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# Post-Traumatic Stress Disorder in Children and Adolescents: Some Recent Research Findings

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## Abstract

Childhood trauma can have a profound effect on development, with a lifelong impact on physical growth, psychological development, and mental health. This chapter provides a framework for adolescent health professionals to understand the impacts of traumatic stress on children and adolescents. This chapter mainly takes the Wenchuan Earthquake studies in China as an example, and reviews recent research findings on epidemiological characteristics of PTSD and related mental disorders, as well as on possible influencing factors and mechanisms for post-traumatic adaptation in children and adolescents. Important intervention strategies for PTSD in children and adolescents are introduced. Prospects for future research are also discussed.

**Keywords:** PTSD, comorbidity, post-traumatic adaptation, protective and risk factors, treatments, children, adolescents

## 1. Introduction

Exposure to potentially traumatic events such as hostilities of school shootings, terrorist attacks, threats of war, destruction of public property, suicide bombings, and natural disasters is highly frequent among young people across the world. Many children appear to be confronted with one or more potentially traumatic events while growing up. As children and adolescents have limited coping strategies and are less capable of effectively protecting themselves, they are more vulnerable to traumatic disaster than adults. It was reported that, in the immediate aftermath of such events, a high percentage of children will experience symptoms of Post-traumatic Stress Disorder (PTSD) with approximately 20–30% going on to develop the full disorder in the first 6 months [1]. However, due to the special stage of their physical and mental development, unique features of pediatric PTSD have less been studied. Fortunately, there is growing recognition of the fact that traumatic events can have severe and lasting impacts on children, and clinicians are becoming increasingly sensitive to the psychological needs of young survivors of traumatic events.

Depending upon the developmental stage and level of cognitive and emotional maturity, the symptomatology of PTSD in children are expected to be different from that in adults [2]. Prevalence and symptomatology of PTSD also vary greatly

among children and adolescents depending upon the traumatic event itself, the severity and duration of exposure, and the child's demographic variables such as gender, age, and ethnicity. For example, rates of PTSD diagnosis are higher among girls, middle school children, and Hispanics [3–5]. Interpersonal traumas, such as sexual and physical assaults, are more likely to result in PTSD than exposure to natural or technological disasters [2, 6]. In addition, numerous psychological, family, and social factors such as parental mental status and, prolonged life disruption could also affect children and adolescents' post-trauma adaptation and recovery [7, 8]. Currently, PTSD is increasingly viewed as a potentially serious disorder in children and adolescents, because of not only the intense suffering it wreaks on young people, but also its adverse effects on biological, psychological, and social development [9]. Left untreated, PTSD can persist for years, increase the children's risk of developing other disorders, and impair their psychosocial functioning in future life [10].

In this chapter, we will take the Wenchuan Earthquake studies in China as an example to introduce current research results of PTSD and related mental disorders, their influencing factors and mechanisms, and intervention strategies in adolescents. The Wenchuan Earthquake is an 8.0-magnitude earthquake that struck Wenchuan County in China's south-western Sichuan Province on May 12, 2008. This massive disaster left 69,197 people dead, 374,176 injured, 18,222 listed as missing, and at least 4.8 million people were rendered homeless in the earthquake affected areas. Moreover, a number of subsequent earthquakes have ravaged south-western China during the years after the Wenchuan Earthquake. Since this earthquake, researchers in China have conducted a series of studies to examine the impacts of earthquake exposure on mental health development among Chinese children and adolescents. For example, Fan and his colleagues established the Wenchuan Earthquake Adolescents Health Cohort (WEAHC) [11], which is a 6-wave longitudinal study across 10 years in a cohort of 2250 adolescents exposed to this disaster. The WEAHC project examined longitudinal epidemiological characteristics of various disaster-related mental health disorders (i.e., PTSD, depression, anxiety, sleep disturbances, etc.), and collected psychological, familial, and genetic data with the aim of exploring potential etiologies of these disorders. In addition to the WEAHC project, other research teams have also conducted longitudinal investigations of child and adolescent earthquake survivors in China since 2008. All these studies have offered novel insights into the epidemiology, symptomology, related risk and proactive factors, and preventive and intervening measures for PTSD and comorbid disorders in Chinese children and adolescents. In this chapter, we will introduce important findings from the WEAHC study as well as these other studies.

Specific issues of this chapter are as follows: (1) assessment of post-traumatic stress disorder in children and adolescents; (2) epidemiological characteristics of PTSD among children and adolescents; (3) possible mechanisms for PTSD in children and adolescents; (4) post-traumatic growth; (5) psychological and pharmacological treatments for children and adolescents with PTSD.

## **2. Assessment of post-traumatic stress disorder in children and adolescents**

There is consensus that core symptoms for the diagnosis of PTSD in children over the age of 7 years are almost similar to those used for adults. However, below this age (particularly below the age of 5 years), there is less agreement on the criteria for diagnosis. Nevertheless, trauma-affected symptoms in younger

children are gradually being identified, such as regression to immature behaviors (becoming more anxious and clingy, and having difficulty settling to sleep), aggression (becoming irritable, having temper tantrums, or displaying destructive behavior), repetitive reenactment in play or drawings, and nightmares may occur less frequently [12]. We also need to be able to identify children and adolescents symptomatology as it relates to their functioning in different contexts.

