most important reason.

Statistical analyses

All analyses were conducted using the software Statistical Package for the Social Sciences (SPSS, version 16.0). P-values <0.05 were considered significant.

Paper I

We used hierarchical multivariate linear regression analysis to determine the adjusted effects of potential predictors of IES-R score at T1. This analysis was performed in four steps; Step 1 included socio-demographic variables such as age, gender, education, employment, marital status, and pre-tsunami mental health problems. Step 2 constituted the additional inclusion of exposure and peritraumatic fear. Step 3 included Big Five personality traits and in step 4 social support was included.

Paired samples t-test was used to examine changes in symptom scores from T1 to T2. To identify variables associated with symptom improvement the difference between IES-R scores at T2 and T1 were entered as dependent variable in a similar hierarchical multivariate linear regression model. Variables regarding exposure and peritraumatic fear were replaced with IES-R score at T1 in step two. Additional information regarding consulting a mental health professional and experiencing of additional adverse life events was included.

Paper II

We used chi square (χ^2) analysis or Fisher's exact test to compare categorical variables and one way analysis of variance (ANOVA) to compare continuous variables. Bivariate regression analysis was used to determine associations between measurements of functional impairment (GAF-F or WSAS) and the type of psychiatric disorders. MDD and DD were grouped together as depressive disorders, and all of the anxiety disorders, except PTSD and specific phobia, were grouped together and labelled "other anxiety disorders" before running

the regression analyses. Multivariate linear regression analysis was applied to determine the independent effect of the disorders, adjusted for age and gender. Spearman's rho ranged from 0.07 to 0.54 between types of psychiatric disorders in the multivariate regression analyses.

Paper III

Bivariate logistic regression analyses was used to determine associations between demographic and background variables, disaster exposure, current posttraumatic stress symptoms and dependent variables such as strengthening of religious beliefs (versus not) or weakening of religious beliefs (versus not). Odds ratio was used as measure of the strength of an association. Multivariate logistic regression analysis was used to determine the adjusted effects of predictors of changes in religious beliefs, controlled for age and gender. All variables that were significant in bivariate analyses were entered in the multivariate regression model. Bivariate analyses were performed using t-tests (continuous variables) and chi-square tests (categorical variables) to compare the religious and the non-religious respondent groups according to demographic and exposure variables. Multiple linear regression analyses were performed to assess the relationship between religiosity and measures of posttraumatic stress (IES-R), general psychopathology (GHQ-28) and life satisfaction (LoL), while adjusting for other significant variables.

Paper IV

Independent t-test was used to compare mean values of continuous variables (age, IES-5, and IES-mean). Other comparisons were performed using Chi-square tests.

Missing values

Missing values in IES-R and GHQ-28 were replaced using the score of that subject on the respective scale-item which revealed the highest kappa value compared with the item of the missing value. Replacement was carried out only if kappa > 0.45, and when less than 30% of the subject's scale-items were missing. In other scales, i.e CSS and LoL, missing data were replaced by the mean value of the other items. There were no missing item-values in IES-5 and WSAS. BFI scales were scored by Harald Engvik at the Department of psychology, University of Oslo.

Ethical considerations

The current study was approved by the Regional Committee for Medical and Health Research Ethics, and by the Norwegian Social Science Data Services. Thus, it followed general standardised research procedures and requirements i.e. voluntary participation, possibility to withdraw at any time, confidentiality, information given regarding use and storing of data. However, as this study included persons who had suffered severe losses and experienced high levels of posttraumatic stress, the practical carrying through was of particular concern. In accordance with common beliefs among general population as well as many clinicians, the ethical committee feared that participation in the study could reactivate posttraumatic stress symptoms in respondents. This thesis is composed of three separate surveys which were all separately approved by the ethical committee.

Although some studies show that participation in trauma-studies can result in increased level of psychological stress for a short period in some persons (Galea et al. 2005b, Parslow et al. 2000), there is no evidence for retraumatization among participants. In a study of burn victims the authors found that only a few persons reacted negatively towards the survey or found the questions being too personal (Willebrand et al. 2004). The negative experience was more pronounced among persons with personality pathology and to a lesser degree to physical exposure. There is increasing evidence that the emotional strain in those who participate in trauma-studies is minimal and the stress related to participation is well tolerated (Griffin et al. 2003, Jorm et al 2007, Newman & Kaloupek 2004). In some cases participation in such studies can even be beneficial (Dyregrov 2000, Griffin et al. 2003, Willebrand et al. 2004). It is suggested that in disaster research, participants should not be automatically considered vulnerable (Levine 2004). However, specific aspects of the research should be thoroughly examined, and there should be procedures in place to provide assistance to participants who experience serious distress.

Due to anonymisation, we had no possibility to follow those who revealed a high symptom level in questionnaires. The respondents had the possibility to write personal comments regarding the survey and the questionnaire. Only a few persons were hostile towards the survey or had experienced worsening of posttraumatic stress symptoms after filling out the questionnaire. During the interview study we arranged for proper support and mental health care for the participants who were currently not followed-up to a satisfying degree by the local health system. Only one participant was identified to have need for a

higher level of support and treatment, and was referred to a mental health specialist by the author.

The telephone interviews in the study of non-responders were carried out by professional trained interviewers under the supervision of the author. The interviewees were given opportunity to talk with the author if they felt the need for it. Although some of the interviewee were emotionally affected during the interview, none of them wished to consult the author.

Summary of results

Paper I – Follow-up study

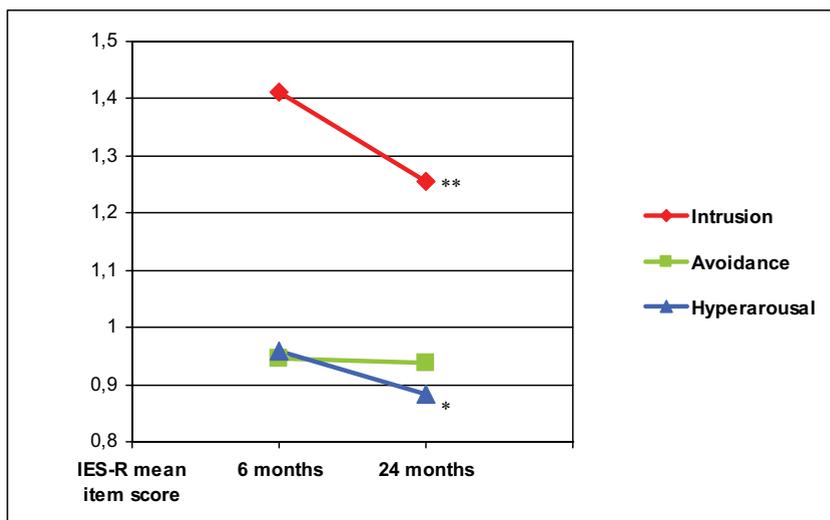
In this study, we aimed to identify predictors of 6 months post-disaster stress symptoms and to study 6 months and 24 months course of symptoms. We used postal questionnaires at two time points to gather data. The study population consisted of those who responded at both assessments (n=674). The mean age in the study sample was 43 years and 47% were men. Among the participants 62% had witnessed death or suffering of others, 36% were chased or caught by the waves and 7% reported that a close family member or friend perished in the tsunami. Impact of Event Scale Revised (IES-R) was used to measure posttraumatic stress symptoms.

Symptoms at T1 were positively related to female sex, older age, unemployment (before tsunami), being chased or caught by the waves, witnessing death or suffering, loss of loved ones, experiencing intense fear during the disaster, low conscientiousness, neuroticism and low levels of social support. Peritraumatic fear, witnessing death or suffering and neuroticism were the strongest predictors of posttraumatic stress at T1. The total explained variance was 43% ($R=0.65$). The IES-R sum score (range 0- 88) declined from 24.6 (SD=18.5) at T1 to 22.9 (SD=18.3) at T2, $p<0.001$. At cluster level, we found a significant reduction in both intrusion and hyperarousal symptoms with the greatest reduction in the intrusion score (Figure 2). There was no significant reduction in avoidance score. We identified various symptom trajectories based on status of being case (IES-R total score ≥ 33) from T1 to T2 (Figure 3). Emotional stability and high IES-R scores at T1, but not received social support, were positively related to symptom improvement. Being referred to a mental health specialist was

negatively related to symptom improvement. Among participants with high level of posttraumatic stress at T1 (IES-R total score ≥ 33), significant symptom improvements were found whether they were referred to a mental health specialist or not.

