Chapter I

Introduction

Tsunami

The Japanese word tsunami translates in English to “harbor wave.” A tsunami is a series of ocean waves generated by any disturbance that displaces a large water mass (Boyarsky and Shneiderman, 2002). About 90–95 percent of tsunamis are caused by large earthquakes (usually magnitude 7.5 or greater) at subduction zones (where one tectonic plate slides over another); the remainder are primarily due to volcanic eruptions (like the eruption of Mt. Krakatoa in 1883) or landslides (like the 1998 Papua New Guinea tsunami generated by a submarine landslide). There are also composite events such as the 1946 subduction earthquake in the Aleutian Islands that triggered a landslide-generated tsunami killing 159 in Hawaii (Fryer et al., 2003). Prehistoric geological evidence has implicated meteorites or comet impacts as a rare cause of tsunami (Bolt, 1978).

Earthquakes caused by large, sudden fault movement at subduction zones are most often associated with generation of the largest tsunamis (e.g., the Sumatra earthquake and tsunami of December 2004). The amount of fault slip is an important factor in determining tsunami size. At subduction zones, the fault zone affected may be as much as hundreds of kilometers long. Vertical movement on the fault may displace tens of cubic kilometers of water. The December 2004 tsunami, for example, caused the seabed to uplift (or subside) 6–10 m in places, displacing an estimated 30 km³ of water (Dalrymple, Grilli & Kirby, 2006). Depth of fault movement is also an important factor in determining whether a tsunami will be generated; shallower ruptures that break the sea floor will generate larger initial
tsunamis. No tsunami was reported for the magnitude 8.7 earthquake that shook Indonesia on March 28, 2005 (leaving 2,000 people feared dead on the island of Nias), likely because fault movement did not break through to the seafloor. In addition, that earthquake occurred beneath shallower water, where less water displacement would occur (Hopkin, 2005; Kerr, 2005).

Once the tsunami is generated, a series of extremely low-frequency, long-wavelength (~300 km) waves propagate in an expanding radius from the area of displacement. These waves differ importantly from surface waves (i.e., those caused by wind) in that tsunami waves are propagated throughout the entire depth of the ocean. For this reason, tsunamis represent a tremendous amount of potential energy, and can travel the speed of a jet airliner (300–600 mph or 500–1000 kph) in deep, open water. Because the energy is spread throughout such a large volume in deep water, tsunamis may be only a few feet high in mid ocean, making them capable of passing under ocean-going ships with little disturbance or detection. The physical characteristics of the fluid pressure wave allow it to travel great distances with very little loss of energy. For example, a subduction earthquake that occurred on January 26, 1700 at the Cascadia subduction zone, encompassing western Washington and Oregon, generated a tsunami that destroyed the island of Honshu (Japan) (Anonymous, 1997; Satake, Wang & Atwater, 2003). About 90–95 percent of the world’s tsunamis have occurred in the Pacific Ocean due to its relatively large size and its bordering “Ring of Fire” comprised of major subduction zones. Great trans-Pacific tsunamis are typically caused by massive earthquakes located at these subduction zones and occur at an interval of about once a decade (McCarty, 2002). As the tsunami enters shallow water near coastlines, the kinetic energy previously spread throughout the large volume of deep ocean water becomes concentrated to a
much smaller volume of water, resulting in a tremendous destructive potential as it inundates the land.

Successive crests may arrive to shore at intervals of every 10–45 minutes. This phenomenon is particularly problematic when responders attempt to rescue victims from the water after the first wave, only to become they victimized by subsequent waves. A single tsunami may be comprised of up to twelve wave crests. Prior to inundation of the wave crest, the sea may recede for an unusually long distance. During the 1960 Chilean tsunami that struck Hilo (Hawaii), this phenomenon tended to attract more people to the shoreline and into the ocean itself, where they were then caught up in the oncoming wave crest. One village in Papua New Guinea reportedly recognized this as a sign of an impending tsunami and took protective actions for shoreline evacuation. In Simelue (Indonesia), an old song about moving to high ground when the earth shakes is reported to have saved lives, and resulted in a relatively low death rate compared to neighboring Sumatra (which was further from the quake epicenter).

A tsunami is usually 3–15 m high. Wave heights averaged 24 m above sea level along the western coastline of Sumatra during inundation of the 2004 Indian Ocean tsunami earthquake (Paulson, 2005). A 70-m wave was recorded following the 1964 Alaska earthquake (Alaska Division of Emergency Services, 1992). Extremely rare mega-tsunamis produced by giant submarine landslides have been implicated globally (McMurty, Watts, Fryer, Smith & Imamura, 2004). Evidence of soil stripping and coral deposits purportedly caused by tsunami inundation has been reported up to an elevation of 365 m in Hawaii (McMurty, Watts, Fryer, Smith & Imamura 2004). At least 100 mega-tsunamis in different parts of the world have been recorded in the past 2000 years according to interpretation of the
sedimentologic and geomorphic imprints left by these events (Scheffers & Kelletat, 2003). The highest tsunami wave ever witnessed occurred at Lituya Bay (Alaska) in 1950. It was triggered by a magnitude 8.0 earthquake-induced landslide, and reached the height of 524 m above the shoreline (i.e., a height three stories higher than the World Trade Center of New York City) (Boyarsky & Shneiderman, 2002).

**Earthquake of 26th December 2004:**

On 26th December 2004, the Indian coastline experienced the most devastating tsunami in recorded history. The tsunami was triggered by an earthquake

![Figure 1.1 Tectonic base map of the Sumatra subduction zone showing major faults. (Source: USGS Earthquake Summary Poster)](image-url)
of magnitude Mw 9.3 at 3.316°N, 95.854°E off the coast of Sumatra (Fig. 1.1) in the Indonesian Archipelago at 06:29 hrs making it the most powerful in the world in the last 40 years.