Children may not report their psychological reactions to the trauma unless they are specifically asked about aspects of trauma [13]. Due to cognitive immaturity, children may not be given the opportunities to talk about the event. Even having the opportunity, limited cognitive and expressive language skills of children may make it difficult to infer their thoughts and feelings smoothly. However, since parents and teachers have often been shown to be poor reporters of symptoms in children [2], directly asking the children about their symptoms is almost always required.

To date, more evaluation tools have been developed to evaluate the reactions and symptoms of children and adolescents exposed to traumatic events. The evaluation tools can be roughly divided into two categories: subjective instruments and (semi-) structured interview tools.

## **2.1 Subjective instruments**

Self-rating or other-rating (usually reported by parents or caregivers) scales are considered as effective tools for screening PTSD in children and adolescents, which can reflect the current stress response of the patient to a certain extent, and are convenient for large-scale use in the trauma-exposed population.

### *2.1.1 Impact of Event Scale-Revised, IES-R*

The Impact of Event Scale-Revised (IES-R) is a self-report measure of current subjective distress in response to a specific traumatic event [14]. Although originally developed for adults, this scale is useful to monitor post-traumatic stress symptoms as well as to track progress with interventions among individuals over the age of 7 years [15].

IES-R is a revised version of the Impact of Event Scale [16], which consists of 22-item, with 3 core symptom clusters of PTSD: intrusion (8 items related to intrusive thoughts, nightmares, intrusive feelings, and imagery associated with the traumatic event), avoidance (8 items related to avoidance of feelings, situations, and ideas), and hyperarousal (6 items related to difficulty concentrating, anger and irritability, psychophysiological arousal upon exposure to reminders and hypervigilance). IES-R requests subjects to report on the degree of distress rather than the frequency of the symptoms and takes approximately 10 min to complete and score with no special training required to administer the questionnaire. It also showed good reliability, validity, and sensitivity to change.

### *2.1.2 The Children's Revised Impact of Event Scale, CRIES-13*

The Children's Revised Impact of Event Scale (CRIES-13) with good reliability and validity as well as a stable factors structure, is a brief child-friendly measure designed to screen children at risk for PTSD. It has been used to screen a large number of at-risk-children following multiple types of traumatic events [17]. According to the DSM criteria with 17 PTSD symptoms across three symptom clusters, CRIES revealed a three-factor solution corresponding to the intrusion (4 items), avoidance (4 items), and arousal (5 items) subscales. Higher scores reflect children's

higher risk with PTSD. According to Smith et al. [18], the scores were related to the children's level of traumatic exposure, anxiety, and depression, as well as distress reported from mothers and teachers.

### *2.1.3 Child PTSD Symptom Scale, CPSS*

The Child PTSD Symptom Scale [19] is a self-report measure of PTSD severity among 8–18 years old children, which is in accordance with the diagnostic criteria in the Diagnostic and Statistical Manual of Mental Disorders (DSM–IV 4th ed. [20]). It seems well understood by children and is relatively quick for them to administer. The CPSS indexes the frequency of the 17 PTSD symptoms (DSM–IV), with each item rated on a 4-point Likert-type scale (0 = not at all, 1 = once a week or less, 2 = 2–4 times a week, 3 = 5 or more times per week). The impact of symptoms on daily function is also measured with seven dichotomously scored items that include aspects such as schoolwork and relationship with one's family [21].

The CPSS can be used as a continuous measure of symptom severity (ranging from 0 to 51), and a cutoff of 11 or above was found to have sensitivity of 95% and specificity of 96% [21]. Foa et al. [19] also reported that the 17 symptom items could be scored dichotomously to generate a DSM–IV consistent diagnosis of PTSD.

### *2.1.4 The UCLA PTSD Reaction Index for DSM-IV, revision 1 (UCLA CPTSD-RI)*

In 1985, the UCLA PTSD Reaction Index, a screening questionnaire based on DSM diagnostic criteria to assess post-traumatic stress reactions among children and adolescents was developed by UCLA Trauma Psychiatry Program.

The UCLA PTSD-RI is a self-report instrument showing satisfactory reliability and validity [22–24], which has been used widely around the world for the measurement of childhood PTSD [25]. The 33-item scale contains two parts: (1) a section with 13 questions (scored dichotomously) that aligned with DSM-IV criterion A (the objective and subjective experiences and memories of the traumatic event); (2) a section with 20 questions map directly onto the DSM-IV criterion B (intrusion), criterion C (sense of “numbness” and avoidance), and criterion D (arousal) for PTSD, with each item scored from 0 (never or rarely) to 4 (most or all of the time).