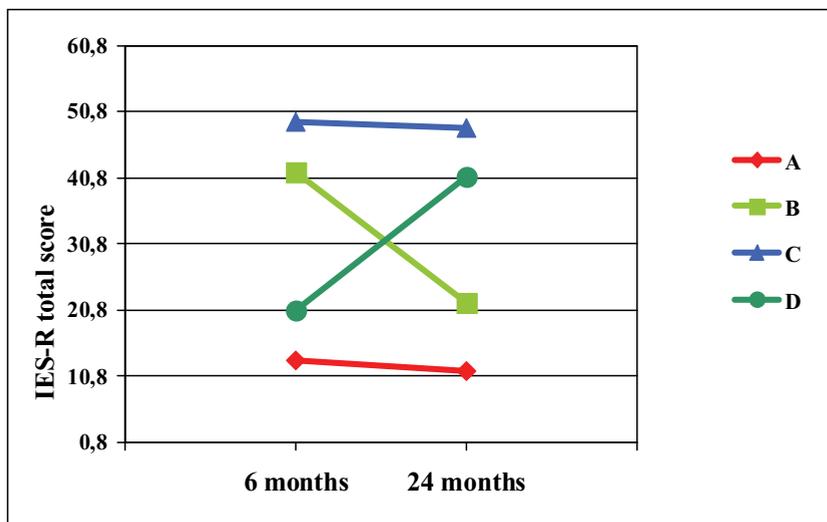
The majority of Norwegian tourists in our study had relatively low levels of posttraumatic stress symptoms in the aftermath. A positive relation between neuroticism and development and maintenance of posttraumatic stress was confirmed. We found that consulting mental health specialists did not facilitate symptom improvement. This may question the effectiveness of psychiatric treatment in real life settings and raises concern about a possible negative effect of psychiatric treatment.

Figure 2. Change in IES-R mean item score from 6 months postdisaster (T1) to 24 months postdisaster (T2) split into three clusters¹.



¹Paired t-test * P<0.01 ** P<0.001

Figure 3. Change in IES-R scores according to status of being case (total score 88, cut-off ≥ 33).



Group	Trajectory	%
A	Non case – Non case	60
B	Case – Non case	11
C	Case – Case	21
D	Non case – Case	8

Paper II – Interview study

In the present study, we aimed to investigate a broader spectrum of long-term psychiatric morbidity and evaluate the proportion of psychopathology that could be attributed to the 2004 tsunami. We also wanted to estimate the association between different psychiatric disorders and functional impairment. Survivors from Khao Lak in Thailand were in-debt interviewed (n=63). Among the participants 81% reported exposure to the waves, 43% were injured and 24% lost close family member in the disaster.

The majority of the study participants (64%) fulfilled the diagnostic criteria for a current psychiatric disorder. The most prevalent disorders were specific phobia (30%), agoraphobia (18%), social anxiety disorder (11%), PTSD (11%), major depressive disorder (MDD, 11%), and dysthymic disorder (DD, 11%) (Table 6). In 24 of the 40 respondents with a current

psychiatric disorder, symptoms had originated after the tsunami. Of the 18 respondents who developed MDD after the tsunami, seven had fully recovered, four had current DD, while seven still fulfilled diagnostic criteria for MDD. In the subgroup of participants who had lost close family members in the tsunami (n=15) about half (n=8) had current DD or MDD and five had PTSD. All the disaster bereaved with current MD (n=4) had comorbidity with current PTSD, whereas none with DD (n=4) had comorbid PTSD.

The post-tsunami 2.5 year incidence of PTSD was 37%. None of the respondents fulfilled DSM-IV criteria for delayed onset PTSD. About half of those who fulfilled the PTSD criteria after the tsunami (11/23) reported substantial symptom reduction within the first year. Seven of the 11 who had recovered had received treatment. The average length of period with disturbing PTSD-symptom in the 11 participants who recovered from PTSD within the first 12 months was 5.8 months (SD=2.6, range 1.5–10.0 months).

A significant decrease in socio-occupational functioning (GAF-F) was found with an increasing number of psychiatric disorders. Analysis showed that the depressive disorders (MDD and DD) and PTSD were associated with self-reported functional impairment (WSAS), while only depressive disorders were associated with clinician assessed functional impairment (GAF-F).

A significant amount of psychiatric morbidity must be expected to follow high-impact natural disasters. Some psychiatric disorders may persist several years after a disaster. Especially the presence of depression and PTSD result in significant functional impairment and are of clinical importance when considering long-term mental health effect of disasters.

Table 6. Psychiatric morbidity among 63 severely exposed Norwegian tsunami survivors 2.5 years after the disaster.

Psychiatric Disorder	Current Prevalence N (%)	Cases with post- tsunami onset N (%)	Post tsunami 2.5 year incidence N (%)
Major Depressive Disorder (MDD)	7 (11.1)	7 (11.1)	18 (28.6)
Dysthymic Disorder (DD)	7 (11.1)	6 (9.5)	
Manic/Hypomanic episode	2 (3.2)	2 (3.2)	7 (11.1)
Panic Disorder	2 (3.2)	2 (3.2)	
Agoraphobia	11 (17.5)	5 (7.9)	
Generalized Anxiety Disorder	4 (6.3)	2 (3.2)	
Social Anxiety Disorder	7 (11.1)	4 (6.3)	
Specific Phobia	19 (30.2)	10 (15.9)	
Obsessive-Compulsive Disorder	2 (3.2)	0	
Posttraumatic Stress Disorder (PTSD)	7 (11.1)	7 (11.1)	23 (36.5)
Alcohol dependence/abuse	5 (7.9)	2 (3.2)	
Drug dependence/abuse	1 (1.6)	0	
Psychotic disorder	0	0	
Anorexia/Bulimia	0	0	
Somatoform Pain Disorder	2 (3.2)	0	
Any psychiatric disorder	40 (63.5)	24 (38.1)	

Paper III – Study of religious changes

Religious ceremonies and participation in memorial services were common among Norwegians in the aftermath of the 2004 tsunami. In this study we wanted to investigate whether tsunami exposure evoked any enduring changes in religious beliefs among Norwegian tourists, and predictors of such changes. In addition, we investigated whether religiosity was linked to post-disaster mental distress or life satisfaction. An adult population of 1180 Norwegian tourists was surveyed by a postal questionnaire two years after the

disaster. The majority reported small/moderate or great/overwhelming perceived threat of death, 39 and 29% respectively.

Among the respondents 87% reported no change in their religious beliefs following the tsunami, 8% reported strengthening and 5% reported weakening in their religious beliefs. Strengthening of religious beliefs was bivariately associated with pre-tsunami mental health problems, life threat intensity as experienced during the tsunami, loss of a family member or close relative, inflicted injuries, posttraumatic stress and post-tsunami adverse life events. A multivariate logistic regression model revealed that strengthening of religious beliefs remained significantly associated with pre-tsunami mental health problems (OR: 1.82, 95% CI: 1.12–2.95, $p=0.015$) and with posttraumatic stress (OR: 1.62, 95% CI: 1.22–2.16, $p=0.001$). Weakening of religious beliefs was bivariately associated with younger age, life threat intensity, posttraumatic stress, and post-tsunami adverse life events. A multivariate logistic regression model showed that weakening of religious beliefs remained significantly associated with younger age (OR: 0.98, 95% CI: 0.96–1.00, $p=0.047$) and posttraumatic stress (OR: 1.72, 95% CI: 1.23–2.41, $p=0.002$). A minority of the study population (11%) was religious. There were no significant differences between the religious and the non-religious groups regarding posttraumatic stress, general psychopathology and life satisfaction (Table 7).

We found a bidirectional change in religious beliefs among a minority of the tourists who experienced the 2004 tsunami; changes in religious beliefs were more common among respondents who had the greatest disaster exposure. Our findings did not support the hypothesis that religious beliefs prevent long-term posttraumatic stress, and religiosity was not associated with higher levels of life satisfaction.

Table 7. Comparing religious and non-religious respondent groups (t-test) according to life satisfaction (LoL), general psychopathology (GHQ-28) and posttraumatic stress (IES-R).

	Religious group <i>n</i> = 128	Non-religious group <i>n</i> = 1133	<i>P</i> -values
LoL ¹			
Mean score	7.38 (SD = 1.92)	7.28 (SD = 1.85)	0.58
GHQ-28 ²			
Mean total score	26.2 (SD = 14.3)	24.3 (SD = 13.4)	0.22
IES-R ³			
Mean total score	24.0 (SD = 19.2)	20.7 (SD = 18.2)	0.06

¹Ladder of Life, ²General Health Questionnaire, ³Impact of Event Scale-Revised

Paper IV – Study of non-responders

Comprehensive studies of non-responders are rarely conducted in disaster research. We examined non-participants in a 2-year postdisaster mail survey of Norwegian tourists who experienced the 2004 tsunami. The aim was to explore whether non-participants differed from participants regarding exposure and posttraumatic stress and to examine self-reported reasons for not participating. A random sample of 171 non-participants was telephone interviewed. Posttraumatic stress was measured by using five items from the IES-R (IES-5).

The age and gender of interviewed non-participants did not differ significantly from the age and gender of those who participated in the questionnaire study. A lower proportion of non-participants reported a perceived threat of death, while a higher proportion reported loss of a close relative or family member in the tsunami (Table 8). The interviewed non-participants had a lower IES-5 mean score, 0.63 (SD = 0.77), than participants, 1.07 (SD = 0.97), $p < 0.001$. Among those more severely exposed, the non-participants had significantly lower IES-5 scores than participants.

