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# Traumatic Exposure, Bereavement and Recovery among Survivors and Close Relatives after Disasters

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#### **Abstract**

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International studies of disasters indicate the risk for developing posttraumatic stress reactions among survivors is high. Modern life implicates increased traveling. During the last decades a large number of Swedish citizens were confronted with disasters taking place outside of their country.

The prevalence of trauma reactions in a population that does not normally experience natural disasters, but are able to return to a community unaffected by the catastrophe, is not well studied. In addition, the effects of bereavement after traumatic circumstances have not been satisfactorily explored. Longitudinal studies on the effects of natural disasters are underrepresented and there are few studies investigating the course of recovery after traumatic exposure.

The aim for this thesis was to examine long-term post-traumatic stress reactions, mental health, and complicated grief after disaster exposure and traumatic bereavement. Data from returned questionnaires were analysed from bereaved Italian and Swedish relatives 18 months after the Linate airplane disaster 2001, and at 14 months and three years from Swedish travelers returning from Southeast Asia after the 2004 tsunami disaster, and from home staying bereaved relatives within the second year after the tsunami disaster. The main outcome measures were GHQ-12, IES-R and Inventory of Complicated Grief.

The findings indicated many survivors were resilient and had ability to recover, but severe exposure to a disaster had considerable impact on psychological distress. Life threat was associated with higher levels of post-traumatic stress reactions, and increased the risk for affected mental health and suicidal ideation. Loss in combination with severe life threat exposure indicated a further increased risk of posttraumatic stress reactions and for complicated grief; this should be considered a substantial risk factor for general mental health. Loss of close relatives, especially loss of children, was associated with higher levels of posttraumatic stress and created a greater risk for complicated grief. Many survivors recovered over time; however, severe exposure and traumatic loss appeared to slow the recovery process. The findings have implications for government and health agencies, regarding the importance of knowledge and awareness of these risks for health, and for organizational structure, training, and accessibility of support and adequate treatment.

*Keywords:* Natural disaster, traumatic exposure, life threat, traumatic bereavement, psychological distress, posttraumatic stress reactions, PTSD, general mental health, suicidal ideation, complicated grief, social support, resilience, recovery

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# Abbreviations

CG	Complicated Grief
CGI	Complicated Grief Index
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders. Fourth Edition
EMDR	Eye Movement Desensitization and Reprocessing
ESTSS	European Society for Traumatic Stress Studies
GHQ-12	General Health Questionnaire-12
ICG	Inventory of Complicated Grief
IES-R	Impact of Event Scale-Revised
ICD-10	WHO International Classification of Diseases, revision 10
ISTSS	International Society for Traumatic Stress Studies
KCKP	Kunskapscentrum för katastrofpsykiatri (National Centre for Disaster Psychiatry)
PTE	Potentially Traumatic Event
PTSD	Posttraumatic Stress Disorder
PGD	Prolonged Grief Disorder
SAS System	Statistical Analysis System
SAS	Scandinavian Airlines System
SD	Standard Deviation
T1	14 month follow-up
T2	Three year follow-up
TFCBT	Trauma focused cognitive behavioral therapy



# Introduction

Experiences from international studies of disasters highlight the risk for developing posttraumatic stress reactions among victims is relatively high. The prevalence of posttraumatic stress reactions after natural disasters varies extensively between 5% and 60% (Galea, Nandi & Vlahov, 2005). The variation can be explained by differences in exposure to trauma, the character and size of the disaster, circumstances and how survivors are identified (Weisaeth, 2001). Even though personal traumas occur every day, Sweden in modern time was spared major disasters until the Estonia ferry disaster in 1994. However, modern life implicates increased travel, and during the last decades, a large number of Swedish citizens have been confronted with the consequences of disasters taking place outside of their country, such as the Linate airplane disaster, 2001, and the 2004 tsunami in South East Asia.

## The Linate airplane disaster

In the aftermath of the September 11, 2001 terrorist attack in the USA, on October 8, 2001, a Scandinavian Airline System (SAS) MD-87 aircraft crashed in bad weather into a small private Cessna plane on the runway at Milan international Linate airport before take-off. Unsatisfying technical conditions at the airport in combination with human mistakes from the control tower was later offered as an explanation of the cause of the disaster. The SAS plane, with an estimated speed of 320 kilometers per hour (200 mph), continued into a baggage-handling hangar, where it exploded. No one in either aircraft survived: 118 people were killed. A massive support organization was activated by the airline company. In the aftermath, self-help organizations were developed in Italy and in Sweden.

## The 2004 tsunami

The tsunami of December 26, 2004, is regarded as one of the most devastating natural disasters in modern time. More than 227 000 people were estimated to have died (Telford, Cosgrove & Houghton, 2006). The impact on the inhabitants in the affected areas in Southeast Asia was massive.

From a North European perspective, Southeast Asia is increasingly popular as a tourist area. The Swedish National Police estimated about 19 000 Swedish tourists were present in Southeast Asia during the holidays, and Swedish travel agencies estimate approximately 7 000 were in the most affected areas on the western coast of Thailand during the tsunami. From 23 European countries, 1970 European individuals were reported dead or missing: 543 victims were Swedish, of which 138 were children, with a median age of 9 years. In terms of number of victims who died at the trauma site, Sweden was one of the most affected countries in Europe (Telford, Cosgrove & Houghton, 2006) (Table 1). Thus, the disaster was exceptional for Sweden in terms of the number of individuals involved at a very distant trauma site. Although being criticized for a slow immediate response (Katastrofkommissionen, 2005; Socialstyrelsen, 2007), the Swedish authorities activated a large medical and psychosocial support organization in health care regions throughout the country for the arrival of returning victims, and in the continued time phases. The Swedish government formed “the Council for Support and Coordination”, and non-governmental organizations such as Ersta Association for Diaconical Work (Ersta), the Swedish Red Cross and Save the Children were financially funded for establishing support activities.

Table 1. Number of estimated killed and missing in some Asian and European countries, Australia, Canada and United States

<b>Country</b>	<b>Number of victims<sup>1</sup></b>	<b>Population (millions)<sup>2</sup></b>
Indonesia	167 540	231
Sri Lanka	35 322	20
India	16 269	1177
Thailand	8 212	63
Maldives	108	0.321
Austria	74	8
Belgium	11	10
Czech Republic	8	10
Denmark	47	5
Finland	179	5
France	95	65
Germany	582	82
Great Britain	150	62
Italy	130	60
Netherlands	36	16
Norway	84	4.7
Sweden	543	9
Switzerland	111	7.5
Australia	26	22
Canada	20	33
United States	31	308

<sup>1</sup> Statistics from Telford, Cosgrove & Houghton, 2006; Katastrofkommissionen, 2005

<sup>2</sup> United Nation Population Division, Economic and Social Council, 2008

# History of the field of psychotraumatology

## From Linneus to Vietnam veterans

The awareness exposure to overwhelming terror can lead to distressing memories, characterized by avoidance of becoming reminded of these memories and of arousal at reminders, has been a central theme in literature from ancient time to the present (van der Kolk, 2007). However, for long periods, there has been a total lapse within the psychiatric discipline of acknowledging the idea overwhelming experiences, in a profound and permanent mode, can alter people's psychology and biology; whereas, during other periods, the psychiatric profession has shown a thorough professional interest (van der Kolk, 2007).

The discussion about the etiology of posttraumatic stress reactions has at times been intense, whether it can be explained as an organic disturbance or as a psychological one; alternatively, if it is the event itself or the subjective interpretation that causes pathology. Another angle is whether an already existing vulnerability explains later reactions as signs of psychological disintegration (van der Kolk, 2007).

Historically, an early contribution in the field of diagnosing consequences of trauma was presented in a doctoral thesis from 1678 by a medical doctor and scientist, Johannes Hofer (Hofer, 1678), who described the syndrome of "Nostalgia". The Swedish scientist Carl von Linneus (Linneus, 1759) describes the syndrome of nostalgia in a medical classification system from 1759. Usually these syndromes referred to soldiers exposed to war experiences and who had developed a medical disturbance afterwards. In the late 19th century, after the introduction of railroads and subsequent accidents, a lively debate took place in England regarding the effects of trauma, especially regarding "railroad spines" (Erichsen, 1866).

Among scientists in the 19<sup>th</sup> century, there was further debate whether the cause of symptoms was organic or psychological. The German neurologist Herman Oppenheim (Oppenheim, 1889) invented the term "traumatic neurosis", claiming functional problems are produced by subtle molecular changes in the central nervous system. The common findings of cardiovascular symptoms in traumatized people, especially combat soldiers, started a long tradition of connecting posttraumatic problems with "cardiac neuroses". Other expressions were "irritable heart" or "soldier's heart", reflecting many of the observations were made on combat soldiers (Da Costa, 1871).

Other important contributions in the area were by Charles Myers, a British military psychiatrist during the First World War, who in the medical literature used the term "shell-shock" (Myers, 1915; Myers, 1940). However, soldiers not directly exposed to combat could also develop the same

symptoms (Myers, 1940), which supported the idea the cause is emotional rather than physical. Consequently, the debate of malingering started.

Another trajectory in the conceptual thinking of the relationship between psychological trauma and symptoms is found within French psychiatry. Sexual abuse of children was well documented during the latter part of the 19<sup>th</sup> century in France. The French psychiatrist Briquet (Briquet, 1859) highlights an association between childhood histories of trauma and symptoms of somatization, intense emotional reactions, dissociation, and fugue states. The neurologist Jean-Martin Charcot (Charcot, 1887), one of the first scientists to explore the relationship between trauma and psychiatric illness at the Salpêtrière Hospital in Paris, describes the problem of both suggestibility and hysterical attacks as dissociative and a result of having endured unbearable experiences (van der Kolk, 2007). One of Charcot's students, Pierre Janet, became a prominent researcher on the nature of dissociation and traumatic memories, and noted that patients with hysteria were unable to attend to their internal processes as mediators in order to respond adaptively to stress. Janet used the word subconscious to describe the collection of memories forming the mental schemes guiding a person's interaction with the environment (Janet, 1904; van der Kolk & van der Hart, 1989). Janet formulated a theory stating the effects of trauma on the mind are based on the notion of failure to integrate traumatic memories. The lack of integration would be caused by extreme emotional arousal at the time of the trauma, resulting in symptoms of what is now described as posttraumatic stress disorder, PTSD.

Until psychoanalysis took over as the dominant way of thinking within the psychiatric disciplines, Janet's clinical observations were widely accepted as the correct formulations of the effects of trauma on the mind. Sigmund Freud originally adopted many of the thoughts of Charcot after visiting him in 1885, and acknowledged this in his early papers on hysteria. However, he abandoned these theories in his writings "The Aetiology of Hysteria" (Freud, 1896), instead claiming repressed instinctual wishes form the foundation of neuroses. Consequently, the relationship between childhood trauma and the development of psychopathology was ignored for many decades, and was simultaneous with lack of research on the effects of real traumatic events on children's lives (van der Kolk, 2007).

The first person to integrate organic and psychological explanations of traumatic reactions was Abram Kardiner, an American psychiatrist who treated traumatized World War I veterans (Monson, Friedman & La Bash, 2007). Kardiner (Kardiner, 1941) identified the connection between the startle response and combat stress and war neurosis; this is considered a key contributor for modern definition of the concept of PTSD. Kardiner was among the first to identify behavioral and cognitive disturbances occurring due to traumatization.

Many observations on the effects of trauma are made by military psychiatrists, but are forgotten in peacetime and not brought into civilian psychiatry. However, after World War II another line of investigation emerged with the study of long-term effects of trauma on the survivors of the Holocaust and other war-related trauma (Eitinger, 1964; Eitinger & Ström, 1973), with findings of increased mortality, general somatic morbidity and psychiatric morbidity and enduring personality changes. Another similar line of research was regarding the “war sailors’ syndrome” from the Allied Convoy Service (Askevold, 1976-1977).

In later years, the experience from the Vietnam War led to an integrated understanding of the effects of trauma on social, psychological and biological functioning (van der Kolk, 2007), although much of the focus was on the effects on males. Since 1975, reports started to be more systematic of the effects of trauma on women and children (Burgess & Holstrom, 1974; Herman & Hirschman, 1981). Other important contributions for linking the effects of war trauma and traumas of civilian life were in the mid 1970s. In his book, *Stress Response Syndromes* Horowitz (Horowitz, 1976) defined the biphasic response to trauma: intrusion and numbing. Other important contributions were by Lindemann with his observations among bereaved relatives after the Coconut Grove Nightclub Fire 1942 (Lindemann, 1944), and Terr (Terr, 1979), who introduced a developmental focus on the effects of trauma on psychological functioning.

## The concept of traumatic stress and posttraumatic stress disorder (PTSD)

After being disregarded as a diagnostic entity for many years, the American psychiatric association included posttraumatic stress disorder (PTSD) in 1980 (DSM III) as an official diagnosis for the first time (Friedman, Keane & Resick, 2007). After several revisions, PTSD is today classified as an anxiety disorder with five criteria (American Psychiatric Association, 2000). These include: (A) the existence of a recognizable stressor usually experienced with intense fear, terror or, helplessness; (B) at least one of three types of re-experiencing symptoms; (C) at least three indicators of avoidance/numbing; and, (D) at least two arousal symptoms, including hyperarousal or startle, sleep disturbance or, trouble concentrating.

