Prevalence of PTSD in School-Age Population Post Earthquake/Tsunami

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Risk Factors

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Abstract

Epidemiological studies show that the most frequent pathology in children after a traumatic event such as a natural disaster is post-traumatic stress disorder (PTSD), reaching a median rate of 40 % across 27 studies with a range of 6–95 %. The strategies used to cope with these traumatic situations are commonly influenced by several risk factors, including the disaster's magnitude and characteristics, individual and familiar premorbid functioning, and sociocultural conditions.

Studies show that female gender and younger age are the most vulnerable subpopulation to develop PTSD symptomatology in children. Also, family

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functioning styles, perception of familiar support, and presence of psychopathology in the caregiver are important predictors for a child to develop PTSD as well as risk factors for chronicity of the illness after a disaster, with the potential to produce long-lasting consequences in socio-emotional development and well-being throughout the life cycle.

The following chapter will present a summary of the epidemiological data available regarding PTSD prevalence in children after exposure to earthquake/tsunami, including risk factors for PTSD development, comorbidity, course of illness, and prognosis, aiming to contribute to the body of literature on the topic in order to inform public policy on emergency preparedness and contribute to develop effective strategies for prevention of PTSD after future disasters.

List of Abbreviations

PTSD	Post-traumatic stress disorder
SES	Socioeconomic status

Introduction

When facing severe traumatic events, children respond with different strategies that imply a greater or lesser degree of adaptation and generating, in some cases, acute or chronic pathologies. In this context, one of these conditions of special severity is the post-traumatic stress disorder (PTSD). PTSD presents itself with particular characteristics and may have significant consequences for child development (Valdivia 2002).

According to Lubit (2014), among the elements that constitute PTSD, the one with larger pathogenicity in children is the feeling of losing control. Natural disasters are characterized by unpredictability of the situation and its consequences and thus maximize the feeling of losing control. The sudden and violent impacts on their victims are features that can be seen with special clarity in earthquakes and tsunamis.

The present chapter aims to present the prevalence of PTSD in school-age population affected by natural disasters such as earthquakes and tsunamis. Studies demonstrate that rates of PTSD in children exposed to traumatic experiences tend to be relatively high (Cova et al. 2013). Therefore, information regarding prevalence, risk factors, comorbidity, and other data becomes particularly relevant in order to understand, diagnose, and treat the pediatric population that present with this disorder.

The National Seismological Center of the University of Chile (2014) defines an earthquake as the manifestation of a sudden liberation of energy during a rupture process of the tectonic plates. One plate "pushes" another until "there is sufficient energy accumulated that it is able to move, generating the rupture and the subsequent earthquake." In other words, the ground moves due to the energy that irradiates from the rupture. Other types of earthquakes are the ones called *cortical*, associated to geological structures called faults, which generate seisms due to volcanic activity or to abrupt changes in the earth's crust (National Seismological Center of the University of Chile 2014).

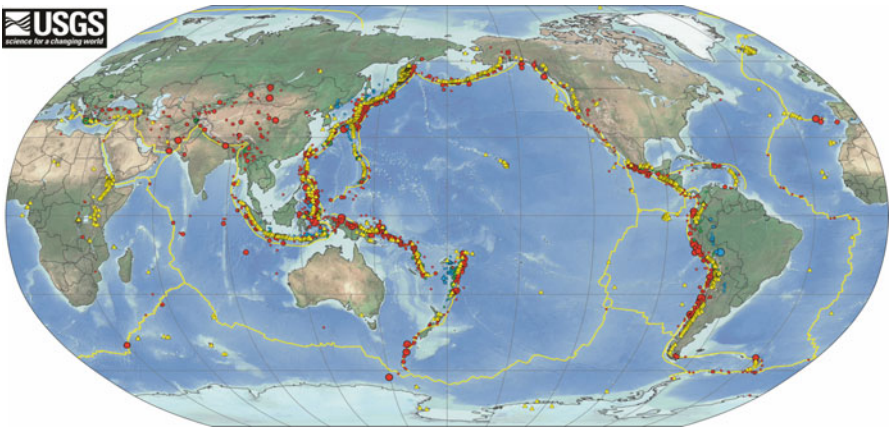

Fig. 1 Map of earthquakes occurring between 1900 and 2012 (Courtesy of the US Geological Survey)