Table 8. Gender and degree of exposure in a random sample of non-participants and the total population of participants in a disaster study of Norwegian Tourists who experienced the 2004 tsunami.

	Non-participants (n = 171)		Participants (n = 1180)		χ^2 (df)
	n	%	n	%	
Gender					3.35 (1)n.s.
Men	97	56.7	581	49.2	
Women	74	43.3	599	50.8	
Stayed in a place hit by the tsunami					28.51 (1)**
No	83	48.5	308	26.1	
Yes	88	51.5	701	66.4	
Unanswered	0		89	7.5	
Threat of death					47.55 (2)**
None	99	58.6	339	28.7	
Small/moderate	36	21.3	422	35.8	
Great/overwhelming	34	20.1	315	26.7	
Unanswered	2		104	8.8	
Loss of family members or close friends					8.09 (1)*
No	149	87.1	1095	92.8	
Yes	22	12.9	79	6.7	
Unanswered	0		6	0.5	

Not significant: n.s. * p<0.01 ** p <0.001

Reasons for not participating were ‘lack of interest or time’ (39%), ‘lack of relevant experiences’ (32%) and ‘too personal or emotionally disturbing’ (15%) (Table 9). More women (21.6% vs. 10.3% men, p<0.05) found the study ‘too personal or emotionally disturbing’. Also, among those who reported great or overwhelming threat of death, this statement was more frequently reported as the main reason for non-participation (32%).

Table 9. Different reasons reported by interviewed non-participants for not taking part in the 24 month post-disaster postal survey.

Possible reasons for not participating	Most important reason			Contributing reasons ¹		
	<i>N</i> (%)	<i>n</i>	%	<i>N</i> (%)	<i>n</i>	%
Too personal or emotionally disturbing	26 (15,2)			37 (21,6)		
I found the study too personal		1	0,6		15	8,8
I was skeptical of the study		5	2,9		15	8,8
The study reminded me too much of the disaster		20	11,7		19	11,1
Lack of relevant experiences	55 (32,2)			118 (69,0)		
I was not in the disaster area when the tsunami struck		13	7,6		55	32,2
I was not directly affected by the disaster		20	11,7		63	36,8
My experiences were of little importance to the study		22	12,9		82	48,0
Lack of interest or time	67 (39,2)			140 (81,9)		
The study was not of any use for me personally		11	6,4		75	45,9
I usually do not reply to questionnaires		2	1,2		80	46,8
I did not have the drive or time to complete the questionnaire		41	24		37	21,6
The questionnaire was too long		13	7,6		70	40,9
Not sure/other reasons	23 (13,4)					

¹Contributing reasons are not mutually exclusive.

Our findings suggest that post-disaster studies may be at risk for response bias in the direction of more severe disaster exposure and pronounced posttraumatic stress reactions. In general, non-response seems not to be related to a fear of re-traumatisation or a high degree of post-traumatic stress.

General Discussion

Discussion of main findings

The majority of adult Norwegian tourists in our study had relatively low levels of posttraumatic stress symptoms six months post-disaster (T1). Low levels of morbidity were also found among Norwegian adolescents exposed to the tsunami 10 months postdisaster (Jensen et al. 2009). High symptom level at T1 among the adults was related to female sex, older age, unemployment, exposure, peritraumatic fear, personality traits such as neuroticism and low conscientiousness, and low levels of social support.

Predictors of posttraumatic stress 6 months postdisaster (T1)

In agreement with many studies of natural disasters, we found that disaster exposure and peritraumatic reactions were among the strongest predictors of posttraumatic stress (Amstadter et al. 2009, Carr et al. 1997b, Finnsdottir & Elkilt 2002, Fullerton & Ursano 2005, Kuwabara et al. 2008, Liu et al. 2006, Salcioglu et al. 2003, Suar et al. 2002). Our results are also comparable to studies of Thai and Sri Lankan tsunami survivors (Hollifield et al. 2008, Tang 2007, Thavichachart et al. 2009).

We found that witnessing abandoned children, seriously injured persons or dead bodies were more strongly related to posttraumatic stress than exposure to water or loss of loved ones. Among the Danish tsunami cohort witnessing others suffering was associated with both PTSD and depression (Rosendal et al. 2011). The pathologizing affect of horror is well documented in studies of children witnessing domestic violence (Bayarri et al. 2011, Lehmann 2000) and soldiers witnessing atrocities (Bartone et al. 1998, Litz et al. 1997, Hoge et al. 2004), but is often given less importance when assessing exposure in disaster survivors (Connor et al. 2006). Witnessing horror was also a key variable in predicting of general psychological distress in a previous study of Norwegian tourists who had been in a disaster affected area at the time of the tsunami (Heir & Weisæth 2008). Our findings indicate that witnessing horror can be just as or even more traumatizing than direct personal exposure. Exposure to grotesque sights should therefore be taken into account when conducting surveys of disaster survivors (Elal & Slade 2005). It is still unclear whether the impact of witness exposure is more severe as a part of survival than persons who are exposed to such grotesque sights in the aftermath. However, some studies do suggest that witness exposure without

danger to life constitutes a lesser risk for enduring posttraumatic stress symptoms (Gil & Caspi 2006, Heir & Weisæth 2008, Thoresen et al. 2009).

Course of posttraumatic stress symptoms

We found a slight but significant decrease in the IES-R sum score from 6 months to 24 months post-disaster. The decrease in posttraumatic stress was more modest than generally expected after natural disasters (Carr et al. 1997b, Norris et al. 2002). This expectation was particularly well-founded as we studied a population who escaped secondary stressors and returned to stable home communities after a short period of time (Galea et al. 2008a, 2008b, Neria et al. 2007). It is likely that among many tourists the duration of significant posttraumatic stress reactions were less than six months, thus resulting in little additional decrease in symptom level from 6 months to 24 months post-disaster. In addition, many of the included persons were not directly exposed to the dangers of the tsunami and may have experienced little or no symptoms in the aftermath. However, the finding also indicates that many who were markedly exposed and experienced personal life threat or suffered loss developed enduring posttraumatic stress symptoms (Johannessen et al. 2009, 2011a, Kraemer et al. 2009, Kristensen 2009, Whalstrøm et al. 2008).

In agreement with previous studies we found different symptom trajectories rather than a stable and consistent level of posttraumatic stress (Bonanno 2004, Norris et al. 2009, O'Donnell, 2007, Tang 2007). As showed in figure 2, the vast majority of the respondents either had low levels of posttraumatic stress or high levels of posttraumatic stress at both times of assessment resulting in little variation in the IES-R total score. This finding suggest that many respondents who had a high level of posttraumatic stress six months postdisaster went on to develop chronic symptoms which is in contrast to findings among the Swedish tsunami cohort. Johannesson et al. (2011a) found a considerable decrease in posttraumatic stress from 14 months to 3 years postdisaster among Swedish tourist exposed to the tsunami and revealed that the rate of recovery was slower among respondents exposed to life threat and among bereaved. Some of the differences could be explained by higher level of exposure among the Swedes compared to Norwegians (Heir et al. 2011). In addition many more Norwegians than Swedes (63 % vs. 16 %) consulted their general practitioner after the tsunami and the Norwegians were generally more satisfied with psychiatric and social services than the Swedes after the tsunami (Michel et al. 2011). Dissatisfaction with the

psychosocial services organized in Sweden after the tsunami may have contributed to the slow recovery observed in severely exposed Swedish tsunami survivors.

Predictors of symptom improvement from 6 to 24 months postdisaster

We found that consulting mental health specialists did not facilitate symptom improvement, which was somewhat surprising as we expected that treatment would alter the course in favor of symptom reduction. However, similar findings were reported in a follow-up study after the New York terror attacks (Boscarino & Adams 2008). This may question the effectiveness of psychiatric treatment of enduring posttraumatic stress symptoms. It also raises concern about a possible negative effect of psychiatric treatment on symptom improvement (Ehlers & Clark 2003, Lilienfeld 2007). It has been suggested that in some settings treatment may enhance perceived helplessness and result in decreased coping self-efficacy (Weisæth 2000, Wessely 2005).

The findings regarding negative effect of treatment on symptom improvement must be interpreted with caution as the follow-up study (paper I) was not designed as an effect-study. In the questionnaire study we did not measure details about the treatment received. However, during the interview study (paper II) respondents told that the common treatment received in specialised setting was supportive psychotherapy with or without the use of psychotropic drugs.