However, PTSD is not the only clinically relevant outcome of traumatic exposure. Other psychiatric consequences include depression, other anxiety disorders, alcohol or drug abuse and, reduced general psychological well being (Chang, Connor, Lai, *et al*, 2005; van Griensven, Chakkraband, Thienkrua, *et al*, 2006). In addition, there is increasing evidence that traumatized people who develop PTSD are at greater risk of developing medical illnesses (Schnurr & Green, 2004).

The diagnosis of PTSD has been criticized (Rosen & Lilienfeld, 2008; Rosen, Spitzer, & McHgh, 2008, Spitzer, First, & Wakefield, 2007), and the criteria for the diagnosis are suggested to be changed in the revised edition of DSM (DSM V), due in 2011-2012 (American Psychiatric Association, DSM V Development).

## Resilience and risk factors

During their lives, many people are exposed to traumatic events; however, the proportion of those who develop posttraumatic stress disorder (PTSD) is considerably lower than the proportion of those who have been exposed (Breslau, 2009; Breslau, Kessler, Chilcoat, *et al*, 1998). Some distress after an abnormal event is considered a normal reaction, but in most cases, this is followed by a rapid return to pre-disaster level of functioning (Bonanno, Wortman & Nesse, 2004).

The interest in factors important for resilience and recovery has increased and Norris *et al* states: “there is growing consensus resilience is better characterized as adaptability rather than stability” (Norris, Tracy & Galea, 2009, p. 2191). Resilience in this sense is a process of “bouncing back” from harm rather than immunity from harm (Layne, Warren, Watson, *et al*, 2007). Further, it has been recognized that psychological resilience should be differentiated from recovery (Norris, Tracy & Galea, 2009), where recovery can involve a longer period of dysfunction or distress, followed by a gradual return to pre-event functioning.

Risk factors for PTSD can be divided into pre-traumatic, peritraumatic and, posttraumatic factors. Pre-traumatic risk factors usually include demographic variables such as age, gender, educational level, previous trauma history and, personal psychiatric history (Brewin, Andrews & Valentine, 2000; Galea, Brewin, Gruber, *et al*, 2007). Genotype assessment resulting from the characterization of the human genome has also become a focus of research and studies on depression have determined a clear gene–environment interaction (Caspi, Sugden, Moffitt, *et al*, 2003; Kaufman, Yang, Douglas-Palumberi, *et al*, 2004).

Peritraumatic risk factors include a dose response relationship, meaning the severity of the traumatic exposure is likely to correlate with later PTSD symptoms (Bonanno, Galea, Bucciarelli, *et al*, 2006; Green, Lindy, Grace, *et al*, 1990; Holen, 1990; North, Pfefferbaum, Tivis, *et al*, 2004; Vogt, King & King, 2007). Peritraumatic factors can also include the individual’s reactions to the trauma, negative appraisals and coping processes, which might be important co-determinants of the psychological and biological stress responses (Olf, Langeland, Draijer, *et al*, 2007).

One of the key posttraumatic factors is whether the traumatized person received social support in the aftermath (Brewin, Andrews & Valentine,

2000). Social support appears an important factor in protecting individuals from developing PTSD after trauma exposure (Friedman, Keane & Resick, 2007).

## The epidemiology of trauma and PTSD

Investigators commonly distinguish between categories of trauma, either trauma caused by violence, such as sexual or physical assault, or other types of trauma, such as accidental injuries, natural disasters and, witnessing traumatic events. In general, trauma caused by interpersonal violence is considered more malevolent, and is the type of trauma most likely to lead to PTSD than traumas caused by accidents or natural disasters (Galea, Nandi & Vlahov, 2005; Kessler, Sonnega, Bromet, *et al*, 1995).

Prevalence of lifetime exposure to trauma is common in different western cultures and exposure to trauma is frequent rather than rare (Norris & Sloane, 2007). In a nationwide sample of adults in the US, 61% of men and 51% of women (Kessler, Sonnega, Bromet, *et al*, 1995) report at least one traumatic event, according to DSM criteria, during their lives. Similar findings are reported by Creamer *et al* (Creamer, Burgess, & MacFarlane, 2001) in a study of 10 000 adults in Australia. A Canadian telephone survey of 1000 selected adults (Stein, Walker, Hazen, *et al*, 1997) determined prevalence rates for life time exposure of 74% for women and 84% for men. The risk of exposure to violence is reported to be highest in the age group under 20 and exposure to sudden unexpected death was highest in the 41-45 age group (Breslau, Kessler, Chilcoat, *et al*, 1998). Residents of inner cities may be disproportionately exposed to some forms of trauma (Osofsky, 1997). De Jong *et al* (de Jong, Komproe, Van Ommeren, *et al*, 2001) studied exposure to trauma in four post conflict, low-income countries, Cambodia, Algeria, Ethiopia and Gaza, and determine very high rates of severe trauma exposure, especially conflict events, after the age of 12 (e.g. 92% in Algeria).

Only a smaller part of those exposed to trauma develop the full syndrome of PTSD. Prevalence rates of lifetime PTSD range from 8% to 12%. In a Swedish population, Frans (Frans, Rimmo, Aberg, *et al*, 2005) determined a life time prevalence of 5.6% and a Dutch study found a life time prevalence of 7.4% (de Vries & Olf, 2009). Exceptions from these levels are found in studies after disasters and other similar situations, where a large number of people share exposure to an overwhelming, recent stressor. After the volcano eruption at Mt St Helens, WA, USA, in 1980, 21% of high-exposure women developed generalized anxiety, depression and, PTSD symptoms, compared to 11% of the men (Murphy, 1986). After devastating floods and mudslides in Mexico in 1999, there was an initial prevalence of 24% PTSD, and among a highly exposed sample experiencing mass casualties and displacement

after the mudslide, the prevalence was 42% (Norris, Murphy, Baker, et al, 2004b). Rates of current PTSD decreased significantly over the following 18 months but remained higher than population norms (Norris, Murphy, Baker, et al, 2004b; Norris & Sloane, 2007).

Larger proportions of survivors develop symptoms below criterion level and partial PTSD can cause substantial dysfunction and suffering. At least one to two times as many people in the current population are estimated to have subsyndromal PTSD than have full PTSD (Norris & Sloane, 2007).

## Psychological effects of traumatic bereavement

Bereavement is one of the most painful experiences of life (Shear, Monk, Houck, et al, 2007), although after a traumatic experience, most bereaved people process their grief and recover (Neria & Litz, 2004). However, sudden and unexpected loss is more pathogenic than “normal” bereavement, affecting both physical and mental health, (Bonanno, Neria, Mancini, et al, 2007; Kaltman & Bonanno, 2003; Lundin, 1984a; Lundin, 1984b): traumatic bereavement is particularly stressful (Bonanno, Kaltman, et al, 1999). It is suggested that loss by traumatic means should be treated as a traumatic stressor and that resulting chronic conditions should be classified as posttraumatic stress disorder, PTSD (Green, 2000; Green, Krupnick, Stockton, et al, 2001).

The negative mental health outcome of traumatic bereavement can follow a longer course, becoming more adverse and featuring both traumatic stress and grief phenomenology (Raphael & Martinek, 1997). Grief may also cause depressive states, especially long-term depression. The conceptualization of PTSD (American Psychiatric Association, 2000) and traumatic grief (Gray, Prigerson & Litz, 2004) contributed to a better understanding of this domain, although different names for the grief condition have been suggested. Horowitz suggests the establishment of a pathological grief disorder (Horowitz, Bonanno & Holen, 1993), later renamed complicated grief disorder (Horowitz, Siegel, Holen, et al, 1997) to allow a better recognition of psychopathology triggered by loss. Prigerson proposed the term Complicated Grief (Prigerson, 2004; Prigerson, Maciejewski, Reynolds, et al, 1995), which later became ‘Prolonged Grief Disorder’, PGD (Boelen & Prigerson, 2007). Recommendations for criteria of the syndrome are presented for the planned revision in DSM-V (Prigerson, Horowitz, Jacobs, et al, 2009).

The study of loss has a long tradition. In his chapter Mourning and Melancholia (Freud, 1957; 1917), Freud described in 1917 how grieving can be complicated by traumatic experiences in connection with the loved object. Lindemann (Lindemann, 1944) defined acute grief in a classical presentation of those who were bereaved by traumatic circumstances of death after the

Coconut Grove Nightclub fire. Parkes (Parkes, 1971) and Bowlby (Bowlby, 1980) later clarified the concept of normal bereavement and Horowitz (Horowitz, 1976) included normal bereavement as a stressor and bereavement as a traumatic stress syndrome, whether or not the loss had come through traumatic death circumstances. Thus, trauma and grief were not conceptualized or clarified separately (Raphael, Martinek & Wooding, 2004). Later studies investigate the association between traumatic incidents and bereavement. In a follow-up at 2.5-3.5 years after the terrorist attacks of World Trade Centre in 2001, complicated grief was common among bereaved adults (Neria, Gross, Litz, *et al*, 2007). After the 2004 tsunami disaster exposure, strong predictors of health complaints were danger of death, bereavement and witness impressions (Heir, Piatigorsky & Weisaeth, 2009).

There are associations between grief reactions and self-reported levels of posttraumatic stress symptoms (Pfefferbaum, Call, Lensgraf, *et al*, 2001). However, there are also distinct differences. Contrary to PTSD, nightmares are not considered a prominent symptom (Shear, Frank, Houck, *et al*, 2005) in complicated grief (CG), whereas the greatest difference between CG and PTSD is in criterion D for PTSD (hyperarousal) (Gray, Prigerson & Litz, 2004). Grief may also cause depressive states, especially long-term (Bonanno, Neria, Mancini, *et al*, 2007; Green, Lindy, Grace, *et al*, 1990).

### Loss due to violent death

There is strong support for a violent nature of a death, rather than suddenness, being the key factor for subsequent PTSD symptoms and enduring distress (Green, Krupnick, Stockton, *et al*, 2001; Kaltman & Bonanno, 2003). Loss from motor vehicle accidents, (Lehman, Wortman & Williams, 1987), suicides (Feigelman, Jordan & Gorman, 2008), loss in intensive care (Anderson, Arnold, Angus, *et al*, 2008), and loss through natural disasters and accidents (Carlier & Gersons, 1997; Ghaffari-Nejad, Ahmadi-Mousavi, Gandomkar, *et al*, 2007; Souza, Bernatsky, Reyes, *et al*, 2007) reveal substantial levels of distress among bereaved relatives.

### Loss of children

Closeness in relationship to the deceased is important (Neria, Gross, Litz, *et al*, 2007). Loss of children is assumed to cause more intensive and persistent grief (Cleiren, Diekstra, Kerkhof, *et al*, 1994; Lundin, 1984b) and makes the grieving process more difficult (Shear, Frank, Houck, *et al*, 2005). However, less is known whether the age of the dead child is associated with subsequent trauma symptoms; although it is suggested the best predictor of grief severity is not the chronological age but the reproductive value of the child, implying the likelihood the child will produce offspring (Bonanno, Kaltman, *et al*, 1999).

## Neurobiological theories and PTSD

Many people exposed to extreme stress will develop intrusive symptoms, but only some will develop avoidance and hyperarousal. When people perceive the environment, sensory signals are sent to the thalamus. Normally, these signals are made conscious through a long loop to sensory areas in the neocortex and can be relayed to former memories in other areas in the brain, such as the amygdala and hippocampus. Emotional aspects from the amygdala are attached, meaning the experiences can be evaluated on a scale from pleasant to unpleasant. In this way, some integration takes place. A model to explain information processing during danger suggests the signals will pass the thalamus and take the short loop directly to the amygdala, which activates the hypothalamus with the HPA-axis and locus coeruleus (Rauch, Shin & Phelps, 2006). In this mode, the stress system is activated. A high degree of activation of the amygdala and related structures can generate emotional responses and sensory impressions. Hippocampus, as a basic organizer of information, has a responsibility to moderate this stress response, as does the prefrontal cortex, where the experience is consciously processed. In situations with extreme arousal, the moderating role of the hippocampus and prefrontal cortex can be disrupted in some individuals. The effect will be a default inhibition on the amygdala, which instead could enhance storage of traumatic memories (Shin, Rauch & Pitman, 2006). The result is memories will be stored unorganized and unprocessed as affective states or in sensory-motor modalities, such as somatic sensations and visual images. These fragmented memories are not localized in time and space; thus, continue to lead an isolated existence (van der Kolk, 1996). Therefore, traumatic memories are characterized as "an eternal presence".

## Social and cognitive theories for understanding mental health effects of disasters

Several theories are proposed to explain disaster mental health. Some social and cognitive theories have gained considerable empirical support (Benight, Cieslak & Waldrep, 2009). A few of them will be presented, and a summary of the theories and key constructs is presented in Table 2.