Depending on the area of the planet, seismologists are able to identify regions with higher or lower *seismic hazard*. This concept refers to the probability of seismic movements of considerable magnitude occurring in a particular period of time. According to the geographic distribution, the Pacific Ring of Fire is characterized as the area with higher concentration of intense seismic and volcanic activity (see Fig. 1, courtesy of USGS).

The magnitude of earthquakes can be measured by the seismographic activity (Richter scale) or by the effect on constructions and buildings as well as the intensity of ground movement perceived by people (Mercalli scale). Large earthquakes whose epicenter is located in the bottom of the sea or near the coast can trigger a "tsunami," defined as "tides produced by impulses in water bodies" (Centro Sismológico de la Universidad de Chile 2014).

Prevalence

It is generally considered that children have higher rates of PTSD than adults.

Epidemiological studies carried out after earthquakes and/or tsunamis have reported prevalence rates ranging from 4.5 % to 95 % of PTSD among exposed children (Şalcıoğlu and Başoğlu 2008; Cova et al. 2013). According to the present literature review, the estimated variability in prevalence of PTSD among school-age children exposed to earthquakes or tsunamis is between 6 % and 95 % (Pynoos et al. 1993; Goenjian et al. 1995; Hsu et al. 2002; Kolaitis et al. 2003; Bulut et al. 2005; Roussos et al. 2005; Giannopoulou et al. 2006; Bal and Jensen 2007; Eksy et al. 2007; Baddam John et al. 2007; Sahin et al. 2007; Agustini et al. 2011; Ayub et al. 2012; Briceño et al. 2013; Gokcen et al. 2013; Cova et al. 2013; López-García and López-Soler 2014; Jia et al. 2013; Usami et al. 2014). The median is 39.9 % across studies, and the modes range between 10–19.9 % and 20–29.9 % (Table 1).

Table 1 Prevalence of PTSD across studies

Study	Event (Richter scale)	PTSD (%)	Post-event evaluation period	Ages
Pynoos et al. (1993)	Earthquake Armenia 1988 (7.2)	70.3 %	18 months	8–16
Goenjian et al. (1995)	Earthquake Armenia 1988 (7.2)	Low exposure 26 %	18 months	8–16
		Moderate exposure 71 %		
		High exposure 95 %		
Hsu et al. (2002)	Earthquake Taiwan, 1999 (7.3)	21.7 %	1.5 month	12–14
Kolaitis et al. (2003)	Earthquake Greece, 1999 (6)	16.5 %	6 months	10–12
Bulut et al. (2005)	Earthquake Turkey, 1999 (7.5)	Low exposure 73.7 %	11 months	10–11
		High exposure 73.2 %		
Roussos et al. (2005)	Earthquake Ano Liosia, Greece, 1999 (6.0)	4.5 %	3 months	Children and adolescents
Giannopoulou et al. (2006)	Earthquake Grecia, 1999 (6)	Low exposure 20.1 %	6–7 months	9–17
		High exposure 35.7 %		
Eksy et al. (2007)	Earthquake Turkey, 1999 (7.5)	60 %	1 month	9–18
Bal and Jensen (2007)	Earthquake Turkey, 1999 (7.5)	28 %	36 months	8–15
Sahin et al. (2007)	Earthquake Turkey, 1999 (7.5)	13 %	8 months	6–11
		6 %	11 months	
Baddam John et al. (2007)	Earthquake/tsunami, Tamil Nadu-Aceh, India, 2004 (9.1–9.3)	81.6 %	2 months	12–18
Agustini et al. (2011)	Earthquake/tsunami, Aceh, Indonesia, 2004 (9.1–9.3)	63.1 %	4.5 years	11–19
Ayub et al. (2012)	Earthquake Kashmir, 2005 (7.7–7.8)	64.8 %	18 months	School-age children
López-García and López-Soler (2014)	Earthquake, Lorca, Spain, 2001 (5.1–5.3)	55 %	1 month	8–12
		40 %	1 year	
Gokcen et al. (2013)	Earthquake, Selcuklu, Konya, 2009	24.3 %	6 months	12–14
Cova et al. (2013)	Earthquake/tsunami Chile, 2010 (8.8)	22 %	6 months	9–16
Briceño et al. (2013)	Earthquake/tsunami Chile, 2010 (8.8)	40.4 %	8 months	8–13
Jia et al. (2013)	Earthquake Sichuan, China, 2008 (8.0)	12.4 %	15 months	8–16
		10.7 %	36 months	
Usami et al. (2014)	Earthquake/tsunami Japan 2011 (9.0–9.2)	19.2 %	8 months	5–15
		17.3 %	20 months	