In confirmation to this, the recorded seismographs of LDEO (Fig. 1.2) show that at around 01:20 GMT on December 26, 2004 there were extraordinary oscillations that subsided 12 hours later. The seismograph for the previous day has shown regular activity but goes off the chart around 01:20 GMT and then subsides by 06:45 GMT. However, things did not become normal until 15:00 GMT.

Figure 1.2 Seismographs for the periods 25th and 26th December 2004 (Source: Lamont-Doherty Earth Observatory, Columbia University)
The earthquake of 26th December 2004 occurred off northwest of Sumatra is not an unusual earthquake from the Plate Tectonics point of view. It has occurred in the vicinity of seismically active zone, close to Sunda Trench in the water depths of about 1300 m. The earthquake epicenter is located relatively at shallow depth, about 10 km below the ocean floor. The high magnitude, Mw 9.3 of the earthquake and its shallow epicenter has triggered tsunami in the northeast Indian Ocean. These were travelled in Open Ocean of the Bay of Bengal and subsequently transformed into a train of catastrophic oscillations on the sea surface close to coastal zones of Sri Lanka, east and west coasts of India (Department of Ocean Development, 2005).

Figure 1.3 Tsunami wave field in the Bay of Bengal one hour after the earth quake.
Figure 1.4 shows the Tsunami devastation areas worldwide
Tsunami Damages Worldwide

The tsunami resulted in the death of over 2,80,000 people spread over 14 countries. Over 3 million of survivors have their livelihoods destroyed. According to the World Health Organization (WHO) Situation Report (2004) the most affected countries (in alphabetic order) are: India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka, Thailand, and Somalia. In these countries, there have been over 2,14,000 deaths, with over 20,000 people were missing and more than 1.5 million people are homeless.

Figure 1.5 shows the epicenter of the earthquake that created tsunami in 2004.
Tsunami Damages in India

In India, the tsunami of 26 December 2004 affected the states of Tamil Nadu, Andhra Pradesh, Kerala and the Union Territories of Pondicherry and the Andaman & Nicobar Islands. Approximately 2,260 km of the coastal area (besides the entire Nicobar Islands) was affected, and the fisheries sector bore the brunt of the tsunami, accounting for 85 percent of the damages. In Andhra Pradesh, the impacts of tsunami were felt by six southern districts (from Nellore in the south, extending up to East Godavari). In Kerala, the effects of the tsunami were felt in a relatively small area, consisting of villages in Kollam, Alappuzha and Ernakulam districts, with most damages concentrated in Kollam district. However, compared to the scale of damages in coastal Tamil Nadu, the physical and economic losses inflicted by the tsunami on Andhra Pradesh and Kerala were much less. This was apparent from the fact that people in these areas (especially in Andhra Pradesh) seemed to have largely overcome the effect of tsunami, except for rehabilitation purposes.

According to a report prepared by the ADB/UN/World Bank in March 2005, in India, a total of 10,881 people died in the tsunami and 6,913 were injured, while 5792 people were reported missing. State-wise, the death toll was 7,983 in Tamil Nadu (with Nagapattinam district alone accounting for 6,051 deaths), 171 in Kerala, 105 in Andhra Pradesh and 591 in Pondicherry (mostly in Karaikal).

Over 7,983 deaths were reported in Tamil Nadu state. The tsunami affected districts in this state are Chennai, Nagapattinam, Cuddalore, Kanniyakumari, Kancheepuram, Pudukottai, Ramanathapuram, Tirunelveli, Thoothukudi, Thiruvallur, Thanjavur, Thiruvarur and Villupuram. Of the 13 coastal districts affected, Nagapattinam district is worst affected where 6,065 people died. Over 824 died in Kanniyakumari and 612 were reported dead in Cuddalore district.
Tsunami Damages in Tamil Nadu

Tamil Nadu is located in the northern hemisphere in the Torrid Zone between 8° and 13°N latitude, and between 78° and 80°E longitude. It is the 11th largest state in India, has a population over 60 million, and occupies an area of about 130,058 km². The climate along the coast is warm and humid, and the rainy season is marked by the onset of the northeast monsoon between mid-September and mid-December. Cyclonic storms occur during this period due to depression in the Bay of Bengal (Krishna, 2005). It’s one the State worst affected by the tsunami disaster in 2004. An estimated population of 8,96,163 were affected with a death toll of 7,793
across eleven districts resulting in massive loss of lives and damage to property. Nagapattinam district reported the maximum number of 6065 deaths and about 1, 96,184 people affected. Then Cuddalore district had a total affected population of 99,704 and death toll of 599 and Kanyakumari total affected population is 1, 87,650 and 808 people lost their lives (WHO, 2006). The state capital Chennai had a death toll of 206 and Kancheepuram district 124. The death tolls in other districts were Pudukkottai (15), Ramanathapuram (6), Tirunelveli (4), Thoothukudi (3), Tiruvallur (28), Thanjavur (22), Tiruvarur (10) and Viluppuram (47). The districts of Nagapattinam followed by Kanyakumari were the worst hit in terms of mortality.