## **2.2 Structured and semi-structured diagnostic interview schedules**

These interview tools have strict implementation procedures, and must be used by professionals or strictly trained surveyors to objectively evaluate the subject's symptoms. Because these tools provide greater diagnostic reliability, they have become major assets in assessing treatment efficacy, epidemiological patterns of psychopathology, and the continuity and validity of psychiatric syndromes appearing in children and adolescents [26]. The contents of most of these interview schedules are generally symptom-based, but differ in format.

### *2.2.1 The schedule for affective disorders and schizophrenia for school-age children-present and lifetime version, K-SADS-PL*

K-SADS-PL is a semi-structured diagnostic interview schedule used by a child and adolescent psychiatry specialists to ascertain both lifetime and current status of mental illness in children and adolescents, which is DSM-IV compatible. It is formatted to interview both parents and children. Score sheet margin notations

are required if the worst current episode symptoms have resolved. This later information is needed to determine whether diagnostic criteria are still met for the disorder. Therefore, symptoms rated in the current episode may not be those that the child is experiencing at the time of the interview [26].

### *2.2.2 Mini international neuropsychiatric interview for children and adolescents, MINI-KID*

MINI-KID is a structured clinical diagnostic interview designed to assess the presence of psychiatric disorders according to ICD-10 and DSM-IV criteria in children and adolescents aged 6–17 years without mental retardation. It is a brief but valid and reliable diagnostic instrument that can be used in clinical settings in psychiatry [27]. MINI-KID can be easily conducted by a trained surveyor, which allows it easy to be used in large-scale epidemiological investigations. MINI has been translated into over 40 different languages and validity and reliability have been reported over 7 different languages [27].

When selecting the appropriate evaluation tool and formulating an evaluation plan, the surveyors need to consider factors based on their own knowledge background, the familiarity of the tools and the objective conditions. The surveyors should first consider the purpose and object of the assessment. For example, a simple and reliable self-report questionnaire is more appropriate to use in large-scale epidemiological surveys, while a more comprehensive and diagnose assessment method seems more suitable for individual assessment. In the selection and planning of assessment tools, the following factors should be considered: the type and severity of trauma, the evaluation of risk and protective factors, the evaluation of children's social functions, the characteristics of children and adolescents' psychological development in different ages, assessments of parents' mental health. In addition, it should be noted that cultural differences may weaken their original effects.

## **3. Epidemiological characteristics of PTSD among children and adolescents**

Due to the lack of relatively mature investigative tools and ethical reasons, the epidemiological characteristics of PTSD in children and adolescents are less studied than that in adults, and research has been mostly focused on children or adolescents at an advanced age. Findings from earlier studies indicate that the prevalence of PTSD in children and adolescents is lower than in adults. But with the development of various survey tools and methods, more and more studies show that the prevalence of PTSD in children and adolescents is not lower than that in adults. In 2002, La Greca et al. [28] reviewed the prevalence of PTSD of children exposed to natural or man-made disasters, and found that 5–10% of the children meet the diagnostic criteria for PTSD. In other traumatic contexts, such as fires, sexual assaults and wars, surveys show that the prevalence of PTSD in children ranges from 25 to 75%.

After the 2008 Wenchuan Earthquake, a large number of studies have been done among child and adolescent earthquake survivors. As stated above, a representative research project is the WEAHC established by Fan et al. [11] in Dujiangyan City, one of the 10 worst affected areas by the Wenchuan Earthquake. A large sample of 2250 adolescents was enrolled in the initial survey conducted at 6 months post-earthquake. Among them, 1573 were followed-up subsequently at 12, 18, 24, and 30 months post-earthquake. Data were collected on adolescents' mental health problems (i.e.,

PTSD, depression, anxiety, and sleep disturbances), earthquake-related stressors (i.e., earthquake exposure and negative life events post-earthquake), psychosocial and familial factors (e.g., trait resilience, coping styles, social support, and parenting styles), and behavioral/social functioning (e.g., prosocial behaviors and academic performance). Five years and a half after the earthquake (October and November 2013), another screening survey on mental health problems were conducted among 3501 adolescents (some were from the original cohort). Based on survey results, 512 adolescents were enrolled for individual clinical interviews and provided their oral mucosal samples for genetic analysis. Data from the WEAHC study provided great opportunity to investigate longitudinal epidemiological characteristics of mental disorders among Chinese adolescent earthquake survivors, as well as to explore the psychosocial and genetic mechanisms underlying these disorders. Aside from the WEAHC, longitudinal investigations of child and adolescent earthquake survivors have also been conducted by other research teams in China after 2008. Yet, many of them were limited by small sample sizes, few survey waves, or short follow-up duration. Regarding epidemiological characteristics of PTSD among child and adolescent earthquake survivors, some major findings from the WEAHC study and other studies are as follows.

First, the WEAHC study showed that prevalence estimates of probable PTSD were 21.0, 23.3, 13.5, and 14.7% at 6, 12, 18, and 24 months after the earthquake [11]. The rates tended to be higher at 12 and 24 months, suggesting an “anniversary reaction” in adolescents’ post-earthquake mental adaptation process. This highlights the importance of providing adolescents with more intensive mental health support around the anniversary dates. In addition, the effects of trauma exposure in childhood can continue into adulthood. For example, data from Wenchuan Earthquake samples found that the prevalence of PTSD among the young adults 8.5 years later after they experienced the 2008 Wenchuan Earthquake was still as high as 4.75% [29].