Table 1 show the PTSD prevalence reported in several studies conducted so far. Conclusions of these studies indicate that the variability in prevalence may be due to methodological aspects (instruments used, differences in the period of evaluation post-event, among others) as well as event and population-specific factors such as proximity to the place where the event occurred and characteristics of the traumatic events experienced by each age group (Cova et al. 2013).

Risk Factors

A series of factors have been identified that may increase the negative effects of experiencing a natural disaster (risk factors). On the other hand, elements that can ameliorate or protect from these consequences have also been identified. Identifying these risk and protective factors is crucial as a mechanism to reduce the number of children who develop PTSD after exposure in a given population. These factors can be categorized as (1) those related to premorbid factors of the population exposed (life conditions, mental health history, cultural patterns, etc.), (2) those related to specific characteristics of the traumatic event (intensity of the seism, degree of exposure to the event, effects on the infrastructure, etc.), and (3) the response to the event (post-traumatic factors; mental health diseases in caregivers, aid delivery, etc.) (La Greca et al. 1996; Hsu et al. 2002). Also, Table 2 presents a summary list of these factors.

Although the experience of threat to life during an earthquake or tsunami is described as the main risk factor of PTSD (Goejian et al. 2005; Lai et al. 2013) in children, there are several other risk and protective factors that can have a significant influence in the child's psychological response. These factors can be classified in three categories, as described below:

1. Premorbid factors
   1.1 *Gender*:
   The gender variable is among the most frequent risk factors associated with developing a PTSD after exposure to an earthquake. Numerous studies describe higher rates of PTSD symptomatology among the female population (Roussos et al. 2005; Baddam John et al. 2007; Cova et al. 2013; Jia et al. 2013). As shown in Table 3, the gender difference is consistent across several studies and can be even 2.68 times higher in women compared to men. Nevertheless, there are some studies that have failed to demonstrate a difference (Hsu et al. 2002; Kolaitis et al. 2003; Groome and Soureti 2004). This encourage some authors to suggest that the gender disparity may be present only under levels of exposure considered low or moderate and when exposure levels are high, the difference between gender does not reach statistical significance (Goenjian et al. 1995). In contrast, Lonigan et al. (1991) show that girls have higher prevalence of PTSD across all levels of exposure. More recent research have suggested that the gender difference

Table 2 Risk factors influencing PTSD

Premorbid conditions	Female gender
	Children and adolescents
	Degree of premorbid functioning and emotional stability patterns
	Personal and family history of psychopathology
	Previous traumatic event experiences
	Social and cultural factors such as violent or abusive environment, lower socioeconomic status (SES), and levels of acceptability of emotional expression, among others
Traumatic event	Threat to his own life
	Threat to a family member's life
	Hospitalization of a family member
	Witness of death or serious injury
	Feeling guilty for someone's death
	Significant material loss or destruction observed
	Intensity of the event
	Geographic location in relation to the event
	Exposition to the event through mass media
	Looting, assaults, robbery
	Social unrest and changes in social organization
Response to the event (post-trauma factors)	PTSD in caregivers
	Lack of psychological support
	Absence or delay in aid delivery