Figure 1.7 shows Tsunami affected districts in Tamil Nadu
Marina beach, Chennai

After tsunami

Boats Damaged after tsunami

Tsunami throws out boats in different areas

Destruction to House interior

A totally ravaged hamlet in Cuddalore
Psycho Social Aspects of Disaster

The psychological impact caused by disasters is much more complex than the physical injuries, its severity on the survivors depends on varies of factors: the degree of exposure, the physical injuries, the loss of possessions, the loss of loved ones, the pre-disaster mental condition, etc. One type of social impact not measured by census data consists of psychosocial impacts and, indeed, research reviews conducted over a period of 25 years have concluded that disasters can cause a wide
range of negative psychosocial responses (Perry & Lindell 1978; Bolin, 1985; Houts, Cleary & Hu, 1988; Gerrity & Flynn 1997). The psychosocial needs are generally seen as something too secondary to attract the attentions of relief agencies, relief workers & governmental organizations (Jaswant, 2000). Prior to the 2004 tsunami there was little data on the psychosocial outcomes of tsunamis. However, there is extensive knowledge available from other major disasters such as earthquakes, floods and hurricanes, showing that the psychological well being of survivors is often greatly affected by the tragic events. (Stevens & Slone, 2008).

**Immediate Psychosocial Responses after the Disasters**

Survivors from potentially traumatic events present with a wide range of distressing psychological and behavioural reactions. Acute reactions are ubiquitous, involving anxiety, depression, agitation, anger, despair, shock, withdrawal, conversion, and dissociation (e.g., Bryant & Harvey, 1997; Shalev, 2002). Other immediate responses after the disaster (within few hours) will be panic, tension, numbness, stunned, dazed, disbelief, survivor’s guilt, relief, elation and euphoria, restlessness, confusion, crying and withdrawal (Sekar, Pan, Pal Babu & Kumar, 2004). Within the first days after the disaster, the immediate reactions are often replaced by traumatic stress reactions such as intrusions both day and night, effortful avoidance of reminders of the event, and hyperarousal (Davidson & McFarlane, 2006). Within the week after a disaster, they report of being fearful, vigilant, hyper-alert (irritable, angry, and unable to sleep), worried, dependent, repeated ‘flashbacks’, weeping, guilt feeling (including survivor’s guilt), sadness, positive reactions including: hoping / thinking of future, getting involved in relief and rescue work, acceptance of disaster as nature’s doing (Sekar, Pan, Pal Babu & Kumar,
Usually after a week traumatic stress reactions will decline or even disappear for the majority of individuals (Norris, Friedman, Watson, Byrne, Diaz & Kaniasty, 2002). About three weeks after the disaster, survivors report of restlessness, feeling panicky, continued intense sadness, unrealistic pessimistic thoughts, outward inactivity, isolated, withdrawn behavior and anxiety manifested as physical symptoms such as palpitations, dizziness, restlessness, nausea, headache, etc (Sekar, Pan, Pal Babu & Kumar, 2004). If the early responses persist after three week, however, they could be a prelude to posttraumatic stress.

Women and children are more likely to experience anxiety and depression. Alternatively, men are more to experience alcohol abuse, physical or somatic complaints, and symptoms of hostility or acting-out (Green, 1996; Green & Lindy, 1994). Posttraumatic stress disorder (PTSD) and depression may arise weeks or months after the traumatic event. The severity of children symptoms depends on factors such as level of exposure to the event, personal injury, loss of loved ones, level of parental support, and dislocation (National Association of School Psychologists, 2006). Life-threatening events during a disaster have been associated with psychological problems in children (Vogel & Vernberg, 1993). Neuner, Shauner, Catani, Ruf & Elbert (2006) found that 14–39% of children met criteria for post-traumatic stress disorder (PTSD) 3–4 weeks after the disaster. Wickrama & Kaspar (2007) found that 41% of adolescents and 19.6% of their mothers had PTSD 4 months after the tsunami. The World Health Organization estimated that approximately 5–10% of tsunami-affected people in Sri Lanka would develop mild or moderate common mental disorders (e.g. depression, anxiety or PTSD) (Miller, 2005). Likewise, The University of Indonesia reported that in Ache province 20-
25% of children in this region were given professional treatment for psychosocial problems (ADRA, 2005). Depression and psychosomatic illnesses were widely reported (ICMH, 2005a). In January 2005 the UN Office for Coordination of Humanitarian Affairs (OCHA) in Thailand reported that 25% of children in the country had been unable to attend school because of fear of a second tsunami (Office of the Coordination of Humanitarian Affairs [OCHA], 2005), and in the Maldives, where the Ministry of Health report says that 7,000 people has been traumatized by the tsunami (ICMH, 2005a), many fishermen report that they could not bring themselves to go to sea again for weeks after the incident. Nightmares, anxiety and panic attacks, disbelief, and survivor guilt and anger were reported to be widespread in the communities directly affected by the tsunami.

Similarly, Norris, Friedman, Watson, Byrne, Diaz & Kaniasty (2002) reported that PTSD was found in 68% of the disaster victims, which constituted the research sample and the second most common psychiatric problem was depression, found in 36% of the sample. Anxiety in various forms was shown in 32% of the sample, and health concerns were also often present (23% of the sample). Moreover, alcoholism and levels of drug abuse have been found to rise after disasters. In 2003, Livanou, Basoglu & Salcioglu reported PTSD and depression seen as an outcome in the survivors of the Turkish 1999 earthquake. Likewise, Gurwitch, Silovsky, Schultz, Kees & Burlingame (2002) conducted a survey in elementary students after the Oklahoma City bombing and found girls endorsed more post-traumatic stress reactions than boys.

Research on psychological response to the stress of natural and technological disasters, and war-related events has accelerated over past few decades (Alexander
and Wells, 1991; Bromet and Schulberg, 1986; Canino, Bravo, Rubio-Stipec & Woodbury, 1990; Chardon, 1997; Gimenez and Vasconcelos, 1997; Hunter, 1993). Research has shown that stress-related psychological responses are associated with individual loss, traumatic injuries or physical assault. Raj and Subramony (2008) found perceived stress and PTSD among survived adolescents one month after the tsunami disaster in Nagapattinam district. Likewise, Math et al., (2008) observed adjustment problems, depression, panic disorders, PTSD, schizophrenia and other disorders among adolescents three months after tsunami in Port Blair. Jones, Ribbe, Cunningham, Weddle & Langley (2002) reported that there is a presence of PTSD symptoms in children and parents six weeks after the fire disaster. Mirzamani, Mohammadi & Besharat (2006) found 84.2% adolescents were diagnosed with PTSD symptoms in boat sinking disaster in Tehran's city park in 2002. Similarly, Yule (1992) found PTSD symptoms in children who survived from the sinking of the cruise ship, Jupiter.