Our finding that social support was inversely related to posttraumatic stress at T1 is consistent with previous findings (Brewin et al. 2000, Ozer et al. 2003). However, social support was not related to symptom improvement from T1 to T2. Our finding indicates that the main positive effect of social support regard to posttraumatic stress is pronounced in the temporal proximity to the disaster. This is in line with previous findings where initial levels of social support did not predict the course of chronic PTSD symptoms (Laffaye et al. 2008). The diminishing effect of social support may be explained by persisting symptoms of avoidance and emotional numbing among Norwegian tourists who experienced the tsunami (Figure 2), which may diminish the supportive efforts of others, result in less social support or even deteriorate social relations (Kanistry & Norris 2008, Wu et al. 2009).

In our study emotional stability was consistently related to both low levels of posttraumatic stress at T1 and symptom improvement from T1 to T2. This was not surprising as individuals with low levels of emotional stability (neuroticism) show relatively stable tendencies to respond with negative emotions to threat or loss (Costa & McRea 1992). A

relation between neuroticism and posttraumatic stress has also been reported in several other studies (Cox et al. 2004, McFarlane 1989, Wu et al. 2011). In a study of Norwegian oil rig survivors, neuroticism was the most important vulnerability factor, strongly related to chronic psychopathology (Bøe et al. 2011).

We found that experience of other stressful life events was negatively related to symptom improvement and was close to statistical significance ($p=0.054$). This finding may partly explain the strong inverse relation between neuroticism and symptom improvement as individuals with high neuroticism have both an increased likelihood of experiencing negative life events and an increased magnitude of emotional reactivity to those events (Laheya 2009). Consistent with previous studies our results imply that neuroticism plays an important role in the maintenance of long term posttraumatic stress symptoms (Carr et al. 1997a, McFarlane 1989). Neuroticism is related to a variety of mental and physical disorders, partially mediated by inappropriate coping strategies (Connor-Smith & Flachsbart 2007, Laheya 2009).

2.5 years prevalence of PTSD and other common psychiatric disorders

Roughly two-thirds of the Norwegian tsunami survivors in Khao Lak fulfilled the diagnostic criteria for a psychiatric disorder 2.5 years after the disaster. This proportion is substantially higher than the 12-month prevalence (32.8%) found in the general Norwegian population (Kringlen et al. 2001). Phobias and depressive disorders were the most prevalent disorders among the tsunami survivors. The life-time prevalence of major depressive disorder (MDD) prior to the tsunami was close to the life-time prevalence of MDD reported for the general Norwegian population (22.2% vs. 17.8%, respectively) (Kringlen et al. 2001). This finding indicates that the mental health of the tsunami survivors prior to the event was quite similar to that of the general population. Therefore, it is reasonable to assume that the higher prevalence of the overall psychiatric morbidity was caused by the tsunami. This assumption is further supported by the observation that the debut of post-tsunami disorders appeared in the close aftermath of the disaster. For example, most of the cases of MDD, dysthymic disorder (DD), and specific phobia, which are disorders often known to appear after environmental experiences (Caspi et al. 2003, Skre et al. 1993), were attributed to the disaster exposure more than other adverse life events.

2.5 years incidence of PTSD and major depression post-tsunami

The post-tsunami incidence of PTSD (36.5%) and MDD (28.6%) was higher among our greatly exposed disaster victims (all respondents fulfilled the A1 criteria for PTSD) than what has been generally reported in studies of natives affected by the 2004 tsunami (Math et al. 2008, Piyasil et al. 2008) as well as studies conducted after other natural disasters (Amstadter et al. 2009, Chou et al. 2007, Liu et al. 2006, North et al. 2004, North et al. 2008). Individuals who were directly exposed and lost close family member in the tsunami had the highest level of psychopathology. However, the post-tsunami incidence of PTSD and MDD was lower than among a subgroup of natives who were in the same highly affected area (Pang Nga province, PTSD 51.7% and MDD 53.2%) (Thavichachart et al. 2009).

Interestingly, our 2.5 years prevalence of PTSD was lower than among Swiss tourists who were assessed at the same time point after the tsunami (Kraemer et al. 2009). Use of clinical interviews versus self-measurement scales for diagnosing PTSD may account for some of the differences.

The recovery rates of PTSD and MDD were relatively high, leading to fewer participants with chronic symptoms (2.5 years post-disaster) than in several other studies of natural disasters (Kessler et al. 2008, North et al. 2004, Salcioglu et al. 2003). In particular, we found low rates of post-disaster panic disorder (PD) and generalized anxiety disorder (GAD) compared to similar disaster studies (Amstadter et al. 2009, Green et al. 1992, Thavichachart et al. 2009). The lower morbidity rates may be explained by the immediate repatriation of our sample to their stable society in Norway. Thus, our sample escaped the post-disaster burden of economic loss, relocation, and disruption of normal life that is typical for many natural disasters (Galea et al. 2008b, Heir et al. 2009b).

Functional impairment

Most of the disorders assessed in our study were related to functional impairment. However, only depressive disorders (MDD, DD) and PTSD remained independently associated with a decrease in socio-occupational functioning when adjusted for other disorders. These findings indicate that the inclusion of both PTSD and depressive disorders is crucial when considering the long-term mental health consequences of disasters (Davidson & McFarlane 2006, Hollifield et al. 2008). Co-morbid depression was also shown to be the strongest risk factor for not recovering from PTSD from 10 months to 28 months postdisaster among the Danish tsunami cohort (Rosendal 2011). Depressive disorders were more strongly associated with

functional impairment than PTSD, which is in accordance with a recently published study of Norwegian citizens who lost a first degree family member in the tsunami (Kristensen et al. 2009).

What predicts changes in religious beliefs?

Our results showed bidirectional changes in religious beliefs in Norwegian disaster survivors two years after the 2004 Southeast Asian tsunami. We found no other study which had examined changes in religious beliefs after a natural disaster. However similar changes have been reported in studies after other type of traumas (Drescher & Foy 1995, Falsetti et al. 2003, Fontana & Rosenheck 2004, Torbjørnsen et al. 2000). In the present study, there was less change in religious beliefs of our population compared to populations of potentially traumatized individuals with prolonged exposure, such as war veterans in the United States (Drescher & Foy 1995, Fontana & Rosenheck 2004) and cancer patients with ongoing threat of life (Torbjørnsen et al. 2000). There was also less change in our study population than in a mixture of US community and mental health treatment samples that had experienced potentially traumatizing events (Falsetti et al. 2003). The respondents in our study experienced the tsunami as a distinct and time-limited stressful event escaping secondary disaster stressors. Thus, the lower prevalence of change in religious belief may be due to the particular type, magnitude, and duration of exposure (Park 2005).

Some survivors may have become more religious due to changes in fundamental philosophical or existential belief systems (Park 2005). Others may have turned to religion to cope with adversity (Pargament 1997) as religion can offer a framework of beliefs that can facilitate restructuring of the meaning of the event. However, if existing religious beliefs fail to provide a sense of meaning, the overwhelming disaster experience may result in destroyed or weakened faith: "If such tragedies and horrors can be permitted to occur, then God cannot possibly exist" (Shaw et al. 2005).

Posttraumatic stress was the main predictor of both strengthening and weakening of religious beliefs. This is in agreement with some previous studies (Falsetti et al. 2003), but not with others (Fontana & Rosenheck 2004). Post-disaster stress may be a confounder for severe disaster exposure which could be the real cause of religious changes or it may have triggered changes in religious beliefs by itself (Ai & Park 2005, Falsetti et al. 2003). It has been suggested that greater spirituality may develop as a coping mechanism in response to personal

suffering (Davidson et al. 2005). Also personal growth in general may follow trauma and subsequent struggle with adversity (Calhoun Tedeschi 2006, Linley & Joseph 2004).

Respondents with pre-tsunami mental health problems were more likely to report strengthening of religious beliefs. It is possible that previous mental health problems evoked spiritual or existential interests at an earlier stage of life (Baetz et al. 2004, Blazer 2007). When coping with the tsunami, a strengthening of religious belief may have been more likely among those who had previously used religion as part of a coping strategy (Pargament 1997).

Religiosity, post-disaster mental distress and life satisfaction

The respondents in this study reported lower levels of religiosity than in community studies of the Norwegian population (Gallup International 2009). This could be due to differences in study questions, as we did not ask specifically about being religious or about beliefs in God. Also, religion may be less important as a source of strength and comfort for people who choose to spend their Christmas holidays abroad.

No differences were found in life satisfaction or general psychological distress between the religious and non-religious survivors. This does not support the general idea that religiosity prevents long-term mental stress (Hackney & Sanders 2003, Hill & Pargament 2003, Kaplan et al. 2005, Shaw et al. 2005) or leads to higher life satisfaction Hackney & Sanders 2003, Harrison et al. 2001, Koenig & Larson 2001, Matthews et al. 1998).

Non-responders – Who are they?

Interviewed non-participants did not differ from the age and gender of those who participated in the questionnaire study. Although fewer reported a perceived threat of death, a higher proportion reported loss of a close relative or family member in the tsunami. Non-participants had lower levels of posttraumatic stress than participants.