Sources: Hsu et al. 2002; La Greca et al. 1996

Table 3 Prevalence of PTSD (%) by gender

	Female (%)	Male (%)	Ratio (F/M)
Cova et al. (2013)	30.4	15.0	2.03
Briceño et al. (2013)	51.4	34.0	1.51
Jia et al. (2013)	20.3	17.7	1.15
Baddam John et al. (2007)	75.9	62.8	1.21
Agustini et al. (2011)	31.8	25.8	1.23
Gokcen et al. (2013)	36.4	13.6	2.68
Giannopoulou et al. (2006)	44.9	25.5	1.76
Usami et al. (2014): 8 months follow-up	20.9	17.6	1.19
Usami et al. (2014): 20 months follow-up	18.6	15.9	1.17

may vary as a function of age, where bigger male to female differences are observed among older children (Usami et al. 2014).

Higher prevalence of PTSD among females could be explained by the fact that women are more likely to report feelings of fear and danger as well as higher level of anxiety prior to the occurrence of the event (Kuwabara et al. 2015).

1.2 *Age and developmental stage*:
The child's age and stage of development are very significant variables to consider when evaluating high-risk populations of PTSD as result of natural disasters. The understanding of the concept of death, perception of vulnerability, coping mechanisms, and efficiency to deal with stressful situations are all variables that evolve throughout the life course. Moreover, the ability to cope with stress and to overcome adversity is strongly associated with the child's age and cognitive and socio-emotional development.

Data found in studies suggest that young children are more vulnerable to develop PTSD symptoms than their older counterparts (Uemoto et al. 2012; Cova et al. 2013). However, other studies found no such difference (Roussos et al. 2005; Thienkrua et al. 2006; Agustini et al. 2011).

A recent Japanese investigation (Kuwabara et al. 2015) studied the association between age of children at the moment of an earthquake and the impact of the disaster where they live (mortality, building destruction both at home and school). Results showed no difference in PTSD scores among children attending elementary school (lower age) regarding the level of impact of the disaster. But, there was a significant difference in scores among adolescents attending seventh and ninth grade, showing higher PTSD symptoms if they lived in a high-impact zone. The authors concluded that age would not protect children severely affected by the disaster from having PTSD, but it might safeguard those with lower levels of exposure.

1.3 *Premorbid Functioning*:

1.3.1 *Personal and Familiar History of Psychopathology*: The presence of previous psychopathology and psychiatric morbidity, whether personal or in a family member, increases the risk of PTSD in children, especially when the family member is the main caregiver (Koenen et al. 2007).

Unresolved previous traumatic experiences increase the risk of post-traumatic symptomatology. Also, as expected, severity and chronicity of PTSD increase with every new event and episode (Cloitre et al. 2009; Lubit 2014). A psychological – newly described – risk factor has been defined as "anxiety sensitivity," which is explained as the intense fear of experiencing the physiological symptoms of anxiety (Kiliç et al. 2008).

1.3.2 *Social and cultural factors*: Some studies report that social and cultural variables can have protective or aggravating influences in the way in which people respond to natural disasters (Garrison et al. 1993; Agaibi and Wilson 2005). Conditions such as poverty and economic hardship, social isolation, and lack of access to basic services and health-care facilities increase the risk of developing PTSD in children (Lubit 2014).

Moreover, there are cultural differences in coping mechanisms and openness to the expression of negative feelings. As an example, description of Chinese and Turkish cultures shows that inhibition of

emotional expression (usually considered a risk factor for PTSD) is socially appreciated and expected.

In Turkey, there is the common belief that emotionally negative or painful experiences are a sign of weakness. Therefore, a cultural tendency to deploy evasive strategies that inhibit the possibility to express emotional burden from stressful events has been noticed. In this type of population, higher prevalence of somatic symptoms is usually observed (Bulut 2013).