There are many post-disaster studies reflecting psychiatric aspects both in acute and long-term settings. In the early post-disaster phases, significant mental health problems have been reported after the tsunami disaster in the Andaman’s. Similarly, 3 months after Orissa super-cyclone, 50% of victims were reported to have posttraumatic stress symptoms (Suar & Khuntia, 2004). Telles, Singh & Joshi (2009) reported that subjects show high rate of PTSD and depression symptoms after one month of the flood in Bihar.

Studies conducted within one year of disasters report prevalence figures for PTSD such as: 4.5% were seen three months after the 1999 earthquake in Ano Liosia, Greece (Roussos et al., 2005); 5% were observed after three months of
hurricane Hugo (Shannon, Lonigan, Finch & Taylor, 1994) and 3% of males and 9% females report PTSD 6 months after Hurricane Andrew (Garrison et al., 1995). Catani, Jacob, Schauer, Kohila & Neuner (2008) in his study found children living in a region affected by a long-lasting violent conflict show 30.4% of PTSD and 19.6% major depression. Lonigan et al., (1991) found higher anxiety and more PTSD symptoms among children who were exposed to hurricane after three months. Girls reported more anxiety and PTSD symptoms than boys. Likewise, Bradburn (1991) reported that traumatic stress related symptoms were seen in children 6-8 months after the earthquake. Curran, Bell, Murray, Loughrey, Roddy & Rocke (1990) found 50% of the survivors developed PTSD after 6 months of Enniskillen bombing of November 1987. Realmuto, Wagner & Bartholow (1991) reported that female and older people show PTSD symptoms 13 months after a manmade technological disaster (Williams pipeline disaster). Perry, Difede, Musngi, Frances & Jacobsberg (1992) found that 45% of patients met PTSD criteria one year following the burn injury, up from the 2-month rate. Roca, Spence & Munster (1992) found an increase of PTSD in burn victims from 7% to 22% at 4-month follow-up and noted that symptoms of emotional numbing and avoidance tended to emerge after discharge from the hospital. Orner, Lynch & Seed (1993) studied a volunteer group of Falkland veterans who had left the service and found that 60% of the subjects met PTSD criteria.
Long Term Psychosocial Problems after Disaster

The label “long-term” in research after traumatic events has been used in studies that vary from one to 60 years after the events. In this study long-term consequences will be referred to as consequences that are present more than six years after the event. This definition conforms to the findings by Kessler, Sonnega, Bromet, Hughes & Nelson (1995) that few individuals remit from PTSD after this point. It is acknowledged, however, that reactions that persist for several years may be appraised as very long-term consequences.

In past years, sparse attention has been given to the long-term mental health in survivors, particularly in studying the progression of survivors’ reactions over time. Some research studies estimates of long-term PTSD by clinical interviews or by self-report questionnaire: 21% of PTSD is found in survivors 10 years after the Piper Alpha oil platform disaster (Hull, Alexander, & Klein, 2002), 28% in victims 14 years after a flooding (Green, Grace, Lindy, Gleser, Leonard & Kramer, 1990), 21% in survivors 27 years after the North Sea oil rig disaster (including PTSD and subsyndromal PTSD; Bøe, Holgersen, & Holen, 2011), and 21% in survivors 36 years after a mudslide (Favaro, Zaetta, Colombo, & Santonastaso, 2004).

Long term psychosocial problems in Children and Adolescents

The progression from childhood through adolescence and into adulthood raises questions as to whether psychological development and maturation decrease or increase the risk of long-lasting posttraumatic stress in individuals who have experienced a single traumatic event in childhood (Morgan, Scourfield, Williams, Jasper & Lewis, 2003). Between 5 and 8 years after the sinking of a cruise ship, a
follow-up of survivors (age 11–17 years at disaster) found that 52% developed PTSD. The duration of PTSD was more than 5 years in 26% of the cases and at follow-up while the point prevalence of PTSD was 34% (Yule, Bolton, Udwin, Boyle, O’Ryan & Nurrish, 2000). Similarly, Morgan, Scourfield, Williams, Jasper & Lewis, (2003) found that 33 years after a coal slag heap collapsed onto a primary school burying the schoolchildren, 29% of the now adult survivors (then aged 4–11 years) suffered from PTSD. Further, a study of adults who 17 years earlier survived a flooding as children found that 7% suffered from current PTSD and one third met the PTSD criteria 2 years after the event (Green & Lindy, 1994). These findings suggest that posttraumatic stress can persist through adolescence and at least until early adulthood.

In addition, indirectly affected children may also experience posttraumatic stress. In a study of 7th-grade children who experienced a bus crash on a school outing, 39% of the children not directly involved in the crash reported moderate or severe acute stress reactions within the first week after the accident. After 9 months, however, only 6% of the same children reported moderate or severe posttraumatic stress (Milgram, Toubiana, Klingman, Raviv, & Goldstein, 1988). After 7 years, the directly affected children experienced more posttraumatic stress and exhibited more mental health help-seeking behaviour than the indirectly affected children and a non-exposed control group, (Tyano et al., 1996). However, the directly exposed children did not differ from the indirectly exposed or controls in terms of general distress. The findings found that the directly exposed children differed from the indirectly exposed children regarding posttraumatic stress, but not in general distress, it was
also supported in a 33-year follow-up study of survivors from a mudslide (Morgan Scourfield, Williams, Jasper & Lewis, 2003).