*Social cognitive theory* outlines the importance of bidirectional interaction between the environment, the individual and, the behavior. This framework suggests a dynamic model of human adaptation through self-regulating behavior, mediated by feedback systems both internally (cognitive appraisal systems) and externally (changes in environmental conditions). A key concept is self-efficacy, defined as the perception of the capability to enact a certain behavior. Mastery, a construct closely related to coping, is predictive of psychological outcomes after disaster (Kaniasty, 2006; Murphy, 1988).

### *Stress and coping theory*

Stress and coping theory (Lazarus & Folkman, 1984) directly addresses the interactive process between environmental stress demands and the individual. In this framework, the role of cognitive appraisal is emphasized. The theory distinguishes between primary appraisal (importance of specific person to environment interaction for own well-being) and secondary appraisal (perception of available resources). Applications of the theory usually focus on studying coping behaviors, problem focused coping and emotion-focused coping. Less attention has been on the cognitive appraisal aspects of the theory (Benight, Cieslak & Waldrep, 2009).

### *Information processing theories*

Several trauma-specific theories have been developed that focus on the importance of information processing in understanding trauma recovery. Horowitz (Horowitz, 1976), regarded as one of the pioneers, highlights cognition as a central factor in the theory of human adaptation to trauma. Horowitz suggests the individual fluctuates between avoidance and assimilation of traumatic material in an attempt to process what has just happened. This process facilitates the traumatic material to be integrated into the person's life experience. However, for some people, the process of integration does not take place and the intrusion of traumatic experiences remains elevated, together with an increase in avoidance of thoughts related to the trauma. When the normal processing fails, symptoms of PTSD will worsen. Janoff-Bulman (Janoff-Bulman, 1992) proposes that what makes an event traumatic is the confrontation of cherished beliefs about the world (e.g. the world is safe) and the self (e.g. I am competent) through a traumatic experience. In emotional processing theory (Foa & Rothbaum, 1998) the importance of cognitively working through a traumatic experience is emphasized. A special focus is on distorted cognitions related to the trauma, current perceptions on personal safety, and self-assessment of competence. A related cognitive theory was developed by Ehlers et al (Ehlers & Clark, 2000), emphasizing the role of cognitive appraisal during the trauma and in the aftermath of the event. Lack of autobiographical integration of the trauma memory, combined with ongoing negative self-appraisals related to the event is considered associated with the PTSD problems (Ehlers & Clark, 2000).

### *The dual processing theory*

The dual processing theory (Brewin, Dalgleish & Joseph, 1996) builds upon advances in neuroscience and observations from social cognitive theory, differentiating between immediate trauma memory consolidation and subsequent self-appraisals. Two memory systems, verbally accessible memory (VAM) and situationally accessible memory (SAM), are suggested to

operate in parallel, although one or the other will dominate at a given moment. The two memory systems need to be integrated to enable the individual to handle reminders of the trauma in a constructive way.

All cognitive theories of trauma emphasize dynamic cognitive processing of a traumatic experience as central to healthy adaptation (Benight, Cieslak & Waldrep, 2009).

Table 2. Theory and key constructs for disaster or trauma mental health research (from Benight, Cieslak & Waldrep, 2009)

<b>Theory</b>	<b>Key constructs</b>	<b>Reference</b>
Social cognitive theory	Coping self-efficacy	Bandura, 1997; Benight & Bandura, 2004
	Mastery	Murphy, 1988; Kaniasty, 2006
	Collective efficacy	Benight, 2004
Stress and coping theory	Primary appraisal, secondary appraisal, problem-focused; emotion-focused coping	Lazarus & Folkman, 1984
Conservation of resources theory	Loss of resources, resource gains, loss spirals	Hobfoll, 2001
Social support deterioration deterrence model	Received social support, perceived social support	Norris & Kaniasty, 1996
Theory of shattered assumptions	Shattered assumptions	Janoff-Bulman, 1992
Emotional processing theory	Self and world schemas Negative cognitions about self and the world	Foa & Rothbaum, 1998; Foa, Ehlers, Clark, Tolin, & Orsillo, 1999; Ehlers & Clark, 2000
Dual processing theory	Verbal accessible memory (VAM), Situational accessible memory (SAM)	Brewin, Dalgleish, & Joseph, 1996

## PTSD and recovery

Some authors claim that in the absence of treatment, the prognosis for recovery is considered poor among people continuing to fulfill the criteria for PTSD one to two years after the event (Norris & Sloane, 2007), however, others disagree with this conclusion. Kessler et al (Kessler, Sonnega, Bromet, *et al*, 1995) claim that the average person with PTSD, even after two years still has a 50% chance of remission without treatment.

One of the key posttraumatic factors is whether the traumatized person received social support in the aftermath (Brewin, Andrews & Valentine, 2000). Bonanno (Bonanno, Galea, Bucciarelli, *et al*, 2007) claims economic and social resources are important factors in recovery after traumatic loss, combined with personal factors such as capacity for positive emotions and

comfort from positive memories. Other factors of importance can include adaptive flexibility and pragmatic coping (Bonanno & Gupta, 2009; Mancini & Bonanno, 2006). Efficient trauma focused psychotherapies for the treatment of PTSD (Bisson, Ehlers, Matthews, *et al*, 2007; Foa, Keane, Friedman, *et al*, 2009), such as eye movement desensitization and reprocessing (EMDR) and, trauma focused cognitive behavioral therapy (TF-CBT) have developed, which can effectively facilitate recovery when spontaneous remission is inhibited.

## Areas for further exploration

Some areas in the field of psychotraumatology are still not well explored. The prevalence of trauma reactions in a population not normally experiencing natural disasters is understudied. Moreover, disaster studies often assess groups seeking help (Holbrook, Hoyt, Stein, *et al*, 2002; McFarlane, Clayer & Bookless, 1997) or residents of an affected area (Chou, Wu, Chou, *et al*, 2007; Goenjian, Walling, Steinberg, *et al*, 2009; Norris, Murphy, Baker, *et al*, 2004a; Ohta, Araki, Kawasaki, *et al*, 2003; Onder, Tural, Aker, *et al*, 2006; Tang, 2007; Tsai, Chou, Chou, *et al*, 2007; van den Berg, Grievink, van der Velden, *et al*, 2008). Few studies investigate the impact of a major natural disaster on a large defined population of visitors from western countries traveling on vacation far from their native country but who are evacuated and able to return to a place unaffected by a catastrophe. In addition, the effects of bereavement after traumatic circumstances are not satisfactory explored (Raphael, Martinek & Wooding, 2004). There is unclear or limited knowledge whether the death of a loved one due to particularly horrific causes is associated with unique complications in addition to, or instead of PTSD (Gray, Prigerson & Litz, 2004) and the emotional and psychological needs of traumatically bereaved have been neglected (Gray, Prigerson & Litz, 2004). Long-term studies on the effects of natural disasters are not well represented and the course of recovery after traumatic exposure is not satisfactory investigated: many studies have a cross sectional methodology. Therefore, it is of scientific importance to be able to follow the course of recovery after disaster exposure in a large population (Galea, Nandi & Vlahov, 2005).

# Aims of the thesis

The main aim of this thesis was to investigate the short- and long-term psychological effects of traumatic exposure and traumatic bereavement after disasters taking place at distant sites from the homes of the victims. In more detail, this implied:

- psychological reactions and the role of psychosocial support through comparing two groups of bereaved relatives from Italy and Sweden, 18 months after traumatic bereavement.
- the association between exposure to the 2004 tsunami and post-traumatic stress reactions, general mental health and, suicidal ideation. The hypothesis was severe exposure to life-threatening danger would increase the probability for post-traumatic stress reactions and affect general mental health 14 months after the disaster. The hypothesis included the effects of bereavement, being physically injured, experiencing a life-threatening situation, witnessing other people suffering and, being exposed to a mass death event.
- the impact of traumatic bereavement and exposure to life danger among bereaved in relation to posttraumatic stress symptoms and mental health. The hypothesis was factors such as exposure to life danger and closeness in relationship to the deceased were related to later reactions of psychological distress and complicated grief.
- the impact of traumatic bereavement on complicated grief, affected mental health and, posttraumatic stress symptoms, in a group of relatives, who were at home and informed about the loss, in relation to a group of relatives, who were both bereaved and exposed to the disaster site. The hypothesis was complicated grief, impaired mental health and, posttraumatic stress reactions were related to degree of exposure. An association between closeness in relationship to the deceased and later reactions was also hypothesized.
- trajectories and long-term rates of recovery by severity of exposure to a natural disaster. The hypotheses were post-traumatic stress reactions and affected mental health would be reduced after three years, compared to 14 months, and the effects would be less reduced among those exposed to life threat and among the bereaved.
- the association between perceived social support after the disaster and later reactions.

# Ethical considerations

The studies were approved by the Ethics Committee of Uppsala University Hospital, Uppsala, Sweden (Paper I, dnr 03-042) and the Regional Ethical Vetting Board, Uppsala, Sweden (Papers II, III, IV and V, dnr 2005:157).

# Materials and Methods

## Subjects and procedures

### Population and study sample

#### **Paper I**

Italian (n=184) and Swedish (n=63) adult (>18 years) bereaved family members of 77 deceased disaster victims were identified through national self-help organizations and invited to participate in the study 18 months after the Linate airplane disaster. Questionnaires (n=247) were distributed by mail and all data were collected anonymously. The response rate was 56% for the Italian group and 84% for the Swedish group: total response rate was 62%. The difference in response rate was not statistically significant.

#### **Paper II, III, IV, and V**

An overview of the study samples in Papers II –V is presented in Table 3.

Table 3. Study overview Papers II – V

<b>Paper</b>	<b>Time point</b>	<b>Sample</b>
Paper II	T1, 14 months	Original sample (n=4932)
Paper III	T1	High- and medium exposed, including bereaved relatives and friends (n=3551)
Paper IV	T1, 14 months 21 months	Bereaved close relatives: Exposed relatives (n=141) Home-staying relatives (n=345)
Paper V	T2, three years	Follow-up sample from T1 (n=3457)

#### **Paper II**

Swedish citizens returning from the affected region in Southeast Asia were registered by the national police at the three main Swedish airports during the first three weeks after the disaster. To be included in the study, individuals had to be at least 16 years old. This resulted in a list of 13,205 Swedish citizens. Ten healthcare regions accepted to participate in the study, accounting for 77% of the individuals registered. An invitation to participate was sent out by mail to 10,501 individuals. Youngsters between 16 and 18

years of age needed written consent from their caregivers. From the individuals invited, 385 actively communicated the wish to abstain from participating, mainly due to not having been in the affected areas. This left a final sample of 10,116 individuals. From the 4932 returned questionnaires, 4910 could be used for a general statistical analysis, which constituted a response rate of 49%. A response rate of at least 70% of the IES-R questionnaire was a minimum criterion for inclusion in the statistical analyses. From the original responses, 88 did not fulfill the minimum criterion, leaving a final sample of 4822 individuals. The final sample was divided into three subgroups: danger-to-life exposure (n= 2012), non-danger-to-life exposure (n= 1507) and low exposure (n= 1303).

### **Paper III**

Among responders who answered the 14-month questionnaire, 3551 persons were identified as tsunami survivors exposed either to danger-to-life or non-danger-to-life. Of these, 499 individuals were identified as bereaved: 189 family members and, 310 friends; whereas, 3048 were identified as tsunami exposed and non-bereaved survivors (reference category). Four people did not respond to the item “bereavement status” and were therefore categorized as missing data. Relatives included: parents, children, grandchildren, spouses/partners, siblings and, other relatives. Friends also included colleagues and workmates. Danger-to-life (high exposure) included 2023 people, and non-danger-to-life (medium exposure) 1528 people. A response rate of at least 70% for the IES-R questionnaire was a minimum criterion for being included in the analyses, where IES-R was the outcome variable.

### **Paper IV**

Data were available from two samples of Swedish bereaved close relatives after the 2004 tsunami: those exposed to the tsunami and those that were home-staying relatives. Close relatives, included spouses/partners, parents and children. To avoid the risk of the same individual being represented in both sub samples, the samples were checked. However, there were participants both in the tsunami-exposed and in the home-staying group from three families, although different individuals were concerned.

#### *Sample 1*

Among responders who answered the 14 months questionnaire, 141 persons were identified as bereaved, close family members. Data collection procedures are previously described (Papers II and III).

#### *Sample 2*

Bereaved close family members, who had not accompanied their relatives to Southeast Asia, were identified by the Swedish police and approached by mail 21 months after the tsunami. Of those invited, 546 persons agreed to

participate in the study. Posted questionnaires were followed by one reminder to non-responders. Out of 353 questionnaires returned, 345 could be used for the statistical analyses, which constituted a response rate of 58%.

Thus, the final combined sample consisted of 486 bereaved relatives: 141 tsunami-exposed relatives and 345 home-staying relatives.