2. Nature of the traumatic event and level of exposure

The level of exposure, whether as objective or subjective experience, and the consequences of the event in terms of its destructiveness are variables that strongly influence the likelihood of developing a PTSD. Several studies indicate that children and adolescents who live in areas of close proximity to the epicenter of an earthquake tend to be more affected than those who live in more distant locations (Goenjian et al. 2005; Giannoupoulou et al. 2006). This association seems to be related to how closely the physical effects of the earthquake are experienced (destruction of buildings and houses, death or injuries of significant persons). The closer to the epicenter, the perception of vulnerability and threat increases.

Studies show that children who feel some degree of guilt by the loss of someone significant to them as well as those who directly witnessed the effects of an earthquake or tsunami have higher risk of developing a PTSD (Rousoos et al. 2005; Jia et al. 2013). However, even though the direct exposure to the destructive experience of an earthquake seems to be strongly correlated with the probability of developing PTSD, one must consider that mass media coverage of these disasters facilitates exposure to children that might not be close to the actual event. Especially for younger children, PTSD symptomatology can be present after this type of exposure as well (Pynoos et al. 1993; Thabet et al. 2013; Holman et al. 2014).

After examining the literature on PTSD prevalence in children, it is noteworthy that there is no evidence of a correlation between PTSD and the objective – or quantifiable – intensity of an earthquake (measured by Richter scale). According to López-Garcia and López-Soler (2014), 59 % of the population affected by the earthquake that struck Turkey in 1999 (7.4 Richter magnitude) presented moderate or serious PTSD 3 years after the event, and 64.8 % of those who suffered the 2005 Kashmir earthquake (7.6 Richter magnitude) presented PTSD 18 months after the incident. Likewise, between 30 % and 37.5 % of those affected by the earthquake in the Italian region of L'Aquila (5.9 Richter magnitude) presented PTSD 10 months after the disaster. On the other hand, Cova et al. (2013) reported that between 15 % and 30.4 % of the pediatric population exposed to the earthquake/tsunami in Chile in 2010 (8.8 Richter magnitude) showed signs of PTSD 6 months after the event.

It must be taken into consideration that the level of destruction of an earthquake can vary significantly depending on the quality of structures and construction regulations in each location, a variable that is directly dependent on the economic development of the affected area (Goenjian et al. 1995).

At the same time, the degree of exposure is not only related to the intensity of the seismic event and its destruction but also with social and individual conditions post earthquake (Vernberg et al. 1996). Delays in receiving aid and stressful events after the seism are factors that can aggravate the feeling of vulnerability and uncertainty in exposed population.

After an earthquake and/or tsunami of great intensity has occurred, social unrest and disorganization often take place. Basic services such as light, water, and gas are usually damaged and could take hours or even days to get restored, which makes it even harder for families to reorganize their daily life. Interruptions of daily routine such as attending school and public transportation are common consequences of the earthquake. Acts of vandalism such as robbery and looting may occur, aggravating the sense of vulnerability and abandonment in the population affected (Lalor 2013).

Although the prevalence of PTSD associated to traumatic events is related to the age and level of development of the children exposed, the level of psychological functioning of the child and the family (or caregivers) must be held into consideration. There is an important association between PTSD in child population and the presence of post-traumatic stress symptoms in the adults responsible for their care. Several studies demonstrate the direct relationship between PTSD in children and PTSD or mood disorders in their parents (Yehuda et al. 2001; Dyregrov and Yule 2006). Also, there are higher rates of psychological abuse and domestic violence in family contexts where the caregivers present PTSD symptoms. These adults tend to perceive parenting as a more demanding task and have more rigid and coercive behavior than parents who do not experience PTSD (Bedregal et al. 2013).