Research suggests that children are an especially vulnerable group in the event of a mass disaster like the Indian Ocean tsunami in 2004 (Vijayakumar, Kannan & Daniel, 2006). The immediate psychosocial impact of the tsunami brought loss, grief, pain and distress. Exposure to such disasters has a devastating impact on the psychological and social well-being of children, adolescents. Losing and separating family member, altering routine daily life activity, disrupting community ties, which caused children become confuse, scare and distress. In the case of the tsunami disaster, many children and adolescent were suffering from psychological consequences following tsunami aftermath and it was exacerbated by loosing and displacing family, staying in the shelter or tents for months, and lack of social support. Even, the children and adolescent exposed to natural disasters are resilient and recover from early post-trauma symptoms, however the capacity of tsunami to affect mental health is vivid. As a direct consequence of natural disasters, PTSD is the most common and devastating mental health disorder identified in children and adolescents (Norris, Friedman, and Watson, 2002). Subsequent studies have demonstrated that children and adolescent can develop PTSD following traumatic events. Much of the research has focused on children and adolescent exposed to natural disasters such as hurricanes (Sallom & Lewis, 2010), flooding (Earls, Smith, Reich & Jung, 1988) and earthquakes (Bal, 2008). They found the symptoms of PTSD among children and adolescences were an exaggerated startle response, repetitive behaviour, intrusive thoughts and flash backs about trauma, sleep disturbances, difficult to concentrate, and somatic symptoms. Hence, children
who suffer from PTSD demonstrate difficulties in academic achievement, social interaction, and aggressive behaviors (Anderson, 2005). Further studies claims that PTSD may have detrimental effects on children ability to achieve developmental milestones in relation to their peers and on their ability to become fully functioning adults. The self awareness begins to develop during adolescence. This is extremely important for children that have been exposed to chronic trauma, as they develop an understanding of what has and is occurring in their environment. Without the development of self-awareness an adolescent will have difficulty processing and understanding experiences, which may leads to ineffective reasoning skills when interacting with the larger world. The literature clearly explains the consequences of PTSD toward growth and development of children and adolescence. However, there are very few research of the long-term outcome of PTSD in children and adolescence (Goenjian, Walling, Steinberg, et al., 2009). Furthermore, there is a paucity of study to examine the long-term effect of the tsunami among children and adolescence in India, especially PTSD and its associated factor.

Based on the previous researches of trauma-induced psychological distress, the findings were pretty much similar from one to another. PTSD, depression, generalized anxiety were found to be significantly associated with disaster events (Fran, Matthew, Patricia, Cheristopher, Eolia & Krzysztof, 2002; James, Ellie & William, 1986), while panic disorder and specific phobias were rare. (Fran, 2001)

**Post Traumatic Stress Disorder**

PTSD is a severe anxiety disorder that can develop after exposure to any event which results in psychological trauma (American Psychiatric Association,
It has been found to be the most prevalent type of psychiatric morbidity after disasters, such as earthquake and tsunami (Neria, Nandi & Galea, 2008). Signs and symptoms of PTSD include re-experiencing original trauma(s), by means of flashbacks or nightmares; avoidance of stimuli associated with the trauma; and increased arousal, such as difficulty falling or staying asleep, anger, and hypervigilance (American Psychiatric Association, 2000).

Studies have shown that posttraumatic stress symptoms and rates of PTSD increase with the nature and severity of disaster events (Staab, Fullerton & Ursano, 1999). Many researches specify that the victims of PTSD after a natural disaster can suffer for long years (Green, Grace, Lindy, Gleser, Leonard & Kramer, 1990). Green (1995) found symptoms of PTSD after 14 years of Buffalo Creek dam disaster and Honig, Grace, Lindy, Newman, and Titchener (1999) found symptoms of PTSD 20 years later among those who were children and adolescents at the time of the dam break. McFarlane, Blumbergs, Policansky & Irwin (1985) found that post-traumatic syndromes began to appear after eight months of ‘Ash Wednesday’ bushfires in Australia. He found that 43% of children talked spontaneously about the fires and that at least 35% still were upset by reminders. Basoglu, Kilic, Salcioglu & Livanou (2004) diagnosed 23% with PTSD and 16% with depression in a random sample of adults 14 months after an earthquake. Pynoos, Goenjian, Tashjian et al., (1993) found PTSD on 231 children from three cities at increasing distances from the devastating earthquake that occurred in Armenia in 1988 after 1 ½ years. Goenjian et al., (1994) found high rate of PTSD symptoms in elderly adults than the younger 1 ½ years after the 1988 earthquake in Armenia. McFarlane (1988) found prevalence rates of 32%, 27%, and 30% of PTSD in a sample of firefighters at 4, 11, and 29
months after the bushfire. Similarly, Elevated distress levels were found up to 5 years following the Three Mile Island nuclear accident survivors (Baum, Gatchel & Schaeffer, 1983; Baum, 1987). Green et al., (1991) found that 37% of children were diagnosed of presence of PTSD after 2 years who were exposed to the Buffalo Creek dam collapse in 1972. Hanford et al., (1986) reported the presence of PTSD in children 1 ½ years after the Three Mile Island nuclear accident in Dauphin County, Pennsylvania. Kinzie et al., (1986) found that 50% of the adult subjects who had been exposed to the Cambodian civil war at the age of 6 to 12 years and then migrated to USA still showed PTSD symptoms. Similarly, Weis'th (1989) found acute PTSD in 54% of the sample initially and 6 months later no recovery from PTSD is reported in the sample of a Norwegian ship crew who were incarcerated and tortured after their ship was seized in Libya. The same author (1985, 1989) evaluated 121 survivors of a Norwegian paint factory explosion and fire 1 week after the disaster, 7 months later, and 4 years later. In the high-exposure group, rates of PTSD-related problems dropped from 43% initially to 36% at 7 months and 18% at 4 years. Rates of PTSD in the low-exposure group were 22% initially, 17% at 7 months, and 2% at 4 years.