### **Paper V**

Three years after the tsunami (T2), a second questionnaire was sent out to the respondents who had participated in the 14 months follow-up (T1, Paper II). The response rate was 70% (n=3457) of those who responded at T1. The T2 sample was divided into three subgroups: high exposure (n=1501), medium exposure (n=1060) and low exposure (n=895).

## **Measures**

### **Paper I**

A special questionnaire was compiled, which covered socio-demographic background variables; estimation of somatic and mental health (pre- and post accident), the need for medical and psychosocial support, acute and in the long-term phase; and, use of antidepressants, tranquilizers and hypnotics. The questionnaire was translated into Italian and Swedish.

### **Paper II, III and V**

A comprehensive questionnaire, adapted to Swedish circumstances from a similar questionnaire used for Norwegian tsunami victims (Heir and Weisaeth, 2008), was compiled and mailed 14 months after the disaster, and followed by one reminder to non-responders (paper II, III). The questionnaire comprised of items covering background information; exposure during the tsunami; reactions after the tsunami; health conditions; bereavement; and, the support and help that followed the tsunami.

Approximately three years after the tsunami, a second questionnaire was sent out, followed by one reminder, and included items on demographic characteristics; bereavement; reactions after the tsunami; previous and additional trauma experiences; health conditions; medication; and, support afterwards (Paper V).

### **Paper IV**

A questionnaire, adapted from the one used in paper II and III, was distributed to home staying relatives. The questionnaire included items that covered background information, health conditions, bereavement, reactions and experiences of support and help that followed the tsunami.

## Psychometric assessment

### **The General Health Questionnaire-12 (GHQ-12)**

The General Health Questionnaire-12 (GHQ-12) (Goldberg, Gater, Sartorius, *et al*, 1997) was used in Papers II, III, IV and V to evaluate respondents' general mental health during the last few weeks before participating in the study. The GHQ-12 has an internationally accepted cut-off score of  $\geq 3$ , indicating a lower degree of mental health (Connor, Foa & Davidson, 2006).

**Suicidal ideation** was measured whether it was observed or not by the respondent during the past 12 months (yes/no).

### **The Impact of Event Scale-22-Revised (IES-R)**

The Impact of Event Scale-22-Revised (IES-R) (Weiss, 2004) was used to evaluate post-traumatic stress reactions, with reference to the respondents' experience of the tsunami (Papers II, III and V) or getting the message about a traumatic loss (Papers I and IV). The respondents were asked to evaluate how disturbing the symptoms had been during the past seven days and instructed to rate each item on a five-point Likert scale ranging from 0 (not at all) to 4 (extremely disturbing). To measure the prevalence of severe posttraumatic reactions, the proportion of respondents with an IES-R mean item score of  $\geq 1.89$  (Weiss, 2004), equivalent to a sum score of  $\geq 41.6$ , was calculated. However, in the regression analyses, sum scores were used (Papers II, III, IV and V).

For Paper I, an Italian translation was used for the Italian responders. The subscales Intrusion, Avoidance and, Hyperarousal, were calculated to evaluate post-traumatic stress reactions. A cut off score of  $\geq 33$  on the combined sub scales Intrusion + Avoidance was chosen to indicate posttraumatic stress reaction.

### **Inventory of Complicated Grief**

To measure CG, the Inventory of Complicated Grief (Prigerson, 1999; Prigerson, 2004; Prigerson, Frank, Kasl, *et al*, 1995) was used (Papers III and IV). The respondents were asked to indicate the frequency of symptoms during the past month on a 5-point scale (0 = almost never, 1 = rarely, 2 = sometimes, 3 = often, 4 = always).

Prigerson (Prigerson, 2004) and others (Neria, Gross, Litz, *et al*, 2007) recommend nine items constitute the concept of complicated grief: yearning for the deceased; preoccupation with the deceased that interrupts normal activities; trouble accepting the loss; detachment; bitterness; loneliness; feeling that part of one's self died; feeling that life is empty; and loss of security or safety. The nine items from the Inventory of Complicated Grief corresponding best to the concept (items 1, 3, 4, 9, 10, 13, 16, 17 and 19)

were selected to create *the Complicated Grief Index*, which was used for the data analyses. The answers to the nine selected items were dichotomized. If the respondent replied with often or always to at least five of these nine symptoms, one of which had to be yearning, it was considered a complicated grief reaction.

**Social support** was measured by one question: “*Are you, on the whole, pleased with the social support you received after the tsunami?*” The respondents rated contentment on a seven-point Likert scale, ranging from 1 (*never*) to 7 (*always*).

## Statistical methods

Significance level was set at  $p = <0.05$  for all papers.

### **Paper I**

The statistical program SPSS (Howitt & Cramer, 2001) was used to perform the statistical analyses. Due to skewed distributions and heterogeneity of variance, non-parametric statistics were used. Chi-square test assessed whether two or more samples differed significantly. To compare three or more samples with different subjects, the Kruskal-Wallis test was used. Dunn’s test was used for multiple contrasts with rank sums. The McNemar test measured significance of changes. The relationship between variables was assessed by Spearman’s rank correlation coefficient. To analyze whether the ranks in one group were larger or smaller than the ranks in the other group, Wilcoxon’s test was used for related data.

### **Papers II, III, IV and V**

The statistical program SAS version 9.1 (SAS, 2002) was used to perform the statistical analyses for Papers II and III. SAS version 9.2 (SAS, 2008) was used for the statistical analyses in Papers IV and V.

For all analyses, the variable “social support” was treated as a continuous covariate; all other independent variables were entered as factors (Papers IV and V).

Linear regression analysis was used to estimate the associations between independent variables and posttraumatic stress reactions (IES-R sum score). This was done separately at first and then in an adjusted model, where all demographic characteristics were included (Papers II, III and IV). Negative binomial regression with log link was used to estimate the association between independent variables and IES-R sum score at the three-year follow-up (Paper V).

Similar analyses were repeated for GHQ-12 and suicidal ideation, although, logistic regression was used as these outcomes were binary (Papers II, III, IV and V). For the analyses of the Complicated Grief Index, logistic

regression was used, but was limited to the group of bereaved relatives (Papers III and IV).

In Papers III and IV, an interaction term of loss and exposure was added to the analyses, as a statistical interaction between these two variables was suspected. In Paper IV, a similar interaction effect between gender and kinship with the deceased was also included.

In Paper V, generalized estimating equations (GEE) analysis estimated the association between independent variables and change in outcome measures over time, while considering correlation between the time points. When IES-R sum was the dependant variable, negative binomial distribution with log link was used, whereas, binomial distribution with logit link was used for the dichotomized GHQ-12 measure and for suicidal ideation. Time (coded as 0 and 1) was included as an independent variable; for each other independent variable in the model, an interaction term of time and the variable was included. The interaction terms were then removed stepwise by a modified manual backwards elimination procedure: the interaction term with the highest type III P-value was removed in each step, until only interaction terms with a Type III P-value of  $<0.05$  remained. However, the interaction terms exposure\*time and loss\*time were not removed, even if they had a type III test  $P >0.05$ .

# Summary of Results

## Demographic characteristics of the samples

### Paper I

The respondents had an average age of 45 years, with a range of 18–91 years: 65% of the responders were women, 58% in the Swedish group and 68% in the Italian group. The pattern of relationship to the deceased person was similar: 27% were partners, 22% were children, 29% were parents and, 21% were siblings.

### Papers II and V

The respondents had an age range of 16 to 90 years with a mean of 43.5 years (Paper II). The proportion of women was 55% (Paper V: 58%). The sample was characterized as a socio-economically stable and well-educated group. A majority of the respondents had grown up in Sweden, more than 40% had a college or university degree (Paper V; 44%), and 70% (Paper V; 74%) were married or living with a partner. The majority had a full-time job. The mean age was similar in the three exposure groups.

In the 14-month follow-up (Paper II), younger people and men were less likely to respond. In the three-year follow-up (Paper V), respondents were older (median age 43 years) than non-respondents were (39 years). Women (74% response rate) were more likely to respond than men were (66% response rate), and those with more than 12 years of education were more likely to respond (74%) than those with lower education levels were (68%). High-exposure people (74%) were more likely to respond than medium- (69%) and low-exposure (66%) people were. No differences between respondents and non-respondents for posttraumatic stress reactions, affected mental health or suicidal ideation, as measured in the first survey, were discerned, nor was there a difference in response rate between bereaved and non-bereaved (Paper V).

### Paper III

The cohort in Paper III included respondents, who in Paper II indicated they had been exposed to danger-to-life or non-danger-to life during the tsunami.

Of the respondents, 56% were female, 43% had more than 12 years of education and, 71% were married or living with partner.

## Paper IV

In the combined sample of tsunami-exposed close relatives and home-staying close relatives, the age of the respondents was between 17 and 86 years, with a mean age of 42 years in the tsunami-exposed and 50 years in the home-staying group. Women comprised 60% of the tsunami-exposed group and 58% of the home-staying group. Of the bereaved tsunami survivors, 47% had more than 12 years of education, whereas, 37% in the home-staying group had more than 12 years of education. Among the tsunami survivors, 53% were married or living with a partner, compared with 73% in the home-staying group.

In the tsunami group, 41% had lost one child or more, 26% had lost a partner, 32% had lost parents/siblings; for the home-staying relatives, 50% had lost one or more child, 4% had lost a partner, and 46% had lost parents/siblings. The median age for loss of children was 14.5 years in the tsunami-exposed group and 34.5 years in the home-staying group.

## Posttraumatic stress reactions

### Prevalence

At 14 months post-disaster (Paper II), 21% in the danger-to-life exposure (high exposure) group, 10% in the non-danger-to-life exposure group (medium exposure) and, 2% in the low exposure group, were considered to have significant posttraumatic stress reactions (Table 4).

At the three-year follow-up, the corresponding figures were attenuated: 12% in the high exposure group, 3% in the medium exposure group and, 0.3% in the low exposure group (Paper V).

Of bereaved close relatives (Paper I), 58.7% of Italian and 42.6% of Swedish relatives were considered to have considerable posttraumatic stress reactions 18 months after the traumatic loss. In comparison, among tsunami-exposed survivors 14 months after the tsunami disaster (Paper III), 41% of bereaved relatives, 26% of bereaved friends and, 13% of the non-bereaved had a high frequency of posttraumatic stress reactions. In a group of close relatives (Paper IV), posttraumatic stress reactions were found among 46% of tsunami-exposed relatives and among 33% of home-staying relatives.

Table 4. Prevalence of posttraumatic stress reactions and affected mental health in different samples

Paper	Sub group	Follow-up (months)	n	Posttraumatic stress reactions, %	GHQ-12 $\geq 3$ , %	
II	Exposure T1	High	14	2012	21	31
		Medium	14	1507	10	23
		Low	14	1303	2	11
V	Exposure T2	High	36	1501	12	28
		Medium	36	1060	3	20
		Low	36	895	0.3	13
I	Bereavement	Italian	18	103	58.7	-
		Swedish	18	50	42.6	-
III	Tsunami relatives <sup>1</sup>	Tsunami relatives <sup>1</sup>	14	187	41	62
		Tsunami friends	14	308	26	38
		Non-bereaved	14	3048	13	24
IV	Tsunami relatives <sup>2</sup>	Tsunami relatives <sup>2</sup>	14	141	46	69
		Home-staying	21	345	33	50
V	Bereaved T2 <sup>3</sup>	36	131	21	43	

<sup>1</sup> Tsunami relatives include partners, parents, children, siblings and, other relatives

<sup>2</sup> Tsunami relatives include partners, parents, children, and siblings.

<sup>3</sup> All who indicated loss of relatives at T2.

## Demographic characteristics in relation to posttraumatic stress reactions

Young (16-24) and old age (>60 years) (Paper IV), female gender (Papers II, III, IV and V), former trauma experiences during childhood (Papers III and IV) and  $\geq 2$  (Paper II) or  $\geq 3$  experiences during adulthood (Papers III and V), previous psychiatric illness and further traumatic experiences after the tsunami (Paper V) were associated with higher levels of posttraumatic stress reactions. Young age (16-18 years) (Paper II), having a partner (Papers II, III and IV) and, more than 9 (Paper II) or 12 years of education (Papers II, III, IV and V) were associated with lower levels of posttraumatic stress reactions.

## Exposure and loss in relation to posttraumatic stress reactions

Adjusting for covariates, the IES-R scores at the 14-month follow-up was predicted to be an average 16.69 points higher in the danger-to-life exposed group than in the low exposure group (Paper II). For the non-danger-to-life exposure group, the IES-R scores were predicted to have an average of 8.55 points higher than in the low exposure group (Paper II; Table 5).