Second, there are individual differences in the long-term change of PTSD symptoms among adolescent earthquake survivors. The WEAHC study observed five different patterns of the PTSD trajectories [30]: resistance (minimal or no symptoms over time, 65.3% of the sample), recovery (initially moderate/severe symptoms followed by a gradual return to pre-trauma functioning, 20.0%), relapsing/remitting (symptoms displaying a cyclical course, 3.3%), delayed dysfunction (initially minimal/no symptoms followed by elevated symptoms, 4.2%), and chronic dysfunction (moderate or severe symptoms over time, 7.2%). Different types of trajectories have their own characteristics, and those who show the latter three patterns are at high risk for PTSD. Post-disaster psychological intervention should focus on prevention, and it is necessary to identify high-risk populations to enhance the pertinence and effectiveness of the intervention.

Third, clinical presentations are exceedingly complex and children with PTSD are at increased risk of having comorbid psychiatric diagnoses. Depression and anxiety disorder have been reported to be common comorbid disorders associated with PTSD [31]. Consistent with previous studies based in western countries, research on the post-traumatic psychological consequences of adolescents after the Wenchuan Earthquake have also proved the prevalence of the comorbidity of PTSD and other mental disorders [32, 33]. One publication from the WEAHC study [34] examined the associations of adolescent survivors’ PTSD symptoms, depression, generalized anxiety disorder (GAD), separation anxiety disorder (SAD), panic disorder, social phobia, conduct disorder, and attention deficit hyperactivity disorder (ADHD) at 1 and 1.5 years post-earthquake. Results showed that 91.9 and 94.0% of the adolescents with PTSD symptoms had at least one comorbid

psychiatric disorder at 1 and 1.5 years post-earthquake, respectively. 54.3 and 50.4% of those without PTSD symptoms had at least one other psychiatric disorder. Compare to behavior problems, PTSD symptoms were more likely to co-occur with subtypes of anxiety or depression symptoms. Adolescents who were identified as having PTSD comorbid with depression or SAD at half year were more likely to have PTSD symptoms over time. Longitudinal analyses showed that depression, GAD, and SAD symptoms at 1 year post-earthquake predicted higher levels of PTSD symptoms at 1.5 years post-earthquake. In turn, increased PTSD symptoms predicted increases in GAD and panic disorder symptoms. The reason of the high prevalence of PTSD and comorbid depression/anxiety may be due to the shared variance resulting from the overlapping symptoms between PTSD and other mental disorders [35]. These findings suggest that specific multi-modal assessments and treatments targeting both PTSD and its comorbid disorders are warranted.

Forth, different environmental and psychological factors have different impacts on post-traumatic adaptations among adolescents with different characteristics. For example, positive coping styles and social support resources have positive effect on post-traumatic adaptation [36], and adolescents with different characteristics (i.e., different ages) need to be trained with different coping skills to guide them in seeking and take good use of various social support resources. In addition, the predictive effects of environmental factors such as negative life events on the post-traumatic psychopathology of certain groups (such as those with high resilience) diminished over time. The design of post-traumatic mental disorder intervention strategies and mental health education efforts should consider the characteristics of different individuals, focus on individuals at high risk for continuing, relapsing or delayed mental symptoms, and fully consider various environmental/psychological factors in implementing targeted intervention.

Finally, the occurrence of post-traumatic mental disorder shows familial aggregation, and the interaction between susceptible genes and family environmental factors have impact on adolescents' post-traumatic mental disorder. HPA axis-related genes and serotonin transporter genes have been evidenced to have a role in various stress-related physical and mental illnesses [37]. The WEAHC study examined the relationship between glucocorticoid receptor gene (NR3C1), one of the key genes involved in the HPA axis regulation, and anxiety disorders in adolescent earthquake survivors. NR3C1 polymorphisms rs6191 GG genotype, rs6196 AA genotype, and rs41423247 GG genotype were found associated with decreased risk of anxiety disorders. There was also a significant interaction between rs41423247 genotypes and maternal warmth in predicting adolescent anxiety disorders; that is, rs41423247 GG genotype was linked with reduced risk of anxiety disorders only when maternal warmth was high. In another case-control study conducted 3 years following the Wenchuan Earthquake, 183 adolescents with the average age of 15 years (64 adolescents diagnosed with PTSD and 119 controls) were investigated. The results showed that serotonin transporter gene polymorphisms (i.e., 5-HTTLPR and 5-HTTVNTR) and earthquake exposure had a significant interaction effects on PTSD of the adolescents. Specifically, when a teenager who carrying an S allele exposed to high level of earthquake exposure, he/she would have a fourfold increased risk in developing PTSD [38]. These findings highlight the importance of considering family and genetic variables in developing interventions. Exposure to traumatic events in early life may influence individuals' gene expression through epigenetic modification, which would have long-term and even lifetime effects on their physical and mental function in the future. Future research on the epigenetic mechanisms underlying the relationship between genetic etiologies, family factors and adolescent PTSD is warranted, to further explore the disease etiology.