In war related disaster studies, many Prisoners of Wars from the Korean conflict were still diagnosed with PTSD after nearly half a century (Page, Engdahl, & Eberly, 1997). Solomon, Regier & Burke (1989) found Israeli combat veterans who had, and had not, suffered combat stress reactions (CSR) during the Lebanon war over a 3- year period. Soldiers who developed combat stress reactions during battle were much more likely to develop PTSD in the subsequent 3 years (63% vs 14% at 1 year). American POWS held in captivity in Japan during World War II
were studied by Speed, Engdahl, Schwartz & Eberly (1989), where Half were found to have experienced PTSD in the year following release from captivity, and 29% still met full criteria over 40 years later. O'Brien and Hughes (1991) reports of PTSD in British army veterans five years after the 1982 conflict. In a study in France, Abenhaim, Dab & Salmi (1992) found 30.7% of PTSD injured victims of terrorist attacks over a period of five years. In two other studies of terrorist attacks (Curran, Bell, Murray, Loughrey, Roddy, & Rocke, 1990; Weisaeth, 1989) PTSD rates higher than 40 percent are reported. Likewise, McFarlane (1996) reported that 15% of the war veterans of Vietnam War in USA still suffered from PTSD after 19 years from the actual combats.

In accident-related research studies, Tyano, Iancu, Solomon, Sever, Goldstein, Touviana & Bleich (1996) found symptoms of long term posttraumatic stress disorder (PTSD), psychiatric symptomatology of a traumatic bus-train collision seven years after the accident. Palinkas, Downs, Petterson & Russell (1993) reported that 9.4 percent of the subjects developed posttraumatic stress disorder, a rate 2.9 times higher than that in the control group 1 year after the Exxon Valdez oil spill disaster.

Other Associated disorders

PTSD is the most commonly studied and most likely outcome in the aftermath of disasters (Leon 2004; Neria, Nandi & Galea, 2008). However it is not the only clinically relevant outcome of traumatic exposure. Other psychological and psychiatric disorders include depression, phobias and other anxiety disorders, dissociative disorders, alcohol and drug abuse, somatization, family disturbance and
general reduced psychological well being (Bromet & Dew 1995; Brown, 2000; Davidson & McFarlane, 2006; Foa, Stein & McFarlane, 2006; Norris et al., 2002).

**Depression, Anxiety and Behavioral problems**

There are a variety of responses to trauma, being exposed to a traumatic event has been shown to increase the likelihood of developing anxiety disorders, depression, substance abuse, self-harm behaviours, externalizing disorders, internalizing disorders, traumatic grief, and academic difficulty (Copeland, Keeler, Angold & Costello, 2007; Costello, Erkanli, Fairbank & Angold, 2002; Giaconia, Reinherz, Silvermen, Pakiz, Frost & Cohen, 1995; Green, Grace, Vary, Kramer, Gleser & Leonard, 1994; Pynoos & Nader, 1993). A survey of the general population has shown that impairment caused by PTSD is comparable to the impairment observed in major depression, which is considered the most impairing mental disorder (Druss, Hwang, Petukhova, Sampson, Wang & Kessler, 2009). Depression is, according to a Meta review, the second most commonly observed psychiatric problem after disasters (Norris et al., 2002). Major depression has been shown to cause a pronounced reduction in psychosocial functioning on a global level (Murray & Lopez, 1996). The post-traumatic depression occurs usually in combination with PTSD, with the common symptoms of sadness, slowness of movement, insomnia or hypersomnia, fatigue, diminished or excessive appetite, difficulties with concentration, apathy and feelings of helplessness, anhedonia, social withdrawal, guilty ruminations, feelings of hopelessness, abandonment, irrevocable life change, preoccupations with loss, irritability (John, 2010). Disaster victims with generalize anxiety disorder show persistent and excessive anxiety about a variety of events or activities, including the disaster and its consequences, which is
far beyond the reality. The condition is associated with symptoms such as restlessness, easily fatigue, difficult concentrating or the mind going blank, irritability, muscle tension, sleep problems (John, 2010). Many depressive and anxiety disorders lead to considerable impairment of social and occupational functioning (Alonso et al., 2004). Burke, Moccia, Borus & Burns (1986) found Signs of distress, depression, fear, and anxiety in girls ten months after a blizzard and flood disaster. Likewise, Swenson, Saylor, Powell, Stokes, Foster & Belter (1996) found higher anxiety and withdrawal and more behavior problems in young children who were exposed to hurricane after 14 months. Similarly, Kroll et al., (1989) reported that the Indo- Chinese refugees in Minneapolis, USA showed 73% strong tendency of depressive disorder and 14% showed PTSD after 18 months. Malt, Blikra & Hoivik (1989) found about one fifth of the subjects reported worse psychological health problems 3 years after the accident in Norway. Desivilya, Gal & Ayalon (1996) found long-term adjustment problems in adolescents 17 years after the terrorist attack in 1974. In a study conducted on over 300 individuals, those who have been diagnosed with a lifetime case of PTSD were found to be at increased risk for depression, anxiety, and substance abuse (Giaconia et al., 1995). Dooley and Gunn (1995) found that bereaved survivors and relatives from a ferry disaster were more likely to express depressive symptoms during the two years after the event compared with non bereaved survivors, whereas the non bereaved were more likely to express various forms of anxiety symptoms.