3. Risk factors influencing trauma-response mechanisms

Family functioning style, perception of intrafamilial support, and the presence of psychopathology in the primary caregiver are important predictors of PTSD development in children after exposure to a disaster. As mentioned, certain studies demonstrate an association between parents with PTSD due to natural disaster and later development of the same disorder in their offspring. Furthermore, PTSD is highly correlated to the emergence of other psychiatric illnesses (such as major depressive disorder, consumption of narcotic and psychotropic substances, and increase in suicidal behavior) and a decrease in the overall family's quality of life (Rapaport et al. 2005).

A survey conducted in Chile (Bedregal et al. 2013) after the 2010 earthquake concluded that homes where the main caregiver exhibited PTSD had higher rates of psychological abuse (33.9 % vs 10.2 %) and physical abuse (5.9 % vs 2.7 %) and children were more likely to witness violence between adult family members (19.5 % vs 8.6 %) compared to households without a parent with PTSD (rates of sexual abuse remained the same). In accordance, results in the family functioning scale showed better in family groups without PTSD. Regarding to parenting styles, supportive parents were linked to positive results in the offspring; while negative, hostile and coercive parenting styles were associated with an increase in behavioral problems after the natural disaster. It is noteworthy that families with a caregiver suffering of PTSD, where more likely to express the belief that parenting should be

Table 4 Psychiatric comorbidity in school-age children suffering from PTSD

Depressive disorder
Anxiety disorders (separation anxiety)
Attention deficit syndrome
Abuse of substances
Suicidal risk

Source: Goenjian et al. 1995; Yehuda et al. 2001; Şalcıoğlu and Başoğlu 2008; Bedregal et al. 2013; Lai et al. 2013

rigid and coercive. At the same time, in these families, upbringing was perceived as more demanding by the offspring and, consequently, has higher frequency of socio-emotional disorders when compared with families with parents without PTSD.

Elements related to the organization of the adult world toward the disaster have shown to make a difference. Quickness in aid and availability of timely mental health support are of significance both for the prevalence of PTSD development and for the risk of subsequent chronicity (Pynoos et al. 1993; La Greca et al. 1996; Hsu et al. 2002).

Psychiatric Comorbidity and PTSD

Even though PTSD is the pathology more often screened for and studied after the occurrence of a natural disaster (Leon 2004), the emergence of other psychiatric pathologies can also be observed in children and adolescents (Bedregal et al. 2013). These include depression, anxiety disorders (especially separation anxiety disorder), attention deficit hyperactivity disorder, and substance abuse (Hien et al. 2004).

Various studies argue that depressive symptoms are the most reliable indicators of PTSD severity (Lai et al. 2013; Goenjian et al. 2005; Jia et al. 2013; Roussos et al. 2005). As a matter of fact, there is a two-way relation between PTSD and depression, where each one becomes a risk factor of the other, increasing the severity of symptoms and complicating recovery (Lai et al. 2013). There is also evidence of higher rates of depression in female adolescents suffering PTSD (as compared to male counterparts) probably due to the fact that women seem to report higher levels of subjective exposure to disaster (Roussos et al. 2005).

Finally, some studies report a significant correlation between PTSD and substance abuse disorder as well as an increase in suicidal risk (Bedregal et al. 2013) (Table 4).

Course and Prognosis

Post-traumatic stress disorder is not an acute disorder. Symptoms and consequences of PTSD often remain for a long period of time after the event. Among the studies reviewed throughout this chapter, PTSD symptomatology may last between 6 months and 4.5 years after the traumatic event has occurred. Data presented in

Table 5 Prevalence of PTSD over time after earthquake/tsunami

Time after earthquake/tsunami (months)	Number of studies analyzed	Average PTSD prevalence[a] (%)
Less than 6	5	44.6
Between 6 and 11	11	31.3
Between 12 and 17	2	28.7
More than 18	9	49.6

Source: 19 studies reviewed (see Table 1 for detailed description), some studies with different prevalence

[a]Average prevalence rates of PTSD according to follow-up time in each study

Table 5 is a summary of the prevalence of PTSD in different studies, as a function of time elapsed from the earthquake/tsunami.