Our findings demonstrate that non-participants can differ from participants with respect to the characteristics being studied despite similarities in age and gender. Non-participation was primarily related to low exposure and lack of interest, whereas posttraumatic stress symptoms were positively associated with participation, even after adjusting for the level of exposure. This is in agreement with a firework disaster study which extracted non-responder data from electronic medical records (Grievink et al. 2006), but contrary to non-responder studies in the field of public health (Criqui 1980, Janzon et al. 1986, Ronmark et al. 1999) and

several post-disaster follow-up studies where the symptom level at the first wave did not predict a loss to follow-up (Carr et al. 1997b, Dijkema et al. 2005, Norris et al. 1999).

Self-reported reasons for not participating

The most important reason for not participating in postal survey was lack of interest or time. Similar reasons for non response were also reported in a population study after an environmental disaster (Foster et al. 1995). We did not find other post-disaster surveys which systematically investigated self reported reasons for not participating. However, many of the reported reasons for not participating in our study are common and have previously been reported in studies of public health: “I did not have the drive or time to complete the questionnaire” (Ronmark et al. 1999), “I usually do not reply to questionnaires” (Janzon et al., 1986), and “The study was not of any use for me personally” (Bakke et al. 1990, Foster et al. 1995).

Very few found our study too personal or were skeptical of the study, which means that, although not participating, the majority were not hostile towards the study itself. This finding is consistent with other studies of non-responders (Nakash et al. 2008, Ronmark et al. 1999). The percentage of interviewees who stated that “the study reminded me too much of the disaster” was relatively low. However, in a subgroup of the most severely exposed interviewees, this statement was more frequently reported as the main reason for non-participation (32%). This finding could be due to the avoidance perspective in post-disaster stress reactions, typically expressed as a psychological defence mechanism against the discomfort of re-experience (Weisæth, 1989d). Also, the decision to not participate may be part of a coping strategy involving a desire to go on with life and attempts to put the traumatic event behind.

The effect of the length of the questionnaire has been inconsistent and subject to controversy (Asch et al. 1997, Edwards et al. 2007, Subar et al. 2001). In our study, relatively few reported the length of the questionnaire as the most important reason for not participating, but it was frequently reported as a contributing reason. It is reasonable to assume that a long questionnaire would be time consuming, which would be less motivating for those who were not directly exposed to the tsunami.

The findings may be limited to brief natural disaster exposures. Long term exposure to environmental disaster which creates somatic health concerns may produce entirely different responses to outreach of surveys (Guey et al. 2008). One may assume that in situations were

information is gathered shortly after the disaster, ongoing stress in daily life may play a more significant role as a reason for non response. Many survivors may find participation overwhelming because of very high levels of psychological distress. However, this assumption is not supported in a study conducted shortly after a firework disaster (Grievink et al. 2006).

Strengths and limitations

Our study has a number of methodological benefits. Virtually the entire adult population of Norwegians who were on Christmas holiday in South-East Asia during the 2004 tsunami was asked to participate in our study, reducing sample selection bias. Having access to information regarding names, age and gender of the whole population, allowed us to make a fairly accurate estimation of those who did not participate in our study. The mental health effects of the tsunami disaster were probably less affected by pre-existing severe psychiatric morbidity due to the nature of the travel. In addition, the relatively fast evacuation of the Norwegian tourists reduced the impact of secondary disaster stressors limiting the impact of trauma to the primary tsunami experience. Finally, regardless of impairment level, our sample received affordable and easily accessible medical and psychiatric care as well as ample community support (Hjemdal 2007, Michel et al. 2011). The majority of the tsunami affected tourists experienced no problems with their financial claims towards insurance companies and travel agencies which diminish the chances for malingering or developing of *compensation neurosis*.

Face to face comprehensive semistructured interviews with Khao Lak survivors gave us detailed information about survival behaviour, course of symptoms regarding posttraumatic stress (PTSD) and depression, reduction in psychosocial functioning due to psychiatric morbidity, coping strategies and treatment seeking behaviour. This information helped us to understand and interpret the data gathered through postal questionnaires. Conducting a follow-up study eliminated many of the problems related to cross-sectional study design.

Generally, it is difficult to compare prevalence rates after natural disasters because of differences in type of disaster, selection of study population, diagnostic instruments, degree of exposure and cultural setting. Although we achieved a high response rate in the interview study (paper II), our study had a relatively small sample size, which limited the further examination of subgroups. We evaluated 18 axis I DSM-IV disorders that are common in the

general population (Sheehan et al. 1998) but we cannot rule out the presence of other psychiatric disorders or conditions that may have influenced the course of psychiatric morbidity post-disaster. Especially the suggested diagnosis *prolonged grief disorder* after traumatic bereavement may be relevant (Johannesson et al. 2011b, Kristensen et al. 2009).

Generalizability

The study sample was a healthy, normal population that was similar to the general Norwegian population with regard to employment and marital status which increases generalizability of the findings. However, participants had a higher than average education level and family constellation with children indicating higher than average levels of socioeconomic status (www.ssb.no/english/).

A major limitation of our study includes relatively low response and reply rates regarding postal questionnaires, which suggests a self-selection bias. However, women and men in all age groups were represented. Also, we mostly studied how variables were correlated to posttraumatic stress which is less likely to be affected by systematic response rate biases compared to calculation of frequency estimates.

The participants at T1 were similar in age but had a higher proportion of women compared to non-participants. Persons lost to follow-up from T1 to T2 compared to the study population were younger and had to a lesser degree been exposed to danger. There were no other statistical differences with regard to socio-demographic variables, exposure, peritraumatic reactions, social support, and posttraumatic stress. Generally, comparisons of subgroups showed that the response rate was much higher among those who had resided in the most severely affected areas, and it was correspondingly lower among those who had been in locations that were less severely affected. Eventually, these findings were confirmed in our study of non-response where we compared a random sample of those who did not participate with those who participated at T2 (paper IV). We also found that symptoms predicted participation even after adjustment for exposure level. In addition, the survey showed that lack of participation was mostly because of perceived study irrelevance and lack of interest or time.

We achieved only a moderate response rate in the study of non-responders. We do not know whether the interviewed non-participants were representative for the whole population of non-responders regarding exposure or symptoms of posttraumatic stress. However, among those who refused to be interviewed when called, refusals were attributed to attitudinal

reasons rather than emotional stress. Another limitation could be the use of IES-5, which may not have achieved exactly the same estimates as the original measure. However, the very high correlation validity of the IES-5 compared to the IES-R indicates that the demonstrated differences in symptom severity between groups are valid.

The findings in paper IV suggest that the prevalence rates of PTSD based on reporting from postal questionnaires would have been overestimated compared to the whole adult population of Norwegian tourist who experienced the tsunami. Nevertheless, our estimation of PTSD prevalence was based on reporting from the interview study (paper II) where we achieved a high response rate and used structured clinical interviews to make psychiatric diagnosis. However, our finding in the follow-up study (paper I) must be interpreted with caution as the selective participation may have biased the results towards increased morbidity interfering with variables of interest like personality traits, coping behaviour and seeking treatment.

In the study of religious changes (paper III) the representativeness of the population in terms of religion may be questioned as participants had chosen to celebrate their Christmas holiday abroad in a non-Christian country. However, more than 90 % of the Norwegian tsunami survivors were in Thailand, where Christmas is celebrated in tourist resorts and also by The Norwegian Church Abroad. The use of single item measures limited an in-depth understanding of the findings given the complex construct of religiosity. Also, the cross-sectional study design did not allow us to draw conclusions about cause-effect relationships.

Generally, our findings may be limited to populations who experience traumatic events with a sudden impact and relatively brief exposure and may not be applicable to other populations that are exposed to chronic stressors.

Recall-bias

Data regarding disaster exposure and peritraumatic reactions were ascertained retrospectively and may be affected by recall bias. Generally, the risk of recall bias increases as the time passes after the index traumatic event. More and more evidence emerges which indicate that memories of stressful events are not so stable and accurate as previously assumed. Heir and colleagues studied whether recalled threat intensity changed over time among Norwegian tourists who experienced the tsunami (Heir et al. 2009a). Compared with a baseline 6-month assessment, they found a greater intensity of recalled perceived life threat at a 2-year

follow-up, suggesting that the memories for stressful events may amplify as time passes. The study also showed that individuals with recall amplification did not improve in PTSD symptom severity from 6 to 24 months, whereas individuals who did not have recall amplification showed a reduction in PTSD symptoms over time. For this reason we have avoided the use of variables solely based on personal appraisal, and rather included more objective defined criteria when measuring exposure.

Implications

In case of large scale emergencies, also where the survivors escape secondary disaster stressors, an initial assessment regarding disaster exposure and peritraumatic stress reactions seems crucial to predict psychiatric morbidity. Also, some knowledge about personality and previous psychosocial functioning may help to make a more accurate prediction regarding disaster survivors who are at increased risk for developing enduring posttraumatic stress symptoms.