**Self Esteem**

Self-esteem is a favorable or unfavorable attitude toward the self (Rosenberg, 1965). It is an individual's sense of his/her value or worth, or the extent to which a
person values, approves of, appreciates, prizes, or likes himself/herself (Blascovich & Tomaka, 1991). Boscarino & Adams (2008) reported that individuals with delayed PTSD after a disaster reported experiencing more negative life events post disaster and had a marked decline in self-esteem. In a study of adolescent survivors of hurricane Katrina, researchers found that the more a family relied on external help in the aftermath, the greater likelihood of a negative impact on adolescent mental health. Young people whose families relied heavily on relief agencies displayed lower self-esteem, greater psychological distress and symptoms of depression (Vigil & Geary, 2008). In one study (Norris and colleagues, 2002) of 400 highly exposed residents of southern Dade County, 25 % of the sample met the criteria of PTSD 6 months after the hurricane. Symptoms of depression and avoidance remained high and poor self esteem observed as late as 30 months after the hurricane struck (Norris, Perilla, Riad, Kaniasty, & Lavizzo, 1999).

**Psychosocial Intervention After a Disaster**

Psychosocial intervention is a therapeutic intervention that uses cognitive, cognitive-behavioral, and supportive interventions to relieve pain. These include education, interventions aimed at aiding relaxation, psychotherapy, and structured or peer support. The term psychosocial intervention aims to improve the psychosocial well-being of people. A number of interventions have been developed for victims with PTSD. For other anxiety disorders, therapists use exposure (e.g., Foa & Kozak, 1986) to require clients to revisit the trauma of the disaster experience. The theory is that in dealing with a traumatic event, we use avoidance strategies to reduce the pain, and these avoidance strategies are part of the symptom picture.
Usually, cognitive restructuring is also a part of therapy used for individuals with PTSD. Disasters lead to a shift in cognitions (Janoff-Bulman and Frieze, 1983) and victims of disaster often have distorted beliefs regarding their safety, the likelihood of another disaster, their personal worth, etc. There are many forms of therapy have been developed for other disorders, such as depression and anxiety, which may result from disasters. Reviews which compare debriefing with cognitive behavioral therapy (CBT) (Litz, Gray, Bryant & Adler, 2002; Ehlers & Clark, 2003) show that CBT is more effective in ameliorating trauma symptoms, perhaps because it is longer term and more focused on symptoms. Trauma-Focused Cognitive Behavioral Therapy (TF-CBT) and cognitive behavioral interventions have been found to be efficacious for use with trauma survivors (Cohen, Mannarino & Deblinger, 2006a). Cognitive behavioral interventions have been employed in both individual and group formats in various community and school programs, usually over a 10-16 week period. CBT approaches include providing information about predictable and expected responses to trauma; engaging children in exercises to identify and appropriately express emotions; practicing anxiety reduction techniques such as relaxation, focused breathing, positive self-talk and thought-stopping; discovering the relationship between thoughts, feelings and behaviors (cognitive restructuring); and guiding children through “titrated re-exposure” using trauma narratives, story-telling, poems, and drawings to help the child slowly achieve mastery over the traumatic situation (Cohen, Mannarino & Deblinger, 2006a). Cognitive processing of the event helps the child to examine and correct misperceptions and distortions. Reconstructing the trauma experience is an integral aspect of processing the event. The goal is to desensitize the child to the trauma
event and traumatic reminders so the child can integrate the trauma into his or her life (Cohen, Mannarino & Deblinger, 2006a). This can be done verbally, in writing or in the context of art or play. A modification of CBT has been developed for childhood traumatic grief following the loss of a loved one (Cohen, Mannarino & Deblinger, 2006a).

New approaches to disaster are being developed recently. A relatively new and controversial therapy for PTSD is Eye Movement Desensitization (EMDR), which involves controlled eye movements back and forth while the client is thinking about the trauma which occurred. For victims of fire, Krakow, Melendrez, Johnston, et al., (2002) described a sleep dynamic therapy, involving psycho educational approaches about sleep, and found that both sleep disturbances and other anxiety and depressive symptoms lessened. Basoglu, Livanou & Salcioglu (2003) report that a single session with an earthquake simulator diminished symptoms of traumatic stress in earthquake victims. Smyth, Hockemeyer, Anderson, et al., (2002) administered the task of writing about victimization experiences in Hurricane Floyd, and found that it reduced the relationship between intrusive thoughts and symptoms, not as dramatic a finding as that of Pennebacker and Harber (1993) who had earlier reported that writing down one's feelings about a disaster can ameliorate symptoms. Lange, Rietdijk, Hudcovicova, van de Ven, Schrieken, & Emmelkamp (2003) have incorporated writing tasks into an Internet treatment for posttraumatic stress, which they report as successful. Neuner, Schauer, Klaschik, Karunakara and Elbert (2004) describe an effective narrative exposure therapy for PTSD in Sudanese refugees, in which participants replayed the events of their life until they formed a coherent narrative. Pitman, Sanders, Zusman, et al., (2002) report that propranolol
administered to victims of trauma interferes with memory of the event and ameliorates the potential for PTSD.

Likewise, Few interventions have been tailored to the needs of children (Wooding & Raphael, 2004), and it is possible that many interventions for children need to be addressed to their parents (Norris, Perilla, Ibanez & Murphy, 2001). There are various treatments available for children and adolescents who have been affected by trauma. Some forms of interventions that are commonly used to treat PTSD in children and adolescents include: pharmacotherapy, CBT, EMDR, family therapy, psychological debriefing, and exposure therapy.