## **4. Possible mechanisms for PTSD in children and adolescents**

### **4.1 Biological factors**

#### *4.1.1 Genetic factors*

Studies have shown that the occurrence of PTSD may be associated with genetic susceptibility. Xian et al. [39] assessed 3304 monozygotic and dizygotic male-male twin pair members with PTSD and found that genetic factors have an impact on all PTSD symptoms. On one hand, stress can induce the abnormal expression of cognition and neuroendocrine related genes, which eventually leads to the occurrence of PTSD. For example, abnormal expression of Corticosterone-related genes may cause PTSD. On the other hand, the development of PTSD may be related to gene polymorphism. At present, most candidate genes for PTSD are located in dopamine system and serotonin system. For example, a meta-analysis showed that 5-hydroxytryptaminetransporter (5-HTT) gene polymorphism is closely related to post-stress affective disorder. In addition, glucocorticoid receptor genes, GABA-A receptors, BDNF genes et al. have been reported to be related to PTSD. It is worth noting that the pathogenic genes of neuropsychiatric diseases are pleiotropic, that is, one genotype can be susceptible to several different mental diseases. Pleiotropy is clearly manifested in PTSD. For example, the incidence of anxiety and affective disorders in patients with PTSD is much higher than that in the general population. Finally, PTSD is often comorbid with many mental illnesses, such as depression and suicidal tendencies, which made its clinical features complex and diverse. As a result, the homogeneity of the research sample decreases, which further increases the difficulty of genetic research.

#### *4.1.2 Neuroendocrine changes*

The role of HPA axis dysfunction in the pathogenesis of PTSD in adults has been extensively researched and explained. Previous studies have found that cortisol levels decreased in adult patients with PTSD, which could also predict the patients' PTSD level after 6 months [40]. Low cortisol levels may strengthen the memory of traumatic events and increase individuals' subjective distressing experience. This kind of distressing experience can change individual's psychological functioning, delay their recovery and increase their adverse reactions, which may affect the ability of the victim to cope with traumatic experience, and in turn, lead to the occurrence of PTSD. However, Lipschitz et al. [41] found that the suppression of salivary cortisol following low-dose dexamethasone in adolescent PTSD patients showed no difference from those who experienced traumatic events without PTSD and healthy non-traumatized controls, while PTSD subjects with co-occurring depression showed higher salivary cortisol level before and after this experiment compared to controls.

#### *4.1.3 Neuroimaging findings*

Brain is a human organ that processes emotions and thoughts. Evidence has identified the changes in brain imaging among adults with PTSD. However, due to immature neurodevelopment, it is thought that the brain changes of children and adolescents with PTSD may be different from those in adults. We reviewed the current neuroimaging findings in children and adolescents and summarize the main findings below:

I. Prefrontal cortex and cognitive impairment: A study conducted by Carrion in 2010 found that in children with PTSD, the decrease in the volume of the left prefrontal cortex was related to their plasma cortisol levels before bed, suggesting that this area may be related to cortisol imbalance in children. In the study of functional magnetic resonance imaging (fMRI), it was found that the key areas of the prefrontal cortex of children with PTSD could not reach the activation level of children of normal age when performing cognitive functions. The above studies suggest that changes in the structure and function of the prefrontal cortex may be related to children's susceptibility to PTSD and cognitive impairment caused by PTSD.

II. Hippocampus and memory, behavioral abnormalities: A series of studies in children and adolescents with PTSD and PTSS have reported inconsistent findings within the hippocampal volumetric and memory as well as behavioral abnormalities. For example, a longitudinal study found that the severity of PTSS and corticosteroid levels can serve as independent predictors of children's hippocampal volume reductions 1 year later [42]. However, De Bellis [43] found that the hippocampal volume of children with PTSD was significantly larger compared to normal controls. In addition, this study also found that hippocampal volume was positively correlated with age at onset of PTSD. Therefore, the researchers hypothesized that the increase in hippocampal volume may be related to behavioral abnormalities such as attention impairment in children with PTSD [43]. Another fMRI study reported the relationship between hippocampus and memory among young PTSD subjects. This study found that during a verbal memory task, the activation of the right hippocampus of the children decreased; while children's avoidance and numbing symptoms was related to reduced activation of the left hippocampus [44]. It's worth noting that, most of these studies were cross-sectional design, future longitudinal study studies with neuropsychological measures as well as trauma control subjects are needed to clarify the role of hippocampal functioning in the development of PTSD in children and adolescents.

## **4.2 Sociopsychological factors**

### *4.2.1 Trauma type and traumatic exposure level*

Mass disasters such as natural disasters, large-scale human-induced accidents, spree shootings, war and terrorism, all have been shown to exert deleterious impacts on children and adolescents. The level of exposure also has consistently been associated with later post-traumatic stress reactions following various types of trauma [45]. These distinctions are likely to result in different effects. For example, many studies conducted after Wenchuan Earthquake all reported that different levels of earthquake exposure level could positively predict adolescents' PTSD at different time points post-earthquake [32, 46].