Our results indicate that witness exposure, especially when experienced in combination with perceived threat to life, is an important predictor of posttraumatic stress. In clinical practice very often the main focus is on direct personal exposure. By giving more attention to witness exposure in therapy setting one may promote a deeper understanding of the psychiatric symptoms developed postdisaster.

Our findings also imply that positive results obtained within research settings regard to psychotherapeutic interventions for PTSD may not always have real-world effectiveness. Also, given that most research trials for psychotherapeutic interventions are relatively short termed, the long-term efficacy of the different psychotherapies is more uncertain. The clinicians must therefore be attentive to lack of effectiveness and more importantly any negative effects of ongoing treatment. Naturalistic studies must be given more importance when preparing clinical guidelines.

As some disaster victims develop chronic psychiatric conditions, governments need to consider planning long-term mental health policies after large scale disasters. The follow-up of individuals with severe and enduring psychopathology should be conducted by specialized mental health professionals. The clinicians must take psychiatric disorders other than PTSD, especially depressive disorders, into account when assessing the long-term effects of disasters.

Our findings suggest that the recipients' perceived relevance of the study is an important motivator for participating in a disaster study. In order to achieve a high and non-biased response rate, it is important to motivate individuals with all levels of exposure and post-disaster symptom severity, as well as designing the study to fit these recipients and requirements.

Future research

There are reasons to believe that Norway like the rest of the Western world might be prone to terrorist attacks and that natural disaster, possibly as a consequence of climatic changes will be a source for traumatic events in the future. Also, increasing levels of travel to places with increased possibility to be struck by a natural disaster or a terrorist attack make many tourists more vulnerable to experience such events. Thus, there is a need to continue the research on psychological effects of disasters.

Most of the known predictors of posttraumatic stress such as peritraumatic reactions and early symptoms are often the same among survivors who recover and those who do not, limiting any real predictive value. More detailed studies are needed to search for other variables to distinguish trauma victims who experience only the acute form from those who go on to develop the chronic form of PTSD. Especially personality traits and stressful life events and their relation to posttraumatic stress need further investigation. More than two assessments may be needed to capture the fluctuating course of posttraumatic stress symptoms.

As a significant number of disaster survivors continue to have enduring symptoms even when treatment is given, continuous efforts are needed to obtain data on effectiveness of treatment in order to increase the use of effective treatments. There is need for more naturalistic studies and controlled studies with a less restricted inclusion criterion to expand the generalization of the findings. More efforts towards identifying potentially harmful elements in therapies should be emphasized.

Because a limited amount of research exists on non-response in post-disaster questionnaire studies, data from other contexts and population subgroups are necessary to have a more thorough understanding of this issue.

Conclusions

Up to 70 % of the Norwegian tourists in our study were directly exposed to the 2004 tsunami. However, the majority had relatively low levels of posttraumatic stress symptoms in the aftermath. Disaster exposure i.e. witnessing death or suffering, being chased or caught by the waves and loss of loved ones, peritraumatic fear, neuroticism and low levels of social support were the strongest predictors of posttraumatic stress six months postdisaster. We found a significant reduction in both intrusion and hyperarousal symptoms from six months (T1) to two years (T2) postdisaster. There was no significant reduction in avoidance score. Symptom improvement from T1 to T2 was related to high symptom level at T1 and emotional stability, but not to perceived social support. Being referred to a mental health specialist did not facilitate symptom improvement. Among severely exposed tourists 10-20% developed enduring mental health problems after the 2004 tsunami.

A significant amount of psychiatric morbidity i.e. depression and anxiety disorders, must be expected to follow high-impact natural disasters. Individuals who were directly exposed and lost close family member in the tsunami had the highest level of psychopathology. Although the recovery rates for PTSD and depression were high among highly exposed survivors, many psychiatric disorders tended to persist 2.5 years postdisaster. The disorders, especially the presence of depression and PTSD, resulted in significant functional impairment. Thus, depressive disorders in addition to PTSD are of clinical importance when considering long-term mental health effect of disasters.

Religion did not play an important role in the lives of Norwegian tourists who experienced the 2004 tsunami. Respondents who had the greatest disaster exposure were more likely to report changes in religious beliefs, strengthened as well as weakened. Our findings did not support the hypothesis that religious beliefs prevent long-term posttraumatic stress. There were no differences in general psychopathology or life satisfaction between religious and non-religious persons.

The overrepresentation of individuals with more disaster experiences or more posttraumatic stress, as demonstrated in our study, may bias the results in postdisaster studies. This can lead to artificially high posttraumatic stress estimations. Assessments of age and gender alone are insufficient for a complete picture of the non-responding population; data of exposure and symptomatology are desirable. In general, non-response is most likely related to

perceived lack of study relevance and lack of interest or time and not to a fear of re-traumatisation or a high degree of post-traumatic stress.

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Appendix 1

IES-R

Nedenfor finner du en liste med utsagn fra mennesker som har vært i katastrofesituasjoner. Vi ber deg for hvert utsagn vurdere i hvilken grad det passer for deg selv gjennom den siste uken for din opplevelse av katastrofen.

<i>Ett kryss per linje</i>	<i>Ikke i det hele tatt</i>	<i>Lite</i>	<i>Moderat</i>	<i>Ganske mye</i>	<i>Svært Mye</i>
1. En hver påminnelse (om katastrofen) har vekket følelser om det som skjedde	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Jeg har sovnet urolig og har våknet om natten	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Ting jeg så og hørte, kunne plutselig bringe frem minner om katastrofen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Jeg har følt meg irritabel og sint.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Jeg har ikke tillatt meg å bli følelsesmessig berørt når jeg tenker på katastrofen eller blir minnet på den	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Tanker om katastrofen har trengt seg på også når jeg ikke har villet.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Jeg har kjent det som uvirkelig, eller som om det ikke har hendt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Jeg har holdt meg unna ting eller situasjoner som kan minne meg om katastrofen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Bilder fra katastrofen har plutselig dukket opp i hodet mitt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Jeg har vært urolig og skvetten	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Jeg har forsøkt å ikke tenke på det	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Jeg har vært klar over at jeg enda har mange følelser om katastrofen, men jeg har ikke sluppet dem til.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Mine følelser knyttet til katastrofen har nærmest vært lammet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

14. Jeg har tatt meg i å handle eller føle det som da katastrofen skjedde
15. Jeg har hatt vanskelig for å fall i søvn på grunn av tanker eller bilder fra katastrofen
16. Jeg har hatt perioder med sterke følelser om katastrofen
17. Jeg har forsøkt å slette det som skjedde fra hukommelsen
18. Jeg har hatt konsentrasjonsproblemer
19. Påminnelser om det som skjedde har gitt meg fysiske reaksjoner, for eksempel svetting, pusteproblemer, kvalme eller hjertebank.....
20. Jeg har hatt drømmer om katastrofen.....
21. Jeg har kjent meg på vakt (vaktsom).....
22. Jeg har forsøkt å la være å snakke om katastrofen

Appendix 2

DSM-IV-TR Diagnostic Criteria for Posttraumatic Stress Disorder (DSM-IV-TR code 309.81)

A. The person has been exposed to a traumatic event in which both of the following were present:

1. the person experienced, witnessed, or was confronted with an event or events that involved actual or threatened death or serious injury, or a threat to the physical integrity of self or others.
2. the person's response involved intense fear, helplessness, or horror.

Note: In children, this may be expressed instead by disorganized or agitated behavior.

B. The traumatic event is persistently reexperienced in one (or more) of the following ways:

1. recurrent and intrusive distressing recollections of the event, including images, thoughts, or perceptions. Note: In young children, repetitive play may occur in which themes or aspects of the trauma are expressed.
2. recurrent distressing dreams of the event. Note: In children, there may be frightening dreams without recognizable content.
3. acting or feeling as if the traumatic event were recurring (includes a sense of reliving the experience, illusions, hallucinations, and dissociative flashback episodes, including those that occur on awakening or when intoxicated). Note: In young children, trauma-specific reenactment may occur.
4. intense psychological distress at exposure to internal or external cues that symbolize or resemble an aspect of the traumatic event.
5. physiological reactivity on exposure to internal or external cues that symbolize or resemble an aspect of the traumatic event.

C. Persistent avoidance of stimuli associated with the trauma and numbing of general responsiveness (not present before the trauma), as indicated by three (or more) of the following:

1. efforts to avoid thoughts, feelings, or conversations associated with the trauma.
2. efforts to avoid activities, places, or people that arouse recollections of the trauma.
3. inability to recall an important aspect of the trauma.
4. markedly diminished interest or participation in significant activities.

5. feeling of detachment or estrangement from others.
6. restricted range of affect (e.g., unable to have loving feelings).
7. sense of a foreshortened future (e.g., does not expect to have a career, marriage, children, or a normal life span).

D. Persistent symptoms of increased arousal (not present before the trauma), as indicated by two (or more) of the following:

1. difficulty falling or staying asleep.
2. irritability or outbursts of anger.
3. difficulty concentrating.
4. hypervigilance.
5. exaggerated startle response.