Table 5. Level of exposure in relation to posttraumatic stress reactions (IES-R)

IES-R				
Exposure level	N	Mean	Adjusted Estimate	CI 95%
Danger-to life exposure	2012	25.63	16.69 ***	15.60- 17.79
Non-danger-to-life exposure	1507	17.45	8.55***	7.39-9.71
Low exposure	1303	8.70	(ref)	

\*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.0001; (ref)= reference category  
Adjusted for covariates

Exposure was associated with higher levels of posttraumatic stress reactions after adjusting for other covariates at the three-year follow-up. In the high-exposure group, the predicted score was approximately three times the predicted score of the low-exposure group: in the medium-exposure group, the predicted score was approximately twice the predicted score of the low-exposure group. In the bereaved group, the score corresponded to an average of 86% higher score than those with no loss (Paper V).

When type of loss was added to the regression analyses for the bereaved groups, higher levels of posttraumatic stress reactions were identified in both tsunami-exposed bereaved relatives, compared to tsunami exposed bereaved friends (Paper III) and, tsunami-exposed close relatives, compared with home-staying bereaved relatives (Paper IV). In addition, loss of children, compared with loss of parents or siblings, was associated with higher levels of posttraumatic stress reactions (Paper IV).

### Interaction between exposure and loss and posttraumatic stress reactions

To investigate if the association between exposure and posttraumatic stress symptoms was different among the various bereavement groups, an interaction term of exposure and loss was included in the linear regression model (Table 6). Within all the bereavement groups, danger-to-life exposure was, in this interaction model, associated with more elevated posttraumatic stress reactions (Paper III). Furthermore, the average impact of danger-to-life exposure was higher for bereaved relatives and friends than for the non-bereaved group. In Paper IV, this interaction effect was not indicated.

Table 6. Linear regression analyses of interaction of loss and exposure in relationship to posttraumatic stress reactions (IES-R), estimates of difference between groups

	Regression results		
	B <sup>a</sup>	SE B	β
<i>Exposure to danger within bereavement groups</i>			
Relatives life-danger <sup>b</sup> vs. Relatives non-life-danger <sup>c</sup>	13.16***	2.92	0.25
Friends life-danger <sup>d</sup> vs. Friends non-life-danger <sup>e</sup>	14.20***	1.90	0.27
No loss life-danger <sup>f</sup> vs. No loss non-life-danger <sup>g</sup>	6.70***	0.61	0.07
<i>Bereavement type within life-danger exposure</i>			
Relatives <sup>b</sup> vs. Friends <sup>d</sup>	4.69*	1.92	0.05
Relatives <sup>b</sup> vs. No loss <sup>f</sup>	15.20***	1.45	0.18
Friends <sup>d</sup> vs. No loss <sup>f</sup>	10.51***	1.38	0.13

Note. IES-R = Impact of Event Scale–Revised; Missing values: education (n=23), IES-R (n=32), bereavement status (n=4).

<sup>a</sup>Adjusted for age, gender, education, family situation, history of traumatic events in childhood and adulthood. <sup>b</sup> Bereaved relatives exposed to life danger (n=145). <sup>c</sup> Bereaved relatives exposed to non-life danger (n=42). <sup>d</sup> Bereaved friends exposed to life danger (n=159). <sup>e</sup> Bereaved friends exposed to non-life danger (n=149). <sup>f</sup> Non-bereaved exposed to life-danger (n=1705). <sup>g</sup> Non-bereaved exposed to non- life danger (n=1315).

\*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001.

## Other factors related to posttraumatic stress symptoms

Personal physical injuries, viewing many dead bodies and injured survivors, experiencing life threat and, not remembering helping others (Paper II) were factors related to more severe posttraumatic stress symptoms.

## Trajectories of change

With dichotomized IES-R scores, four trajectories of traumatic stress reactions from T1 and T2 were defined: resilient, remitted, delayed, and persistent (Paper V). Among the respondents, 76.6% of high-exposure survivors, 91% of medium-exposure survivors, 98.2% of the low-exposure group and, 51.9% of the bereaved group were identified as resilient (Figure 1). Of the respondents, 11.9% of the high-exposure survivors, 6% of the medium-exposure survivors, 1.5% of the low-exposure group and, 26% of the bereaved group were identified as remitted; whereas, 3% of the high-exposure survivors, 1% of the medium-exposure survivors, 0.1% of the low-exposure group and, 3% of the bereaved group, were identified as delayed. Finally, among the respondents, 8.5% of the high-exposure survivors, 1.9% of the medium-exposure survivors, 0.2% of the low-exposure group and, 19.1% of the bereaved group were identified with persistent reactions.

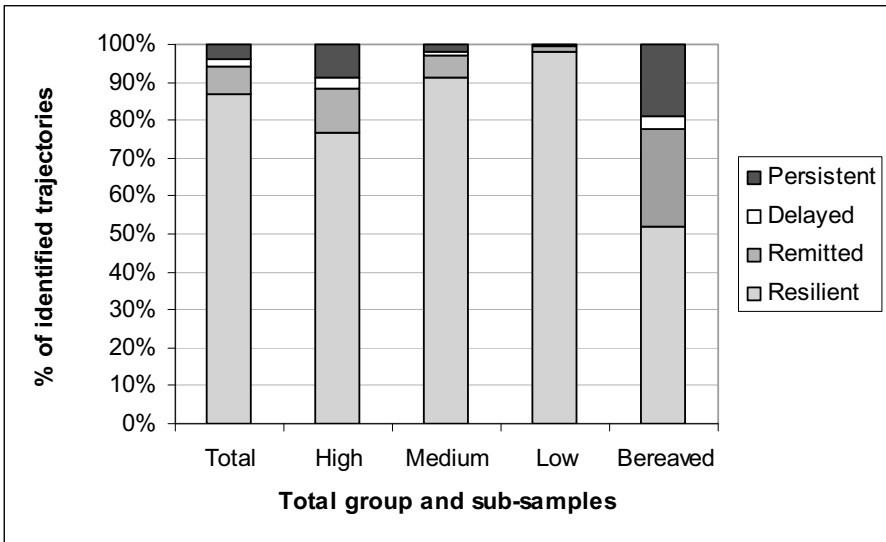


Figure 1. Identified trajectories of traumatic stress reactions and proportions, total sample (n=3457), high (n=1501), medium (n=1060), and low (n=896) exposure groups and, the group of bereaved (n=131).

There was a decrease in posttraumatic stress reactions from T1 to T2 (Paper V) in the three exposure groups, and in bereaved and non-bereaved responders (Figure 2). However, the high-exposure group and the bereaved responders generally recovered from higher levels of posttraumatic stress reactions. The proportional recovery was not as large in the high-exposure group (corresponding to a predicted 30% lower IES-R at T2) and the medium-exposure group (corresponding to a predicted 35% lower IES-R at T2) as in the low-exposure group (corresponding to a predicted 42% lower IES-R at T2). Loss of relatives predicted a further slower recovery, predicting on average a 9% higher score on IES-R at T2 than high- and medium-exposure non-bereaved.

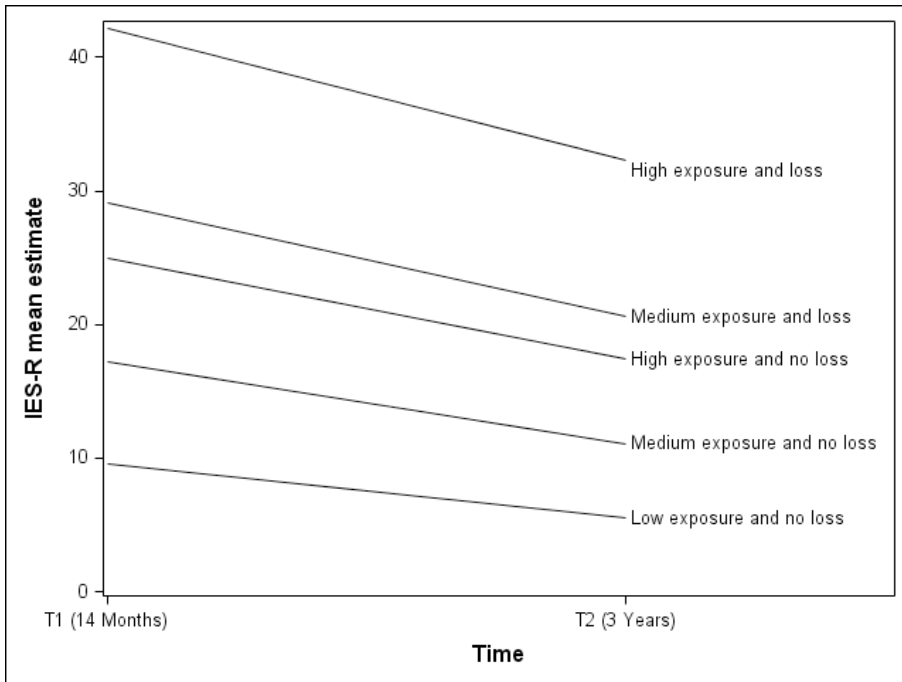


Figure 2. Estimated trajectories of recovery between 14-month and 3-year follow-ups, adjusted for covariates.

## General mental health

### Prevalence

Signs of affected mental health (Table 4) 14-months after the tsunami were displayed by 31% in the danger-to-life exposure group, 23% in the non-danger-to-life exposure group and, 11% in the low exposure group (Paper II). At the three-year follow-up (Paper V), 28% in the high exposure group presented signs of affected general mental health, compared with 20% in the medium-exposure group and, 13% in the low-exposed group. Among tsunami-exposed bereaved relatives, corresponding figures were 62%, compared with 38% of bereaved friends and, 24% of non-bereaved survivors (Paper III). Impaired mental health was demonstrated by 69% of tsunami-exposed close relatives and 50% of home-staying close relatives (Paper IV). For bereaved survivors after three years, the corresponding figure was 43% (Paper V).

Another indicator of general mental health, suicidal ideation, was confirmed by 13% of high-exposed, 9% of medium-exposed and, 6% of low-exposed tsunami survivors after 14 months (Paper II) and, 38% of bereaved relatives, 17% of bereaved friends and 9% of non-bereaved (Paper III). The level of suicidal ideation at the three-year follow-up (Paper V) was similar to

the 14-month figures: 12% in the high-exposure group, 8% in the medium-exposure group and, 6% in the low-exposure group. However, among the bereaved, 23% confirmed suicidal ideation at the three-year follow-up.

### Demographic characteristics in relation to general mental health

Younger age (Papers II and IV); female gender (Papers II, III, IV and V); single status (Papers II and III); having a history of 1-2 childhood traumas or more than three childhood traumas (Papers III and V) or, at least two (Paper II), or three (Papers II, III and V) previous traumatic experiences in adulthood; and, previous psychiatric illness (Paper V), increased the risk for affected mental health.

Younger age (19–25 years; 25–30 years; 31-40 years, Paper II: 16-24 years; 25-40 years, Paper V), female gender (Paper V) and, having a history of at least two previous traumatic experiences in adulthood (Paper V) heightened the risk for suicidal ideation. Older age (61–70 years) and more than 12 years of education attenuated the risk for suicidal ideation (Paper II).

### Exposure and loss in relation to general mental health

There was an increased risk for affected mental health in the danger-to-life exposure (high exposure) group (Papers II and V), and in the non-danger-to-life exposure (medium exposure) group (Papers II and V), compared with the low exposure group, at both the 14-month and the three-year follow-up. This trend was most pronounced in the danger-to-life exposure group. A similar pattern was apparent regarding suicidal ideations at 14 months (Paper II).

When type of loss was included in the analyses, tsunami-exposed bereaved relatives and bereaved friends had a higher risk for affected mental health than non-bereaved (Paper III). This was also the case for those exposed to danger-to-life, compared to non-danger-to-life (Paper III). Tsunami-exposed bereaved survivors had a heightened risk for impaired mental health than home staying (Paper IV). The risk for suicidal ideations at T2 (Paper V) increased in the high-exposure group and in the bereaved group.

### Interactions between exposure and loss and general mental health

There was a higher risk for impaired mental health and suicidal ideation for bereaved relatives and friends who were exposed to life danger, than those exposed to non-life danger (Paper III). The highest adjusted odds ratios were for those who had lost children (Papers III and IV): there was a tendency

towards increased psychological distress among those who had lost younger (<19 years) children (Papers III and IV).

### Trajectories of change

For low-exposed respondents, there was no change in odds of affected mental health at T2, compared with T1 (Paper V). However, high- and medium-exposure respondents had decreased odds for affected mental health at T2 (Table 7). A similar result was found for bereaved respondents: a further decreased risk for affected mental health was found at T2, compared with T1. Among demographic variables, younger age predicted increased risk of mental health impairment from T1 to T2, as did exposure for 1-2 post-tsunami traumas.

Table 7. Odds of affected mental health at the three-year follow-up compared with odds of affected mental health at 14-months.

Variable		n	GHQ-12≥3	
			OR	CI 95%
Exposure	High	1501	0.60	0.44-0.82
	Medium	1060	0.61	0.44-0.86
	Low	895	1.16	0.85-1.59
Bereavement	Yes	131	0.39	0.23-0.64
Age	16-24	518	1.56	1.13-2.14
	25-40	952	1.30	1.00-1.69
Post-tsunami trauma	1-2	1379	1.34	1.06-1.70

For suicidal ideation, no change in odds between T1 and T2 in the different exposure groups was identified. However, for bereaved persons, the odds for suicidal ideations decreased from T1 to T2.