The information displayed in Table 5 highlights that a significant proportion of children remains with symptoms for months and even years after the event. In other words, the passage of time does not always result in reduction of symptoms (Kiliç et al. 2008; Jia et al. 2013; Agustini et al. 2011). Furthermore, variables affecting prevalence depend on the characteristics of the disaster and the population affected rather than the elapsed time since the event. This implies that having suffered PTSD in childhood can leave consequences that may last for decades and could be carried to adulthood (Valdivia 2002).

A cohort study conducted by Jia et al. (2013) at Sichuan evaluated approximately 600 children of the most severely affected districts by the earthquake in 2008. The study measured prevalence of PTSD and depression using standardized instruments in children at months 15 and 36 after the event. Exclusion criteria included children who had suffered other kinds of trauma before or after the seism and those with severe learning disabilities. Children's mean age was 11 years old. The results showed that prevalence remained constant both for PTSD and depression between the two follow-up periods. The continuity of the symptoms can be explained by the series of adversities that occurred after the tragedy, the secondary stress that entails from the pathology, and the alterations in social atmosphere post earthquake.

Children with no direct traumatic experience showed an increase in PTSD prevalence over time, suggesting that this group where the ones to whom the least psychological support was offered. Other subgroups of children with heightened vulnerability to increase risk of PTSD over time were those who suffered the loss or serious injury of a family member. Other factors associated to PTSD chronicity are comorbidity with depression; the presence of PTSD in parents; and negative, hostile, and coercive styles of parenting, as documented in previous studies (Jia et al. 2013).

According to studies carried after the tsunami that hit the coast of Japan in 2011 (Iwadare et al. 2014), girls exhibited the slowest recovery from PTSD symptoms compared to boys. Among adolescents, females also showed a slower recovery than males. Overall, young children have higher initial PTSD prevalence but better rates of subsequent recovery, and some authors have suggested that there might be a spontaneous resolution of PTSD of up to 50 % of the affected children (Kuwabara et al. 2015).

Conclusions

According to the available evidence, natural disasters such as earthquakes and tsunamis constitute events of high emotional impact, given its violent, unexpected, and uncontrollable eruption. After reviewing 27 studies across the globe, PTSD prevalence in children after earthquake/tsunamis ranges between 6 % and 95 %, with a median of 40 %. Females and younger age children report the highest PTSD prevalence as compared to males and older children after exposure to a natural disaster.

Frequent risk factors for developing PTSD in children include those who suffered significant losses, witnessed death or severely injured people, had personal and sociocultural risk factors prior to the events, or were under the care of adults with significant post-traumatic symptomatology.

The more frequent comorbid condition associated with PTSD is depression, which in itself constitutes a risk factor for more severe symptomatology. The negative impact of PTSD in child development can be long-lasting throughout the life cycle.

Other modifiable situations are of pivotal relevance in the development of PTSD in school-age children. Among these are the response of the community toward the disaster, the quickness and efficiency in aid delivered, maintenance of social organization, availability of health-care centers, and promotion of supportive parenting styles, which could significantly improve outcomes and prevent more serious pathology. It is noteworthy that all these factors could be subject to preventive interventions carried out in preparation for the occurrence of earthquakes and tsunamis.

Most studies reviewed highlight the need of public policy toward emergency preparedness and urban planification in areas with high frequency of seismologic activity as a mechanism to prevent severe consequences in the population. These programs should aim on the one hand the assessment of the immediate response capacity of the aid, protection, and health-care system to assist areas of impact and on the other hand the implementation of the mechanisms to intervene in the long term to minimize the risk of PTSD chronicity and associated depression in the population affected.

In the same way, there is an important need for specialized care, as timely support and management of post-traumatic symptomatology in children affected are of uttermost importance. In areas where there is high risk of natural disasters occurring, psychoeducation on how to support and prevent trauma in children and adolescents should be provided to the adult population, especially parents, teachers, and health-care providers.