E. Duration of the disturbance (symptoms in Criteria B, C, and D) is more than 1 month.

F. The disturbance causes clinically significant distress or impairment in social, occupational, or other important areas of functioning.

Specify if:

Acute: if duration of symptoms is less than 3 months

Chronic: if duration of symptoms is 3 months or more

Specify if:

With Delayed Onset: if onset of symptoms is at least 6 months after the stressor.

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Changes in religious beliefs and the relation of religiosity to posttraumatic stress and life satisfaction after a natural disaster

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Abstract

Objective To study changes in religious beliefs and predictors of such changes in a community sample exposed to a natural disaster, and to investigate whether religiosity was linked to post-disaster mental distress or life satisfaction.

Methods An adult population of 1,180 Norwegian tourists who experienced the 2004 tsunami was surveyed by a postal questionnaire 2 years after the disaster. Data included religiosity, disaster exposure, general psychopathology, posttraumatic stress and life satisfaction.

Results Among the respondents, 8% reported strengthening and 5% reported weakening of their religious beliefs. Strengthening was associated with pre-tsunami mental health problems (OR: 1.82, 95% CI: 1.12–2.95) and post-traumatic stress (OR: 1.62, 95% CI: 1.22–2.16). Weakening was associated with younger age (OR: 0.98, 95% CI: 0.96–1.00) and posttraumatic stress (OR: 1.72, 95% CI: 1.23–2.41). Two years after the tsunami, 11% of the sample considered themselves to be positively religious. There were no significant differences in posttraumatic stress, general psychopathology or life satisfaction between religious and non-religious groups.

Conclusions Religion did not play an important role in the lives of Norwegian tsunami survivors in general. Respondents who had the greatest disaster exposure were more likely to report changes in religious beliefs in both

directions. Religious beliefs did not prevent post-disaster long-term mental distress, and religiosity was not related to higher levels of life satisfaction.

Keywords Norwegian tourist · 2004 tsunami · Changes in religious beliefs · Religiosity · Posttraumatic stress

Introduction

Traumatic events affect not only the psychological dimension of the self, but also the faith system that gives meaning to life [40]. Religious beliefs can develop through the experience of traumatic events, and religion and spiritual beliefs can be helpful in psychological recovery [37]. Traumatic experiences sometimes enhance religious beliefs [7] or lead to an increase in religious activity [35]; alternatively, such experiences can result in a weakening of religious commitment [36] or even abandonment of religious faith [11].

Religion has often been perceived as a source of comfort, meaning and purpose for individuals who experience traumatizing life events [8, 34]. For many people, religion can make suffering understandable and bearable [32], and provides a means of coping in times of extreme stress [30, 31]. There have been many studies of religious coping [20] and of the relationship between religiosity and mental health [16, 18, 27]. The findings are somewhat inconclusive, although most report that religious commitment is related to better mental health [29]. Most of the studies are from the USA where religion seems to play an important role both at the community level [12, 26] and in the lives of many victims [34]. Also, the literature on the religion–health connection has focused almost exclusively on

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religion as predictor of health resulting in few studies where religiosity is used as an outcome measure [24].

In many European countries, religion plays a secondary role in daily life activities [19]. According to an international Gallup survey [15], the Norwegians are among the least religious people in Europe. Although the majority of Norwegians are members of the state church, religiosity does not impact on the daily lives of most individuals. Yet, attendance to religious ceremonies and participation in memorial services were striking among Norwegians in the aftermath of the 2004 tsunami. Such collective ritual response has also been described in the acute phase after major accidents in Norway [9]. However, it is unclear what role religion plays in the lives of Norwegian trauma victims in the long run and whether major disasters can induce enduring changes in religious beliefs.

In the present study, we explored the association of characteristics of survivors of a natural disaster and their religious beliefs. We specifically address four questions. First, what is the prevalence of changes in the strength of religious faith following the 2004 tsunami in Norwegian tourists? Second, what factors predict these changes? Third, does religion play an important role in the lives of the tsunami survivors 2 years after the disaster? And finally, are there any differences regarding posttraumatic stress, general psychopathology and life satisfaction between those who report that religion is a source of strength and those who do not?

Methods

Study sample and design

The 2004 southeast Asia tsunami was one of the largest tragedies in recent history with a death toll of 226,408 (Centre for Research on the Epidemiology of Disasters, de Louvain, Belgium, e-mail of 25 June 2008). In the days following the disaster, all Norwegian tourists were repatriated from disaster-affected countries and registered by the police upon their arrival in Norway. To investigate the long-term mental health aspects, 2 years after the tsunami a questionnaire was mailed to all registered individuals over the age of 18 years at the time of the disaster ($N = 2,468$). The questionnaire was returned by 1,180 survivors (49.3% response rate, 76 persons not located). The average current age of respondents was 45.0 years ($SD = 12.9$); 49.2% were men, 58.2% had ≥ 13 years of education, 68.5% were currently married or cohabitating and 73% were employed. The reported lifetime prevalence of contact with a general practitioner, psychologist or psychiatrist for mental health concerns was 23.3% prior to the tsunami.

Most respondents had been exposed to the tsunami as threat to their lives and/or horrific witness experiences [22].

We investigated lack of participation with follow-up telephone interviews in a random sample of non-participants ($n = 171$) [25]. Non-participants did not differ significantly from participants in terms of age and gender, but they reported lower levels of disaster exposure and lower levels of posttraumatic stress symptoms. The most frequently reported reasons for not participating in the study were lack of interest or time (39.2%) and not being directly affected by the disaster (32.2%).

The study was approved by the regional committee for medical research ethics and by the Norwegian Social Science Data Services.

Measures

Religiosity

Changes in religious beliefs were measured by a question from the 'Religious Outcome Scale' [33]: do you feel that you have become more religious after the tsunami? Subjects were asked to answer this question using a five-point scale: 1 = much more religious; 2 = somewhat more religious; 3 = no change; 4 = somewhat less religious; 5 = much less religious. Responses 1 and 2 were considered as strengthening of religious beliefs, while responses 4 and 5 were considered as weakening of religious beliefs.

Religiosity at the time of the study ("current religiosity") was measured by a question from Zuckerman's three-item Index of Religiousness [41]: how much is religion a source of strength and comfort to you? Responses were coded on a four-point scale ranging from 1 (= "none") to 4 (= "a great deal"). Responses 1 and 2 were considered to indicate that the respondent was less religious (labeled non-religious), while responses 3 and 4 were considered to indicate that the respondent was positively religious (labeled religious).

Both questions concerning religion addressed personal feelings of religiosity rather than attachment to a religious community or participation in religious activities. Thus, the questions were applicable to all the respondents regardless of their specific belief system.

Disaster exposure

Respondents were asked about the degree to which they perceived that their life had been threatened by the tsunami, whether a close relative or friend died in the tsunami, and whether they sustained physical injuries from the tsunami. In a previous study of Norwegian tsunami survivors, the life threat intensity was the best predictor of health complaints [23].

Posttraumatic stressors and symptoms

The “List of Threatening Experiences, questionnaire version (LTE-Q)” [4] was used to assess additional stress experienced after the tsunami. This instrument measures 12 adverse life events during the previous year that carry significant long-term threat.

Current posttraumatic stress symptoms were measured using the Impact of Event Scale-Revised (IES-R) [39]. The IES-R is a 22-item self-report measure of subjective distress following exposure to traumatic events. Symptom severity was measured according to the original IES-R by five response anchors (0 = not at all, 1 = a little bit, 2 = moderately, 3 = quite a bit and 4 = extremely), as experienced in the previous 7 days.

The General Health Questionnaire (GHQ-28) [17], scored on a four-point Likert scale (0,1,2,3), was used as a measure of general psychopathology.

Life satisfaction was measured with Cantril’s Ladder of Life (LOL) [6] which consists of ten steps. The top rung of the ladder (10) represents the best possible life imaginable and the bottom rung (1) represents the worst possible life. Respondents were instructed to write the number of the step on which they felt they currently stood.

Statistics

Bivariate logistic regression analyses were used to determine associations between demographic and background variables, disaster exposure, current posttraumatic stress symptoms and dependent variables such as strengthening of religious beliefs (versus not) or weakening of religious beliefs (versus not). Odds ratio was used as measure of the strength of an association. Multivariate logistic regression analysis was used to determine the adjusted effects of predictors of changes in religious beliefs, controlled for age and gender. All variables that were significant in bivariate analyses were entered in the multivariate regression model. Bivariate analyses were performed using *t* tests (continuous variables) and Chi-square tests (categorical variables) to compare the religious and the non-religious respondent groups according to demographic and exposure variables. Multiple linear regression analyses were performed to assess the relationship between religiosity and measures of posttraumatic stress (IES-R), general psychopathology (GHQ-28) and life satisfaction (LOL), while adjusting for other significant variables.

All analyses were conducted using the software Statistical Package for the Social Sciences (SPSS, version 16.0). *P* values <0.05 were considered to be significant.