In addition, the severity of disaster exposure includes objective exposure level (e.g., direct exposure such as death, disappearance and/or injury of family members, house damage, property loss and direct witness of traumatic events) and the severity of subjective fear. Studies examining the impact of trauma exposure on PTSD have found that PTSD is more directly affected by objective exposure, and social support plays a moderating role in the relationship between objective exposure and PTSD [47].

#### *4.2.2 Personality characteristics*

Studies have shown that children and adolescents' negative personality characteristics are associated with their PTSD symptoms. For example, it was reported that neuroticism was significantly related to PTSD, and emotion-oriented coping partly mediated the effect of neuroticism on PTSD symptoms [48]. Extraversion was reported to have significant indirect effects on both PTSD and post-traumatic growth through social support [49]. Further, An et al. [50] longitudinally investigated the contribution of personality in the development of PTSD and found that neuroticism was an independent and significant predictor of subsequent PTSD. In addition, gratitude was reported to be a protective factor of relieving PTSD symptoms [51].

#### *4.2.3 Cognitive models*

PTSD is thought to be maintained by a range of cognitive and behavioral strategies that the individual uses to control the current threat [52]. At an early stage of a traumatic event, children and adolescents' cognitive reconstruction of the disaster and the reorganization of post-traumatic broken memory all influence the occurrence of PTSD [53]. Their problematic appraisals of the trauma and/or its aftermath are also considered to increase the risk of developing PTSD. Dunmore et al. [54] found that cognitive processing style during assault (mental defeat, mental confusion, detachment); appraisal of assault sequelae (appraisal of symptoms, perceived negative responses of others, permanent change); negative beliefs about self and world; and maladaptive control strategies (avoidance/safety seeking) could significantly predict PTSD in the 9 months follow-up. Thus, misunderstanding of traumatic events can lead to secondary trauma.

#### *4.2.4 Social support*

Social support is a robust protective factor for post-traumatic mental health [55]. Supportive social environment can not only provide individuals with necessary coping resources, but also provide them with a safe environment, reduce their experience of subsequent negative life events, and encourage them to think positively about traumatic events, thereby helping to reduce the negative impact of traumatic events on individuals and promote positive changes after trauma. Much literature on adolescent exposure to Wenchuan Earthquake also suggested the positive protective effect of social support on alleviating PTSD. For example, Zhao et al. [56] found that social support (both subjective support and support availability) improved the quality of life of the earthquake survivors with PTSD symptoms. Moreover, Wu et al. reported that among all the social support resources, the support of parents and teachers is the most important [47].

#### *4.2.5 Age and gender*

There are gender differences in children and adolescent's defense and coping styles, as well as the effects of social support, which have important influence on their post-traumatic reactions. Many studies have found that girls are more likely to have PTSD symptoms than boys following disasters [30, 33, 57]. Generally, female more often use strategies such as repression and fantasy to deal with traumatic events [58]. Second, there are also gender differences in the neuroendocrine

reaction caused by trauma. Girls have more adverse physical and psychological reactions after trauma, which may further aggravate girls' PTSD symptoms [59].

Children's experience of danger, their perception and understanding of trauma, susceptibility to parental distress, own coping styles and skills, and memory of trauma may vary with ages. Most studies suggest a positive relationship between PTSD and children's age after the earthquake [30]. However, another study reported that at 1 month after the earthquake, the incidence of PTSD in survivors under 15 years of age was significantly higher than that in survivors over 15 years [60]. Age differences are also shown in children's experience of specific post-traumatic symptoms and previous studies results are mixed. For preschool children, they may display more overt aggression and destructiveness as well as behavioral re-enactments of the traumatic event. While, the reactions of children over the age of 8–10 years, are more similar to those manifested by adults [61]. Inconsistent research conclusions may be related to differences in stressors, study criteria, measurement and distance from stressors. For example, a study of earthquake reported that there was an interaction between age and distance from the epicenter, younger children in areas closer to the epicenter showed severer PTSD symptoms while older children in areas far away from the epicenter showed severer PTSD symptoms [62]. The reason may be that in areas far away from the epicenter, older children are more likely to follow media coverage of the earthquake and experience alternative trauma; younger children are more susceptible to direct trauma exposure. All these current explanations are tentative and should be interpreted cautiously, also, future studies are suggested to further illustrate these possible explanations and explain with caution due to the complex nature of PTSD.

#### *4.2.6 Family factors*

Family environmental factors (e.g., poor parent-child relationship and family adversity) are risk factors that accelerate PTSD. In addition, as family members sometimes encounter a disaster simultaneously, children's and parents' post-disaster symptoms can be highly interactive [63, 64]. Parents' response after the trauma event affects children's judgment of the event, and their coping styles are imitated by children. In addition, given mothers are primary caregivers of children, maternal poor psychological states, continued focus on the disaster event, or changes in family support could be a risk factor for children's post-traumatic symptoms. Moreover, some studies also suggest that the incidence of PTSD is substantially related to genetic factors. Xian et al. [39] investigated 3304 monozygotic and dizygotic male-male twin pair subjects to examine whether and to what degree genetic and environmental contributed to PTSD. The results showed that genetic and family environmental factors have influence on all PTSD symptoms, the liability for PTSD being 20.0% due to genetic contribution specific to PTSD.