In the past three decades, there have been many advances in the development and evaluation of psychological treatments and interventions for a multitude of child and adolescent problems (La Greca, Silverman, & Lochman, 2009). In a survey conducted in 1998-1999 by the American Academy of Child and Adolescent Psychiatry and the International Society for Traumatic Stress Studies, the majority of psychiatrists preferred pharmacotherapy (20.4%; Cohen, Mannario & Rogal, 2001). For the other psychiatrists, Cognitive Behavioural Therapy (CBT) was preferred (22.6%; Cohen, Mannarino, & Rogal, 2001). Trauma-focused treatments have been developed to allow for children and adolescents to review the trauma in a safe secure environment guided by a trained professional. CBT and other trauma-focused methods have been reported to assist with the reduction of traumatic reactions (such as PTSD and behavioural issues) and aid in the development of a deeper understanding and healthier perceptions of the trauma (American Psychological Association Presidential Task Force on Posttraumatic Stress Disorder and Trauma in Children and Adolescents, 2008). Unfortunately, many of the
treatments and services available for children and adolescents who have been exposed to trauma have not been empirically studied and thus the evidence of effectiveness is not known (American Psychological Association Presidential Task Force on Posttraumatic Stress Disorder and Trauma in Children and Adolescents, 2008; La Greca, Silverman, & Lochman, 2009).

The need for interventions has gradually become more recognized (Raphael & Wooding, 2004). Effective intervention strategies should enhance children and adolescents long term psychosocial adaptation.

Need for the Study

A disaster is a severe, relatively sudden and unexpected disruption of normal structural arrangements with in a social system over which the system has no firm control (Burton, Kates, & White, 1978). On December 26th 2004 a submarine earthquake northwest of Sumatra, Indonesia occurred, with a magnitude of 9.0, caused a giant shockwave or tsunami that ruined the shorelines of Indonesia, Sri Lanka, India, Thailand and other countries in Southeast Asia. It was one of the worst natural disasters in history, with estimates of more than 2,80,000 deaths, 27,000 individuals missing, and approximately 1.2 million people displaced; in addition, the extensive damage to homes and property altered the lives of millions of people (UNICEF, 2005). The unprecedented calamity affected many coastal districts of Tamil Nadu, India, resulting in 7,983 deaths and the need to relocate 44,207 individuals to camps and 4,99,962 to safer areas (WHO, 2004). It was found that 3 to 4 weeks after the tsunami, 14% to 39% of the children had PTSD. After the disaster, many victims were interviewed 75% loosed their own property, 76% lost
their family members, and/or 72% lost their friends. Those findings showed that the psychological impact of the tsunami persisted well after the event. Approximately 21% had PTSD, 16% had severe depression, 30% had severe anxiety and 22% had somatic symptoms. In addition to these psychological difficulties, many of those interviewed also had difficulties in their work, social life, and family life (WHO, 2004). Risk factors for adverse psychological outcomes in disasters are the severity of individual exposure, including such features as bereavement, injury to oneself or a family member, the perception of threat to life, separation from family, extensive loss of property and displacement. The children and adolescents affected by the shock and tragedy are particularly vulnerable.

Many disaster studies revealed that after tsunami 2004 disaster, immediate psychosocial problems like Post traumatic Stress Disorder (PTSD), depression, anxiety, fear, sleep disturbances and other behavioral problems were found in the survivors especially in children and adolescents. A study conducted by Agustini & Mutsuo (2012) found that children and adolescence who live through 2004 tsunami disaster do experience long-term of PTSD symptoms (63.1%) after 4.5 years in Indonesia. Likewise, Hussain (2011) reported that in his study he found many psychiatric disorders tended to persisted 2.5 years post disaster in Norwegian tourists who experienced the 2004 tsunami. The disorders, especially the presence of depression and PTSD, resulted in significant functional impairment.

Reviews of disaster studies have concluded that large scale community traumas can result in a significant increase in psychological problems in the short-term and can have significant negative physical and mental health consequences for years post disaster (Brewin, Andrew, &Valentine, 2000; Bromet & Dew, 1995;
Rubbonis & Bickman, 1991). Lazaratou, Paparrigopoulos, Galanos, Psarros, Dikeos & Soldatos, (2008) studied the psychological impact of a catastrophic earthquake in a sample of 121 survivors, 50 years after the event retrospectively in the island of Cephallonia, across the western coast of Greece and 78% of the victims reported the impact of the earthquake. Hull, Alexander & Klien, (2002) studied the survivors of the Piper Alpha oil platform disaster 1988 and found that 21% of the survivors had post-traumatic stress disorder (PTSD) after ten years. Murphy (1984) studied the relationship between symptoms and stressful life events in 155 samples 11 months after the Mount St. Helens Volcanic Eruption and when compared with control group, bereaved subjects reported significantly higher level of stress.

To our knowledge, many international long term disaster studies in adolescents were published whereas, in India very few disaster studies have been published regarding the long term psychosocial impacts in adolescents and also not much research were done in long term psychosocial interventions. An extensive research revealed that dearth of study found to be done in this area. It has been suggested that the lack of research studies in this area is due to the factor that this population are more difficult to find and treat (Bisson, Ehlers, Matthews, Pilling, Richrds & Turner, 2007), possibly because of the severe and multiple traumatic incidents occurring in their contexts like cyclone (Silove, 1999). Adolescence stage is a transition period from childhood to adult hood, if any psychosocial problems exist in childhood and persist till adolescence, it may impair the individuals personal and social life functioning and its impacts reflects to the society very severely. Though it has been 6 years since tsunami struck in the Indian coastline, many of them especially adolescents who were exposed directly exhibit certain psychosocial
problems and it is important to provide them proper psychosocial intervention to reduce their problems and improve their quality of life. With this above said background this study aims to find the long term psychosocial impact among adolescences and to develop the psychosocial interventions for reducing the effect of psychosocial problems among adolescence in tsunami-affected provinces in southern Tamil Nadu.

The next chapter, review of literature, will give an insight into research done in the past on these aspects.