## Complicated grief

### Prevalence

According to the Complicated Grief Index, signs of complicated grief were indicated among 38% of tsunami-exposed bereaved relatives (Paper III), 45% of tsunami-exposed bereaved close relatives and, 26% of home-staying relatives (Paper IV). The correlation between the Complicated Grief Index and IES-R within the group of bereaved relatives was 0.46 (Paper III). The three-year prevalence among bereaved close relatives was 24%.

## Demographic characteristics in relation to complicated grief

Among demographic variables, younger age (16-24) and female gender presented an increased risk for complicated grief (Paper IV).

## Exposure and loss in relation to complicated grief

The risk for complicated grief was heightened among tsunami-exposed bereaved relatives (OR=3.01, 95% CI = 1.77–5.11), compared to home-staying relatives (Paper IV). Within the group of bereaved relatives, the risk for complicated grief was higher for those who had lost children or lost a partner than for those who lost other relatives (Paper III; Table 8). Among close relatives, loss of children, compared to loss of parents/siblings (OR = 3.28, CI = 1.64-6.56) increased the risk for complicated grief (Paper IV).

Table 8. Linear regression analyses and logistic regression analyses of relationship between type of loss and posttraumatic stress reactions (IES-R) and complicated grief (CGI).

Type of loss	IES-R						CGI		
	n	Scores		Linear regression results			Cases	Logistic regression results	
		M	SD	B	SE B	β	%	OR	95% CI
Partner + child	19	35.08	18.88	10.02*	3.97	0.04	50	29.91***	4.15 – 215.31
Child	38	38.58	16.29	17.80***	2.73	0.10	51	38.18***	6.66 – 218.80
Partner	36	41.75	20.02	16.80***	2.84	0.09	43	14.41**	2.35 – 88.36
Parents or siblings	46	37.64	19.00	15.33***	2.49	0.10	39	10.31**	1.96 – 54.07
Other relatives	48	28.25	18.92	7.50**	2.43	0.05	6	1.00	
Friends	308	27.93	20.86	6.94***	1.00	0.11			
No loss	3020	20.67	17.31	--		--			

Note. IES-R = Impact of Event Scale-Revised. CGI = Complicated Grief Index (only relatives). CI = Confidence Interval; -- = Reference category

<sup>a</sup> Missing values: education (n=23), IES-R (n=32), bereavement status (n=4), CGI (n=15).

<sup>b</sup> Adjusted for exposure level, age, gender, education, family situation, history of traumatic events in childhood and adulthood.

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001

For male gender, the loss of children, compared to other types of losses, increased the risk for complicated grief (Paper IV; Table 9). For female gender, loss of children, increased the risk, but with less magnitude. However, for women, no differences between loss of children and loss of partner were indicated. Generally, women had more complicated grief

reactions than men had (women: loss of children 42%, loss of partner 54%, and loss of parents/siblings 32%; men: loss of children 34%, loss of partner 11%, and loss of parents/siblings 10%, Paper IV).

Table 9. Logistic regression analysis of complicated grief vs. type of loss and gender interaction.

<b>Complicated grief<sup>a</sup></b>		
Contrasts between types of loss	OR	CI 95 %
<b>Men</b>		
Children <sup>b</sup> vs parents/siblings <sup>c</sup>	6.67***	2.41-18.48
Children <sup>b</sup> vs partner <sup>d</sup>	7.26*	1.44-36.71
<b>Women</b>		
Children <sup>e</sup> vs parents/siblings <sup>f</sup>	2.29*	1.05-4.97
Children <sup>e</sup> vs partner <sup>g</sup>	1.13	0.42-3.00

<sup>a</sup> Missing values (n=22). Adjusted for exposure level, age, gender, education, family situation, history of traumatic events in childhood and adulthood

<sup>b</sup> men bereaved of children (n=92)

<sup>c</sup> men bereaved of parents/siblings (n= 83)

<sup>d</sup> men bereaved of partner (n=19)

<sup>e</sup> women bereaved of children (n=125)

<sup>f</sup> women bereaved of parents/siblings (n=117)

<sup>g</sup> women bereaved of partner (n=28)

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

## Professional interventions/medication

In the Linate follow-up (Paper I), both groups indicated they utilized psychosocial support organizations for individual acute need. It was more common among Italian bereaved relatives to indicate “family/friends or employer”, “family doctor” or “no contact”: psychotherapy was more frequently indicated among Swedish relatives. At 18 months after the disaster, the need for psychotherapy was more likely to be expressed by Swedish relatives (44.7%) than by Italian relatives (24%). The need for psychotherapeutic and medical treatment was correlated with higher IES-R scores. Bereaved Italian relatives indicated more frequently use of antidepressants and tranquilizers (45%) during the acute phase than Swedish relatives did (18.4%, Paper I). The difference remained 18 months after the disaster, even if the use of medication had reduced considerably (21% Italian relatives and 6% Swedish relatives). About half of the respondents indicated they used hypnotics promptly after the disaster. The need for hypnotics decreased, but was twice as common among Italian relatives (26%) than among Swedish relatives (12.2%) 18-months after the disaster.

At the three-year follow-up after the tsunami (Paper V), 11.5% of the respondents indicated the use of analgesics on a daily or weekly basis: 5%

used hypnotics, 1% used tranquilizers and, 2% used antidepressants on a regular basis. The corresponding figures for bereaved survivors were: 11% hypnotics, 3% tranquilizers and, 11% antidepressants.

## Social support

No difference in perceived social support was determined between tsunami-exposed and home-staying bereaved relatives (median= 5 in both groups, Mann Whitney  $U=33661.5$ ,  $p=0.39$ , Paper IV). There was an association between perceived social support and posttraumatic stress reactions ( $B = -3.78$  for each extra point,  $CI = -4.59- -2.96$ , Paper IV). The risk for complicated grief decreased with higher levels of satisfaction (OR 0.67 for an increase of one point,  $CI = 0.58-0.76$ ). Impaired mental health had a similar association (OR = 0.61,  $CI = 0.54 - 0.70$ ).

Satisfaction with social support was associated with lower levels of posttraumatic stress reactions three years after the tsunami and indicated a decreased risk for affected mental health (OR = 0.78,  $CI = 0.74 - 0.83$ ) and suicidal ideation (OR = 0.77,  $CI = 0.73 - 0.84$ ) for an increase of one point on the scale (Paper V).

## Errata

### Paper 1

Due to a technical error in the original analyses, one of the items in the IES-R was wrongly located to the Hyperarousal subscale instead of to the Intrusion subscale. Therefore, the analyses (Table II, Table III and, Figure 3, in Paper I) have been reworked. Errata have not been found to affect the results of the paper.

### Measures (Page 112)

“A score of 33 points indicates a score that lies above a possible mean of 32 (maximum 64) and reflects a considerable rated disturbance”.

**Revised Table II, page 112 in original paper**

Revised Table II. Mean values (M), standard deviations (Sd) and t-values of IES-R sub-scales for Italian and Swedish bereaved relatives.

Sub-scales	Italian (n= 103)		Swedish (n=50)		Total group (n=153)		t-value	P
	M	Sd	M	Sd	M	Sd		
Intrusion	21.23	6.58	19.37	7.95	20.59	7.11	1.54	NS
Avoidance	14.60	7.45	14.17	8.34	14.45	7.75	0.32	NS
Hyperarousal	12.75	6.31	9.69	7.07	11.7	6.72	2.71	0.01
I+A	35.83	11.86	33.54	14.88	35.04	12.97	1.03	NS
Total I+A+H	48.58	16.94	43.23	21.02	46.74	18.55	1.69	NS

Note. I = Intrusion; A = Avoidance; H = Hyperarousal; NS = non-significant

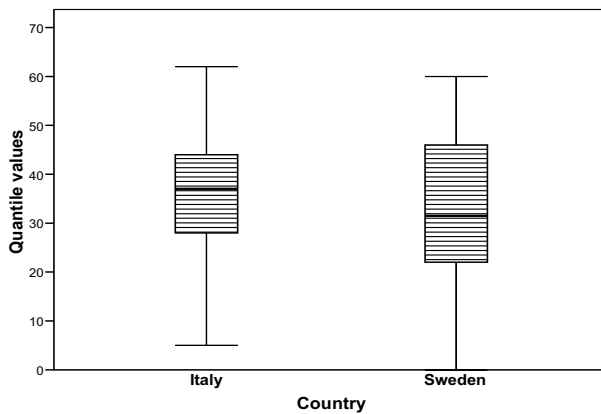
**Revised Table III, page 114 in original paper**

Revised Table III. Mean (M), standard deviation (Sd) and t-values in sub-scales and total score on IES-R for women, men and, the total group 18-months after the Linate airplane disaster.

Sub-scale	Women (n = 88)		Men (n=65)		Total group (n = 153)		t-value	P
	M	Sd	M	Sd	M	Sd		
Intrusion	21.81	6.86	18.36	7.24	20.59	7.11	2.88	0.05
Avoidance	15.56	7.54	12.04	7.43	14.45	7.75	2.74	0.05
Hyperarousal	12.94	6.56	9.15	6.41	11.70	6.72	3.39	0.05
I+A	37.37	12.24	30.40	13.15	35.04	12.97	3.23	0.05
I+A+H	50.31	17.46	39.55	18.69	46.74	18.55	3.50	0.05

Note. I = Intrusion;. A = Avoidance; H = Hyperarousal

**Revised figure 3, page 113 in original paper**



Revised Figure 3. Nationality and IES-R median score for Intrusion + Avoidance in relation to nationality (Italy and Sweden).

# General discussion

In an age of global communication, it has become natural for many people to make extensive journeys, for both business and pleasure and recreation. Mostly, tourists and travelers do not end up in disasters, but sometimes the most unexpected and disastrous events occur. Some of these events are of a magnitude that creates major headlines in media worldwide; others are equally horrifying, but affect only a few. For people generally, there might be a belief that, after a few weeks of psychological turmoil, exposed survivors recover and forget about their distressing experiences (Brewin, 2003), continuing their lives without any complications. However, regardless of magnitude, for society and, especially for health care, awareness of the possible health consequences for those affected is vitally important.

In this thesis, it was possible to demonstrate resilience and recovery among a majority of affected people. However, severe disaster exposure was associated with heightened posttraumatic stress reactions and heightened risk for affected mental health. Furthermore, disaster exposure in combination with loss was linked to a more severe impact on victims than with traumatic loss without disaster exposure. Although exposure to life threat and loss appeared most detrimental, other peritraumatic factors related to heightened symptoms were exposure to many dead bodies, experiencing life threat and, presenting signs of cognitive confusion. In addition, an interaction of life threat exposure and loss appeared more detrimental than loss without life threat exposure. Close relationship to the deceased increased the prevalence of psychological distress, the highest levels were found among those who had lost children. The rate of recovery was slower among respondents exposed to life threat and among those who were traumatically bereaved.

## Demographic characteristics

The tsunami cohort was a large adult, presumably healthy, non-psychiatric population. The individuals participating represented a substantial proportion of the population registered on return to Swedish airports, and were from both urban and rural areas in different parts of the country, including the three major metropolitan areas. A limitation in relation to the general population might be they belonged to a group disposed to travel, which could also refer to the Linate sample. In this respect, they might represent a

part of the population, with a high level of employment, education and, financial resources. In the group participating in the study, there was a slight overrepresentation of women, whereas, those not participating had a slight overrepresentation of younger men.

Consistent with previous reports (Brewin, Andrews & Valentine, 2000), demographic factors such as younger age, female gender (Breslau, 2009), being single and, experiencing earlier trauma in childhood (Breslau, Chilcoat, Kessler, *et al*, 1999), or adulthood were found to be risk factors for greater distress. Former psychiatric problems and experienced traumatic life events were associated with higher levels of long-term posttraumatic stress reactions and higher risk of affected mental health. However, it was difficult to make any statement about the causality between effects of additional traumas and higher levels of reactions without thorough knowledge of relationship between earlier life patterns, personality and, prior disorders.

## Resilience

A majority of the survivors presented a pattern of resilience, indicating many of those exposed managed well regarding posttraumatic stress reactions: this concurred with Bonanno (Bonanno & Gupta, 2009), who claims even if potentially traumatic events (PTEs) can be highly aversive, only a relatively small subset of those exposed to such events will typically exhibit chronic pathological reactions. Resilience could be considered a result of normal coping skills and normal human adaptation mechanisms (Masten, 2001). Multiple protective factors are suggested to buffer against adverse experiences, including flexible adaptation and pragmatic coping (Mancini & Bonanno, 2006), supportive relations and community resources (Hobfoll & Jackson, 1991). Many tsunami survivors indicated survival was caused by both luck and own ability, and a majority reported family and friends were the most important helpers, rendering a high level of satisfaction (Johannesson, Michel, Arnberg, *et al*, 2006). In addition, in Sweden, community resources for support were highly activated for a considerable time after the tsunami disaster.