Results

The majority of responding Norwegian tourists, 86.5% (*n* = 1,005) reported no change in their religious beliefs following the tsunami, 97 (8.3%) reported strengthening of religious beliefs and 60 (5.2%) reported weakening. Strengthening of religious beliefs was bivariately associated with pre-tsunami mental health problems, life threat intensity as experienced during the tsunami, loss of a family member or close friend, inflicted injuries, posttraumatic stress and post-tsunami adverse life events (Table 1).

A multivariate logistic regression model revealed that strengthening of religious beliefs remained significantly associated with pre-tsunami mental health problems (OR: 1.82, 95% CI: 1.12–2.95, *P* = 0.015) and with posttraumatic stress (OR: 1.62, 95% CI: 1.22–2.16, *P* = 0.001).

Weakening of religious beliefs was bivariately associated with younger age, life threat intensity, posttraumatic stress and post-tsunami adverse life events (Table 2).

A multivariate logistic regression model showed that weakening of religious beliefs remained significantly associated with younger age (OR: 0.98, 95% CI: 0.96–1.00, *P* = 0.047) and posttraumatic stress (OR: 1.72, 95% CI: 1.23–2.41, *P* = 0.002).

A minority of the study population (10.8%) reported that religion was an important source of personal strength and comfort (positively religious). Religiosity was associated with female sex, older age, unemployment, and pre-tsunami mental health problems, but not with exposure (analyses not shown). There were no significant differences between the religious and the non-religious groups regarding posttraumatic stress, general psychopathology and life satisfaction (Table 3).

Also when controlling for potential confounders such as gender, age, unemployment, and pre-tsunami mental health problems, no significant association between religiosity and posttraumatic stress, general psychopathology or life satisfaction were found.

Discussion

Our results showed bidirectional changes in religious beliefs in Norwegian disaster survivors 2 years after the 2004 southeast Asian tsunami. To the authors’ knowledge, no other study has examined changes in religious beliefs after a natural disaster. However, similar changes have been reported in studies after other types of traumas [11, 13, 14, 38]. In the present study, there was less change in religious beliefs compared to populations of potentially traumatized individuals with prolonged exposure, such as US war veterans [11, 14] and cancer patients

Table 1 Overview of bivariate logistic regression analyses conducted to determine general associations between becoming more religious and demographic variables, exposure variables and current posttraumatic stress

	Total <i>N</i>	More religious <i>n</i> (%) or mean	Odds ratio
Gender			
Male	568	41 (7.2)	
Female	594	56 (9.4)	1.34
Missing	17		
Age (years)^a			
Missing	17		
Age (years) ^a	1,162	41.9 vs. 41.7	1.00
Education			
<13 years	466	36 (7.7)	
≥13 years	676	60 (8.9)	1.16
Missing	37		
Married or cohabiting^a			
Yes	816	62 (7.6)	
No	327	32 (9.8)	1.32
Missing	36		
Employed^a			
Yes	922	74 (8.0)	
No	240	23 (9.6)	0.82
Missing	17		
Pre-tsunami mental health problems			
No	870	60 (6.9)	
Yes	275	35 (12.7)	1.97*
Missing	34		
Life threat intensity			
None	335	14 (4.2)	
Small/moderate	415	28 (6.7)	1.66
Great/overwhelming	311	47 (15.1)	4.08**
Missing	118		
Loss of family members or close friends			
No	1,079	81 (7.5)	
Yes	79	15 (19.0)	2.89**
Missing	21		
Physical injury			
No	1,002	71 (7.1)	
Yes	141	25 (17.7)	2.83**
Missing	36		
Post-tsunami adverse life events			
No	436	24 (5.5)	
Yes	714	73 (10.2)	1.96**
Missing	29		
IES-R^b (mean item score)			
Missing	1,158	0.90 vs. 1.55	2.21**
Missing	21		

* $P < 0.01$ ** $P < 0.001$ ^a At the time of the disaster^b Impact of event scale-revised**Table 2** Overview of bivariate logistic regression analyses conducted to determine general associations between becoming less religious and demographic variables, exposure variables and current posttraumatic stress

	Total <i>N</i>	Less religious <i>n</i> (%) or mean	Odds ratio
Gender			
Male	568	35 (6.2)	
Female	594	25 (4.2)	0.67
Missing	17		
Age (years)^a			
Missing	17		
Age (years) ^a	1,162	42.1 vs. 38.6	0.98*
Education			
<13 years	466	28 (6.0)	
≥13 years	676	30 (4.4)	0.73
Missing	37		
Married or cohabiting^a			
Yes	816	38 (4.7)	
No	327	21 (6.4)	1.41
Missing	36		
Employed^a			
Yes	922	47 (5.1)	
No	240	13 (5.4)	0.94
Missing	17		
Pre-tsunami mental health problems			
No	870	44 (5.1)	
Yes	275	15 (5.5)	1.08
Missing	34		
Life threat intensity			
None	335	10 (3.0)	
Small/moderate	415	23 (5.5)	1.91
Great/overwhelming	311	22 (7.1)	2.47*
Missing	118		
Loss of family members or close friends			
No	1,079	54 (5.0)	
Yes	79	5 (6.3)	1.28
Missing	21		
Physical injury			
No	1,002	48 (4.8)	
Yes	141	10 (7.1)	1.52
Missing	36		
Post-tsunami adverse life events			
No	436	14 (3.2)	
Yes	714	46 (6.4)	2.01*
Missing	29		
IES-R^b (mean item score)			
Missing	1,158	0.93 vs. 1.41	1.81**
Missing	21		

* $P < 0.05$ ** $P < 0.001$ ^a At the time of the disaster^b Impact of event scale-revised

Table 3 Comparing religious and non-religious respondent groups (*t* test) according to life satisfaction (LOL), general psychopathology (GHQ-28) and posttraumatic stress (IES-R)

	Religious group <i>n</i> = 128	Non-religious group <i>n</i> = 1,133	<i>P</i> values
LOL ^a			
Mean score	7.38 (SD = 1.92)	7.28 (SD = 1.85)	0.58
GHQ-28 ^b			
Mean total score	26.2 (SD = 14.3)	24.3 (SD = 13.4)	0.22
IES-R ^c			
Mean total score	24.0 (SD = 19.2)	20.7 (SD = 18.2)	0.06

^a Ladder of life^b General health questionnaire^c Impact of event scale-revised

with ongoing threat of life [38]. There was also less change in our study population than in a mixture of US community and mental health treatment samples that had experienced various potentially traumatizing events [13]. The respondents in the present study experienced the tsunami as a distinct and time-limited stressful event. Due to repatriation to safe and stable communities in Norway, they escaped the typical burden of secondary disaster stressors. Thus, the lower prevalence of change in religious belief may be due to the particular type, magnitude and duration of exposure [34].

Posttraumatic stress was the main predictor of both strengthening and weakening of religious beliefs. This is in agreement with some previous studies [13], but not with others [14]. Post-disaster stress may be a confounder for severe disaster exposure, which could be the real cause of religious changes or it may have triggered changes in religious beliefs by itself [1, 13]. It has been suggested that greater spirituality may develop as a coping mechanism in response to personal suffering [10]. Also, personal growth in general may follow trauma and subsequent struggle with adversity [5, 28].

Respondents with pre-tsunami mental health problems were more likely to report strengthening of religious beliefs. It is possible that previous mental health problems evoked spiritual or existential interests at an earlier stage of life [2, 3]. When coping with the tsunami, a strengthening of religious belief may have been more likely among those who had previously used religion as part of a coping strategy [32].

No differences were found in life satisfaction or general psychological distress between the religious and non-religious survivors. This does not support the general idea that religiosity prevents long-term mental stress [18, 24, 37] or leads to higher life satisfaction [18, 20, 27].

Limitations

The cross-sectional study design did not allow us to draw conclusions about cause–effect relationships. Use of single item measures limits an in-depth understanding of the findings given the complex construct of religiosity [24]. Also, caution should be exercised in generalizing our findings, which may be limited to populations who experience traumatic events with a sudden impact and relatively brief exposure.

The representativeness of the population in terms of religion may be questioned as participants had chosen to celebrate their Christmas holiday abroad in a non-Christian country. However, more than 90% of the Norwegian tsunami survivors were in Thailand, where Christmas is celebrated in tourist resorts and also by the Norwegian Church Abroad. Further, the participants were similar to the age- and gender-adjusted Norwegian population with regard to employment and marital status [21].

Conclusion

We found a bidirectional change in religious beliefs among a minority of the tourists who experienced the 2004 tsunami; changes in religious beliefs were more common among respondents who had the greatest disaster exposure. Our findings did not support the hypothesis that religious beliefs prevent long-term posttraumatic stress, and religiosity was not associated with higher levels of life satisfaction. Future studies should focus on repeated measures of religiosity, posttraumatic stress and life quality to examine religious stability, changes in religious beliefs and cause–effect relationships.

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