## **5. Post-traumatic growth among children and adolescents exposed to Wenchuan Earthquake**

PTSD is a prevalent psychiatric disorder in adolescents after traumatic events. However, researchers found personal growth in the aftermath of traumatic events [65, 66]. Tedeschi and Calhoun [67] used the term post-traumatic growth (PTG) to describe these positive outcomes after struggling with a traumatic experience. Dimensions of PTG encompass recognition and elaboration of personal strengths,

enhanced interpersonal relationships, and positive changes in life priorities [68]. Prior studies revealed that survivors may develop PTG in spite of different types of traumatic events [69, 70]. For example, Jin et al. [71] found that the PTG prevalence among adolescents after the earthquake was even up to 51.1%.

Take the trends of PTG in Chinese adolescent sample as example. One study found that the average PTG was 2.96 (ranging from 0 to 5) among adolescents 1 year after the Wenchuan Earthquake, suggesting the relative high level of PTG among adolescent survivors. Further analysis found that PTG in this time showed significant difference in gender (female was higher than that of male) and, insignificant difference was found in grades. However, a decreased tendency of PTG (average mean = 2.77) after 2.5 years was observed in Wenchuan Earthquake [72].

After 3.5 years of Wenchuan Earthquake, the average of PTG was 2.78, and there were significant differences in gender and grades. Specifically, female had higher PTG than male, and junior students was lower than that of senior students [73]. This research group followed the development of PTG among this adolescent sample, and found the average of PTG was 2.68 after 4.5 years earthquake. Further analysis of the results at 8.5 years after the earthquake were similar to 3.5 years after the earthquake, with average mean was 2.80, a higher female and ethnic minorities level of PTG than that of male and Chinese Han population (the majority ethnic of the Chinese population), and lower levels of PTG among junior students than that among senior students [29].

The relationship between PTSD and PTG has been one of the interested areas among researchers. A review of 77 papers showed that the relationship was ambiguous [74]. The particular reason that accounts for this unclear relationship is that most studies employed cross-sectional rather than longitudinal designs, making it impossible for us to establish a definitive causal relationship. Some study of Wenchuan Earthquake examined the longitudinal relationships between PTSD and PTG among adolescents. A three-wave, cross-lagged study found that PTSD reported at 3.5 and 4.5 years after the earthquake both could predicted PTG 4.5 and 5.5 years after the earthquake, respectively, while PTG did not predict PTSD during the 3 years follow-up. This study suggests that, after exposure to traumatic events, PTSD and PTG can coexist in individuals, and the relieved PTSD symptoms do not indicate the improvement of PTG [75]. This relationship between PTSD and PTG may be because that cognitive pathways to PTSD and PTG is different. For example, deliberate rumination leads to PTG whereas intrusive rumination elicits PTSD in a long time after trauma [76].

From previous mentioned studies, the PTG level of adolescents was highest at 1 year after the earthquake, and although it has declined slightly since then, it has remained at a high level for a long time. That phenomenon could be explained that traumatic events like the earthquake might bring psychological stresses, and it is this stresses that may encourage adolescent survivors to use positive coping ways to overcome the negative outcomes because of traumatic events. During this coping process, having a new interpretation and understanding of traumatic events may help adolescents achieve personal growth. As the negative effects of traumatic events on individuals decreased when time passes, therefore, this decreased situation not only eases the stresses of traumatic events, but also reduces the incentive for individuals to implement PTG. Meanwhile, female may be better than male to develop PTG and senior survivors may be more likely to develop PTG than junior students. Moreover, the racial disparities in PTG level suggest that cultural factors may need to be consider in PTG research. Together, all these suggest that the relationships between gender and PTG is stable over time, the same result was observed when grade differences were considered.

## **6. Treatments for children and adolescents with post-traumatic stress disorder**

### **6.1 Psychological treatments**

Young people with PTSD may suffer from major depression, aggression, and conduct disorder [77, 78]. They may also be more likely to have suicidal ideation and attempts [79]. Left untreated, PTSD can lead to negative effects on sufferers' adulthood, such as college drop-out [80] and lower quality of life [81]. The National Child Traumatic Stress Network (NCTSN) suggests that trauma treatments should not only help children receive timely and appropriate treatments to recover from traumatic events but also build their resilience to cope with future stress more successfully. Hence, the identification of high-risk children and adolescents and providing them with appropriate and timely treatments are essential and imperative.