Finally, young children, even when they are distant victims of the disaster, should be protected from further exposure from adult narratives and mass media. The continuous repetition of crude images increases and perpetuates the subjective experimentation of the traumatic event, jeopardizing children whom otherwise would not be at risk and amplifying the negative consequences on the mental health and well-being of the population.

Practice and Procedures

TEPT assessment in children exposed to earthquakes is usually conducted universally to all population affected by the disaster, as opposed to a clinical setting. This distinction is relevant to understand studies in this topic, since, when facing a disaster, community usually focuses on physical injuries, minimizing or considering normal a wide range of emotional reactions to the event.

Studies on TEPT in pediatric population usually use self-reported measures or layperson-supervised surveys. Some studies use a two-phase methodology with an initial screening and then an individual interview conducted by a psychiatrist. This increases accuracy but tends to slow down the process and increases costs. Commonly used measures across different studies are CRIES (Perrin et al. 2005), CPSS (Foa et al. 2001), and CPTSD-RI (Pynoos et al. 1987). Older studies have used instruments applied to parents, but it is known that "by-proxy" measures are less reliable, since parents tend to underestimate symptomatology of their children (Kar 2009), in part because of interference with their own symptoms and also because children usually do not verbally report until someone asks them directly (Wolfe et al. 1994).

The abovementioned situations explain the difficulty of assessing TEPT in preschool and elementary school-age children. Hence, there is a need for further research into better instruments to assess PTSD symptomatology in children of this age group.

Therefore, it is relevant that all countries (especially those with high frequency of natural disasters) are prepared to assess PTSD in children and adolescents by making sure that cross-cultural validated measures of PTSD for children are available (Şalcıoğlu and Başoğlu 2008) and that assessments of PTSD in children be conducted in general population and directly with the child, as opposed to interviewing parents. In this context, there is still a need to develop new methodology that enables us to directly assess younger children with accuracy, not only for purely academic interest but mainly as a mechanism to identify those who are at more risk of long-lasting emotional sequelae and to provide stronger support and targeted interventions.

Key Facts of Earthquakes/Tsunamis

- Earthquakes are defined as the manifestation of a sudden liberation of energy during a rupture process of the tectonic plates.
- The magnitude of earthquakes can be measured by the seismographic activity (Richter scale) or by the effect on constructions and buildings as well as the intensity of ground movement perceived by people (Mercalli scale).
- Large earthquakes with epicenters located at the bottom of the sea or near the coast can potentially trigger a "tsunami," defined as "tides produced by impulses in water bodies."

- The highest risk zone for earthquakes and tsunamis in the world is the "Ring of Fire," countries around the Pacific Ocean.
- Countries with largest earthquakes and tsunamis in the world with published data on psychological impact in the pediatric population are Indonesia (2004), Japan (2011), and Chile (2010).

Summary Points

- Children are more vulnerable than adults to develop PTSD after exposure to traumatic events.
- Characteristics of unpredictability and uncontrollability of natural disasters – especially earthquakes and tsunamis – increase the likelihood of developing PTSD in school-age children.
- Prevalence of PTSD in children exposed to earthquakes/tsunamis ranges from 6 % to 95 % in different studies.
- Risk factors for developing PTSD can be categorized as (1) those related to the traumatic event, (2) those related to individual characteristics, and (3) those related to social and cultural characteristics of the population exposed.
- Premorbid demographic risk factors for developing PTSD include female gender and the age and developmental stage of the children exposed.
- Premorbid functioning such as personal and familiar history of psychopathology as well as social and cultural factors of the community affected also influences the prevalence of PTSD.
- The nature of the traumatic event and the level of exposure and threat are significant modifiers of the risk of developing PTSD symptoms and their severity.
- Other psychiatric illnesses such as depression, separation anxiety disorder, and substance abuse are common comorbidities of PTSD after natural disasters in children and adolescents.
- Chronicity of PTSD symptoms tends to be the rule rather than the exception in children and adolescents who develop PTSD after an earthquake/tsunami.

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