Nonetheless, approximately 12% of those exposed to life threat during the tsunami had either persistent or delayed posttraumatic stress reactions three years later: the corresponding figure for high- or medium-exposed bereaved survivors was approximately 21%. However, only two time points were measured and, as a large group within the sample did not have a distinct trajectory pattern, no further analyses were performed.

## Effects of exposure

Severe exposure to danger to life, i.e. being caught or almost caught by the tsunami waves, was consequently associated with higher levels of post-traumatic stress reactions (Paper II). The difference in outcome between the exposure groups suggested life danger had a greater effect on a person's mental health than other exposure factors, causing more severe post-traumatic stress symptoms. Similarly, non-danger-to-life exposure differed from low exposure, an observation in line with others (Brewin, Andrews & Valentine, 2000; Galea, Nandi & Vlahov, 2005; Green, Lindy, Grace, *et al*, 1990; Neria, Nandi & Galea, 2007; Norris, Friedman & Watson, 2002; North, Pfefferbaum, Tivis, *et al*, 2004) demonstrating a relationship between trauma severity and PTSD symptoms. Few studies examine the course of PTSD after natural disasters (Neria, Nandi & Galea, 2007). However, the difference between the exposure groups remained after three years: severe exposure to the disaster and traumatic bereavement were still associated with heightened posttraumatic stress reactions. Exposure to danger-to-life increased the risk for posttraumatic stress reactions both for those who had lost relatives and those who had lost friends more than non-bereaved survivors (Paper III).

Other factors related to more severe posttraumatic stress reactions were physical injury, seeing many dead bodies, experiencing life threat and, presenting signs of cognitive confusion. People who had experienced personal physical injury were likely to have more severe posttraumatic reactions. Physical injury increases the risk for post-traumatic stress disorder (Koren, Hemel & Klein, 2006), after traffic road accidents (Coronas, Garcia-Pares, Viladrich, *et al*, 2007), and, interpersonal violence (Johansen, Wahl, Eilertsen, *et al*, 2007). More than 20% of injured trauma survivors present symptoms consistent with a diagnosis of PTSD 12 months after acute care in in-patient hospitalization (Zatzick, Rivara, Nathens, *et al*, 2007). In the sample presented here, many individuals who indicated severely exposure to the tsunami also had physical injuries. Experiencing the situation as life-threatening was associated with later PTSD reactions, which confirmed the findings of Basoglu (Basoglu, Kilic, Salcioglu, *et al*, 2004) that fear during disaster plays an important role for later outcome.

Similarly, there was a relation between exposure and affected mental health: 31% survivors in the danger-to-life group and 23% in the non-danger-to-life group indicated affected mental health after 14 months (Paper II). The levels of affected mental health were higher than the results of a Swedish national survey (Wamala, Bostrom & Nyqvist, 2007), where 22% of women and 14% of men had signs of affected mental health. Furthermore, a sample of multiple-exposed tsunami survivors from the Stockholm area reported higher levels of psychological distress than a matched non-exposed population based sample (Wahlstrom, Michelsen, Schulman, *et al*, 2009). In comparison, after a

bushfire in Australia, (McFarlane, Clayer & Bookless, 1997), 42% of people affected by the fire had potential psychiatric problems at a 12-month follow-up, and 23% at a 20-month follow-up. One reason for the higher rates in the Australian sample could be the selected group had a proportion of former help seekers living in the community where the disaster took place.

After three years, high exposure to the tsunami was associated with psychological distress, with 28% presenting signs of affected general mental health, compared with 20% of the medium-exposure group (Paper V). For the bereaved, the corresponding figure was 43%, indicating the profound effect of bereavement at three years post loss.

The level of suicidal ideation during the last twelve months was modest in all groups: 12% in the high-exposure group, 8% in the medium-exposure group and, 6% in the low-exposure group. Among the bereaved, 23% still confirmed suicidal ideation at the three-year survey. Thus, bereavement appeared to have a considerable effect on mental health after three years.

## Exposure and loss

Man-made disasters are argued to have a more profound effect on victims than natural disasters (Norris & Sloane, 2007). However, this study demonstrated that over one and a half years after the tsunami disaster, a large proportion of the bereaved relatives presented signs of posttraumatic stress reactions and affected mental health. The proportion of bereaved tsunami survivors with substantial levels of PTSD symptoms was high (45%), compared with 25% in the group of bereaved friends (Paper III) and one-third of home-staying relatives (Paper IV). The level of symptoms among bereaved relatives (Paper III) was similar to the level among bereaved Swedish relatives in Paper I. The tsunami bereaved had been directly exposed to the disaster, which was not the case for the relatives in Paper I.

Traumatic loss is a stressful experience of the same magnitude as exposure to own life threat, included in the A criteria for DSM IV. The overlap in reactions from own trauma exposure and from loss of a loved one caused by a sudden traumatic event has been highlighted (Gray, Prigerson & Litz, 2004; Pfefferbaum, Call, Lensgraf, *et al*, 2001, Shear, Frank, Houck, *et al*, 2005) and, bereavement affects the basic psychological need of attachment, which complicates the processing of the trauma (Shear, Monk, Houck, *et al*, 2007). The data presented here (Papers II, III and IV) supported previous findings (Breslau, Kessler, Chilcoat, *et al*, 1998; Hsu, Chong, Yang, *et al*, 2002; Neria, Gross, Litz, *et al*, 2007) that experiencing the loss of a family member is related to later distress reactions. The impact of direct trauma exposure was evident in the three outcome measures. The burden for the individual in managing the combined load of exposure to a traumatic event and a traumatic

loss was heavy, as demonstrated by the higher risk of developing complicated grief reactions, impaired mental health and, PTSD reactions.

Complicated grief and posttraumatic stress reactions had an inter-correlation of 0.46, which could reflect PTSD symptoms captured overall distress (Paper III). However, unlike posttraumatic stress reactions, complicated grief, which was common among bereaved relatives, was not associated with earlier trauma experiences, and suggests the two measurements reflected different aspects of trauma and loss to some extent; a suggestion also previously proposed (Neria & Litz, 2004). Direct exposure to the tsunami, compared to being at home, heightened the risk of complicated grief (Paper IV): signs of complicated grief were present among 45% of exposed close relatives and among one-quarter (25%) of home-staying relatives, a relation that was corresponding to an equivalent sample of interviewed Norwegian tsunami bereaved relatives (Kristensen, Weisaeth & Heir, 2009), although the estimated prevalence was lower in the Norwegian sample. The Swedish rates were also higher than rates of at approximately 10–20% among bereaved people in general (Shear, Frank, Houck, *et al*, 2005).

Personal loss greatly increased the level of affected mental health among the bereaved tsunami survivors, which was confirmed by approximately two-thirds (62%) of tsunami-exposed bereaved relatives having more symptoms, compared to 38% of bereaved friends and 50% of the home-staying relatives. Although the levels of distress were generally higher in the tsunami-exposed relatives, a substantial proportion of the home-staying relatives not directly exposed to the disaster, displayed problems: this concurred with other studies (Neria, Nandi & Galea, 2007). Furthermore, the levels of distress were higher among home-staying relatives than bereaved tsunami-exposed friends (Paper III).

Suicidal ideation was common among bereaved relatives, a finding that concurred with previous studies (Raphael & Martinek, 1997; Prigerson, Bierhals, Kasl, *et al*, 1997; Bonanno, Neria, Mancini, *et al*, 2007). Over 40% of bereaved relatives admitted to suicidal ideation during the 12 months after the tsunami, compared to 16% among bereaved friends and 9% of the non-bereaved. This finding can be compared with the most exposed survivors in Paper II, where 13% admitted suicidal ideations.

## Interactions

In Paper II, evidence for exposure to life danger being related to later psychological distress was identified. In Paper III, the study focused on what was most pathogenic, the loss itself or having been exposed to danger-to-life. Specific exposure variables, e.g. experiences of being taken or almost taken by the tsunami waves and, confrontation with other disaster-related stressors, were identified. The main difference between the two exposure groups was

the danger-to-life exposure group faced a life-threatening situation, i.e. being either engulfed or chased by the tsunami waves. The non-danger-to-life exposure group faced the consequences of the disaster, by going through the time phases of insecurity of the fate of relatives, seeing dead bodies or the suffering of others, witnessing abandoned children etc.

An interaction effect between severe exposure and traumatic loss was indicated (Paper III), giving a hint of the magnitude of the effort required for the individual to handle the disrupter of safety, security and, bonds of attachment. Exposure to life danger, compared with exposure to non-life danger was associated with more pronounced posttraumatic stress reactions among bereaved relatives. Bereaved friends, exposed to life danger during the tsunami, had higher levels of posttraumatic reactions, compared to friends not exposed to danger-to-life. In addition, exposure to life danger increased the risk for affected mental health and suicidal ideation among bereaved relatives and friends.

## Closeness in relationship

In modern society, the ties between friends could be for many as close as the ties commonly found between family members. Therefore, in Paper III, the focus was on both the groups of bereaved relatives and the groups of bereaved friends. Loss of relatives was associated with higher levels of posttraumatic stress and created a greater risk of affected mental health than loss of friends did, indicating the rupture of attachment being possibly more profound in relatives: the effects of loss on relatives confirmed earlier findings (Breslau, Kessler, Chilcoat, *et al*, 1998; Hsu, Chong, Yang, *et al*, 2002) Accordingly, after the 2001 World Trade Center terrorist attacks, family members were identified as more affected than those who had lost acquaintances (Shear, Jackson, Essock, *et al*, 2006). However, the impact of loss of friends was substantial, indicating the importance of this type of bereavement.

The most salient signs of posttraumatic stress reactions, affected mental health and, suicidal ideation were identified among those who had lost children (Papers I, III and IV), which corresponded to findings from other studies (Dyregrov, Nordanger & Dyregrov, 2003; Neria, Gross, Litz, *et al*, 2007). In accordance with prior studies (Lundin, 1984b; Shear, Frank, Houck, *et al*, 2005), loss of children was associated with higher risk for complicated grief. In this respect, loss of children had a similar effect on the tsunami-exposed and the home-staying group, indicating being on site, having a possible responsibility for children at the time of the disaster did not appear to increase later reactions.

As the groups differed in age, the effect of the age of the dead child was considered; for complicated grief and posttraumatic stress reactions, the age

of the lost child did not influence the outcome. However, those who were bereaved of young children (<18 years) appeared to have a higher risk of impaired mental health than those whose deceased children were adult. These findings, if confirmed, would contrast to the discussion by Neria et al. (Neria, Nandi & Galea, 2007).

An effect of gender was demonstrated for type of loss (Paper IV), which concurred with earlier findings (Murphy, Brown, Tillery, *et al*, 1999). Both men (21%) and women (39%) had in general high levels of complicated grief reactions, but type of loss had less impact on the risk for complicated grief among women. In contrast, men who had lost children presented a higher risk for complicated grief than for loss of partners or parents/siblings.

## Recovery

The comparison of symptoms between the 14-month and the three-year survey indicated signs of recovery from posttraumatic stress reactions in all three exposure groups: this confirmed findings from other studies (Carr, Lewin, Webster, *et al*, 1997; Norris, Tracy, & Galea, 2009; Onder, Tural, Aker, *et al*, 2006) in that recovery can continue after the first year. The levels of distress differed among the three groups, with the high-exposed group (exposed to life threat) recovering from higher levels of posttraumatic stress reactions. The high exposure group (30% estimated recovery) and the medium exposure group (35% estimated recovery) did not recover as much as the low exposure group (42% estimated recovery), indicating the impact of exposure slowed the process of recuperation.

Although the high-exposed and the bereaved group had higher levels of posttraumatic stress reactions at the initial assessment, the levels of distress attenuated between the 14-months and the three-year follow-ups. Although a general statistical trend over time toward the average mean could be assumed, the slope of recovery indicated a slower recovery process for the most affected groups. The reason for this is speculative. Processing traumatic experiences implies advanced psychological processes of memory consolidation, categorizing and integrating impressions, of cognitive appraisal of self and environment and, of mentally differentiating the self from the event. The slower recovery among the most severe exposed survivors could be consistent with a model of heightened amygdala reactivity after high-intensity trauma exposure, slowing down hippocampal and prefrontal cortex activity, resulting in a relatively slow recovery (Ganzel, Casey, Glover, *et al*, 2007; Tucker, Pfefferbaum, North, *et al*, 2007).

In contrast to posttraumatic stress reactions, the level of change in mental health appeared modest, although there was a positive progress towards recovery among high and medium-exposed respondents. In general, distress

was lower than previously reported findings among earthquake survivors (Carr, V. J., Lewin, T. J., Webster, R. A., *et al*, 1997; Ohta, Araki, Kawasaki, *et al*, 2003). The low-exposure group demonstrated a small increase in symptoms, but this change could be explained by the effect of age and post-tsunami stressful events. Similarly, the medium-exposure group had decreased odds, although the unadjusted proportions were similar between the two time points: this could also be explained by age and post-tsunami events.

Bereaved respondents had a decreased risk of affected mental health at three years, although the impact in this particular group was still substantially higher (43%) than for non-bereaved survivors (20.7%). This confirmed reports that chronic grief reactions tend to be more prevalent after more extreme losses (Kaltman & Bonanno, 2003). In contrast to Chou (Chou, Wu, Chou, *et al*, 2007), no evidence was found for change in prevalence of suicidal ideations for the different exposure conditions: bereaved respondents had decreased prevalence between the two time points, indicating a process towards recovery.

## Professional interventions/medication

This thesis focused on outcome in relation to exposure and traumatic loss. It was not possible within the scope of the thesis to specifically examine the influence of mediating factors such as medical, social or, psychotherapeutic interventions.

However, a cultural difference between the Italian and Swedish relatives regarding type of interventions in the aftermath of the disaster was identified (Paper I). In the Swedish group, psychotherapy was more common; whereas, in the Italian group, the use of medication was more common. This might reflect a difference in cultural attitude; how individuals deal with traumatic loss and how the request for support in the aftermath is expressed. At the time of the event, there was an elaborated public organization for psychosocial disaster support in Sweden, and elaborated access to professional psychotherapy, which might reflect the differences.

The consumption of medication was lower among Swedish relatives than among Italian relatives, possibly reflecting the different cultures in the health care system in Sweden and in Italy (Paper I). The consumption of medication among the tsunami bereaved (Paper V) (hypnotics 11%, tranquilizers 3%, and antidepressants 11%) might be difficult to compare but was similar to the average consumption among Swedish women in 2009 (Socialstyrelsen, 2009). This could suggest the bereaved population handled their distress by a variety of means.

## Social support

One factor positively associated with recovery in the tsunami cohort at both follow-ups was overall satisfaction with social support (Paper V), which confirmed social support as an important factor for resilience after natural disasters (Norris & Kaniasty, 1996) and after other traumatic exposure (Koenen, Stellman, Stellman, et al, 2003). In this thesis, personality factors were not considered; however, it was reasonable to assume the above-mentioned factors might reflect an underlying capacity, such as a satisfying social network, in addition to the ability to utilize societal resources such as medical, economic, psychological, and social support, which might be helpful in the recovery process.

## Methodological considerations

Self-report questionnaires, which were applied in all papers in this thesis, are not clinical measures of mental health and PTSD, which should be considered when evaluating the outcome of these studies. The length of time between the events and the study should also be considered, and render cautiousness regarding the quality and validity of retrospective data.

The response rate (49%) in Paper II, from which data was used in Papers III and V, and partly in Paper IV, was rather low. However, low response rates are common in disaster studies (McFarlane, Clayer et al. 1997, Selly, King et al. 1997). Lower response rates from the worst affected victims could be assumed, perhaps because of avoiding reminders of the trauma, and could have resulted in an underestimation of PTSD symptoms. Another possibility was the least affected travelers were not motivated to participate in the study, which mainly focused on exposure to the tsunami. A Norwegian study after the 2004 tsunami (Hussain, Weisaeth & Heir, 2009) considers non-response is related more to lack of interest and relevant experience than to fear of re-traumatization. Such a situation would increase overestimation of the effects.

In Paper IV, the two groups compared differed in demographic background, although this was adjusted for in the analyses. In addition, there was a time difference of seven months in assessing outcome between the tsunami-exposed group and the home-staying relatives, which might have affected outcome, and is one reason the differences between the two groups should be interpreted with caution. However, the differences in tsunami-exposed and home-staying bereaved relatives concurred with a Norwegian study of tsunami-bereaved relatives (Kristensen, Weisaeth, & Heir, 2009). In addition, the anniversary of the disaster and bereavement had passed for both groups, and the assessments were made within the second year of the loss, which might reduce the effect of the time difference. Stability and even

increase in PTSD symptoms at 12- and 24- months follow-up after sudden loss is reported (Murphy, Brown, Tillery, *et al*, 1999). Furthermore, the Linate study, which had an 18 month follow-up, implying only three months difference from the home staying tsunami-bereaved sample, indicated a similar outcome. Therefore, the influence of time on the two sub-samples appeared limited, especially regarding complicated grief reactions.

In Paper I, the bereaved populations from two cultural backgrounds were compared. The difference in cultural background could explain some of the differences found in the study. Although the response rate was higher in the Swedish sample, it was not statistically significant, but could be a reason for some caution regarding the conclusions. No special grief or depression scale, which might have differentiated more in response patterns, was used in the paper.

Papers I - IV are cross-sectional, which makes establishment of causal or temporal relationships unfeasible. Another limitation is the lack of systematic assessment of the tsunami disaster victims upon their return to Sweden. Therefore, the development of reactions from the acute phase to the time of the first survey at 14-months post disaster could not be estimated.

In Paper III, data regarding complicated grief was limited. Due to the formulation of the questionnaire, relatives, but not friends, were instructed to answer particular questions concerning grief, which meant this aspect could not be fully analyzed.

There was a slight overrepresentation of women participating in the studies, whereas, those not participating were slightly overrepresented by younger men. A further limitation could be the group examined was characterized by people with sufficient economic resources for spending holidays abroad, which might separate them from a more randomly selected population-based control group. However, as indicated by the findings of Wahlström *et al* (Wahlstrom, Michelsen, Schulman, *et al*, 2009), in a subsample of multiple-exposed tsunami survivors, the level of psychological distress was higher after 14 months than in a matched population sample.

Notwithstanding these limitations, one of the major strengths of these studies was the large cohort with a wide age-range in the tsunami studies, representing both urban and rural areas in different parts of the country, and who had suffered during a limited time under varying conditions. Thus, there was possibility to assess a homogenous, non-clinical population with different levels of trauma exposure, consisting of travelers registered by the authorities on return to their home country. In many disaster studies, the affected population lives and remains in the affected area also suffering from profoundly affected infrastructure and loss of personal belongings (Basoglu, Livanou, Salcioglu, *et al*, 2003; Hsu, Chong, Yang, *et al*, 2002; McFarlane, Clayer & Bookless, 1997; Norris, Murphy, Baker, *et al*, 2004a; van Griensven, Chakkraband, Thienkrua, *et al*, 2006). It is also common to assess groups seeking support for mental health problems or other disaster-

related problems (Holbrook, Hoyt, Stein, *et al*, 2002; McFarlane, Clayer & Bookless, 1997). Comparison groups are difficult to locate in disaster studies; however, it was possible to identify a large group travelling in the area but unexposed to the devastating consequences of the tsunami, and these individuals travelling in Southeast Asia, irrespective of geographical proximity to the tsunami, were approached. Thus, an appropriate comparison group was established. Besides the cultural comparison in Paper I, an additional strength was the possibility of examining the effects of traumatic bereavement and accentuated impact of both being exposed to trauma and suffering the sudden loss of a significant other. Furthermore, in a longitudinal study, it was possible to analyze the long-term effects of extreme exposure to trauma in a presumably healthy and normal population, where the survivors could return to an intact domestic infrastructure. This makes the study unique.

## Clinical implications

Although many survivors displayed different degrees of resilience, coping and recovery ability, exposure to life threat and traumatic bereavement can result in long-term effects on mental health and appeared to slow down the recovery process. There is a substantial burden on people developing full or partial PTSD, with decreased quality of life and decreased productivity. Special attention should be given to disaster-exposed younger survivors, single people and, those who have a prior trauma history. Another group in need of special attention are survivors with dissociative tendencies, who might have difficulty in cognitively processing disaster experiences without additional support. Sudden and traumatic bereavement might cause substantial, and sometimes additional, suffering for those affected. From a clinical trauma perspective, these findings highlighted the importance of understanding that loss through violent causes may result in symptoms of PTSD and complicated grief. Traumatic bereavement without treatment may develop into chronic conditions of complicated grief reactions and impaired general mental health. This can have implications for how clients are educated in understanding their reactions and for how clinicians apply effective treatment alternatives.

In addition, the findings have implications for health agencies regarding endurance and preparedness for interventions and adequate treatment options. Important interventions in the acute phase, for those in need, are the promotion of practical, emotional and social support, safety, and hope for facilitating recovery with a sense of coping. Health care organizations active in the aftermath are responsible for assessing those who continue to display symptoms and to offer long-term support. Furthermore, health agencies have

a responsibility to provide personnel specially trained in effective trauma focused psychotherapy methods for those in need.

To be readily activated in the eventuality of major disasters, health care organizations are dependent on support through governmental, legislative and organizational structure. Therefore, knowledge and awareness of the effects of traumatic exposure and traumatic loss at a governmental level is vital.

## Future research

Based on the results of these studies, some directions for future research can be proposed.

The course of PTSD in the intermediate and long-term after disasters needs to be further explored to increase understanding of individual suffering and the cost for society in general.

Despite increasing knowledge about resilience, social support and risk factors, the mental trajectories after severe traumatic stress exposure, such as the ability for resilience and recovery in human beings is still not fully understood.

Research on information processing mechanisms and dissociative complications in relation to recovery after exposure to large scale disasters, and after more personal traumas, needs to be promoted.

The effects of traumatic bereavement need further investigation.

Complicated grief is not yet recognized as a mental disorder. Further clinical research is warranted for different populations, as diagnostic criteria, assessment instruments and psychological treatment methods are underdeveloped.

## Conclusions

Many survivors show resilience and ability to recover after disaster exposure. However, exposure to a disaster has a considerable impact on psychological distress and mental health. Severe exposure to life threat demonstrates a relationship with PTSD symptoms and will increase the risk for affected mental health, including suicidal ideation.

Traumatic bereavement increases the risk of complicated grief, affected mental health and, posttraumatic stress reactions. Loss in combination with severe life-threat exposure should be considered a substantial risk factor for mental health, as it further increases the risk for posttraumatic stress reactions.

Close relationship with the deceased is associated with higher levels of posttraumatic stress and creates a greater risk for complicated grief. The

association of closeness in relationship and complicated grief appears to differ between genders. This suggests men are less affected by loss of partner than loss of children, whereas, for women, loss of children and partners appears equally detrimental.

Many recover over time; however, severe exposure and traumatic loss appears to slow the recovery process.

The findings have implications for health agencies in terms of organizational structure, training and, accessibility for support and adequate treatment.

# Summary in Swedish - Svensk sammanfattning

Risken för att de som överlever en allvarlig händelse kan komma att utveckla posttraumatiska stressreaktioner är relativt stor, något som erfarenheter från internationella studier pekar på. Dagens livsstil har medfört en ökad grad av resande, och under de sista decennierna har därigenom ett stort antal svenskar konfronterats med allvarliga händelser som ägt rum långt utanför vårt lands gränser.

Det finns få studier om förekomsten av traumareaktioner i en population som normalt inte har erfarenhet av naturkatastrofer, men som kunnat återvända hem till ett intakt samhälle. Dessutom är det otillfredsställande undersökt hur konsekvenserna av förluster i samband med traumatiska omständigheter påverkar de drabbade. Det är därutöver en brist på långtidsuppföljningar avseende effekter av naturkatastrofer och studier som undersökt hur möjligheten till återhämtning ser ut efter exponering för svåra trauman.

Syftet med denna avhandling var att undersöka hur exponering för en allvarlig händelse och för traumatiska förluster påverkat drabbade avseende posttraumatiska stressreaktioner, allmänt psykiskt välbefinnande och reaktioner på komplicerad sorg. Analyser har genomförts av svaren i frågeformulär från förlustdrabbade italienska och svenska anhöriga 18 månader efter Linateolyckan 2001, från återvändande svenskar 14 månader och tre år efter tsunamin i Sydostasien 2004, och från hemmavarande förlustdrabbade anhöriga under det andra året efter tsunamikatastrofen. Fyra av dessa studier är tvärsnittsstudier medan den sista är longitudinell. Huvudsakliga utfallsmått har varit GHQ-12, IES-R och Inventory of Complicated Grief.

Resultaten pekar på motståndskraft och förmåga till återhämtning hos många som drabbats, men allvarlig exponering för traumatiska upplevelser gav fortfarande efter tre år tydliga avtryck avseende psykiska svårigheter. Exponering för livshot var relaterat till förhöjda nivåer av posttraumatiska stressreaktioner och ökad risk för nedsatt psykiskt välbefinnande inklusive självmordstankar. Traumatisk förlust i kombination med allvarligt livshot pekade mot en ytterligare förhöjd risk för posttraumatiska stressreaktioner och för reaktioner på komplicerad sorg, och bör därför betraktas som en avsevärd riskfaktor för psykisk hälsa. Förlust av nära anhöriga, i synnerhet

barn, medförde högre grad av posttraumatiska stressreaktioner och innebar en högre risk för komplicerad sorg.

Många drabbade återhämtar sig över tid, men svår exponering och traumatiska förluster förefaller att försvåra återhämtningen. Resultaten pekar på vikten av att myndigheter och sjukvård har kunskap om dessa hälsorisker, vilket i sin tur har betydelse för planering, organisation, utbildning och tillgänglighet avseende stöd och adekvat behandling.

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