Currently, the number of treatment models for PTSD has proliferated. The first-line treatments encompass trauma-focused CBT (i.e., TF-CBT) [82, 83] and Prolonged Exposure for Adolescents (i.e., PE-A) [84]. Traditionally, components of treatments include: psychoeducation about PTSD, affective modulation and cognitive processing, behavioral activation, relaxation skills, trauma narrative, in vivo mastery of trauma reminders, conjoint parent-child sessions, and future safety and development [85, 86]. Furthermore, cognitive behavioral interventions for trauma in schools (CBITS) [87, 88] and trauma and grief component therapy for adolescents (TGCT) [89] are also welcomed as efficient ways to treat traumatized youths mainly due to available resources of schools. Eye Movement Desensitization and Reprocessing (EMDR), using dual-stimulation exercises to lower emotional arousal of the traumatic triggers [90], is evidenced as a promising method for youths with PTSD [91, 92]. Given the various and effective aspects of intervention, different treatments can be employed as a combination to gain a superior result. For example, TF-CBT combined with supportive therapy and a psychodynamic form (i.e., play therapy) showed a better result [93]. Though it is true that forms of treatments have made progress, they are subject to some drawbacks such as high drop-out rates [94–96]. It is mainly because the nature of trauma symptoms (especially avoidance) leads participants to be unwilling to address the traumatic event directly and reprocess the details of their suffering [97]. It is therefore difficult to see the long-term efficacy and benefits of treatments if participants have poor adherence.

Unlike traditional CBT interventions, mindfulness-based interventions (MBIs), as “third-wave” cognitive behavioral treatments, were proposed to solve this high drop-out problem. Mindfulness is characterized by paying attention to one's experience in the present moment in a non-judgmental manner [98]. There are some theoretical reasons to explain the potential mechanisms why mindfulness may reduce PTSD. Mindfulness interventions can help the sufferers to improve the ability to distinguish the past and present, so as to lower the re-experiencing symptoms [99] of post-traumatic stress disorder. In addition, increasing sufferers' capability to tolerate distressing memories, thoughts, and feelings when employing mindfulness interventions may be more likely to reduce avoidance of distressing memories [100]. Furthermore, hyperarousal of PTSD could decrease because of the training in stress reduction and relaxation [101]. Within MBIs, Mindfulness-based stress reduction (MBSR) and Mindfulness-based cognitive therapy (MBCT) were widely cited in the background of MBIs. Compared with trauma-focused therapies, MBIs showed equally efficacious and significantly lower drop-out rate [102], and were well-accepted for PTSD treatments of youths [103]. Despite the

prior research showed positive effects of MBIs in youth with PTSD, the mean effect size among youths is still lower than adults. Hence, some adaptive programs should be developed to gain satisfying results among youths [104] by shortening the session length, for example, from 90 to 30–45 min. Second, different exercises are suggested to provide specific needs for youths, such as more body scans and drawings. Third, children are more dependent on caregivers; inviting caregivers to treatment sessions should also be concerned.

In addition, art therapy is another promising intervention programmer, which promotes expression and healing. It is acknowledged that traumatic memories are sometimes overwhelming, and difficult to express in words alone [105]. Art therapy as an alternative approach can help sufferers to access the traumatic memory safely [106]. More importantly, young children are often unable to provide coherent descriptions about the traumatic event mainly due to their limited language capacity [107], making it difficult for clinicians to offer suitable interventions in helping these young children. Some previous empirical studies have provided preliminary evidence that art therapy could ameliorate PTSD symptoms in children [108, 109]. For example, Lyshak-Stelzer et al. [110] recruited 29 valid participants (14 took a trauma-focused expressive art therapy protocol (TF-ART); 15 completed a treatment-as-usual (TAU) control condition; the average age was 15.07). Results showed that patients in TF-ART had greater reduction in PTSD symptom severity than youth in the TAU condition. To support future research and practice of employing art therapy for PTSD treatment, Spiegel et al. [105] concluded some characteristics that differ from other approaches of treating PTSD: relaxation, non-verbal expression, containment of traumatic material within an object or image, symbolic expression, externalization of traumatic memories and emotions, and enjoying the pleasure that arose from creation. Again, prior studies reported promising results for art therapy in relieving PTSD among youths; however, future studies need to develop more effective and age-appropriate treatments under art therapy structure.

In conclusion, both traditional approaches like TF-CBT and the “third-wave” treatments like mindfulness-based interventions provide positive preliminary evidence in PTSD treatments among youths. Although the various interventions provide necessary helps in mitigating PTSD, it is still far way to go in developing PTSD treatments among youths. Future studies should expand the sample size, use randomized controlled trials and offer long follow-up assessments after treatments to make more definitive conclusions about the efficacy of PTSD treatments among youths. Also, researchers and practitioners need to continue to contribute to developing adaptive interventions in youths.

## **6.2 Pharmacological treatments**

To date, experiences with efficacious pharmacological interventions used for children and adolescents with PTSD are relatively lack. A common consensus is that adopting some targeted pharmacological treatments for young patients, especially for hyperarousal symptoms, sleep problems and psychiatric comorbidity, may improve their life quality and social functions [111, 112].

There was evidence supporting the using of pharmacological treatments such as serotonin-selective reuptake inhibitors (SSRIs), divalproex sodium (DVP), atypical antipsychotics and beta-receptor antagonism in reducing PTSD symptoms among children and adolescents. SSRIs have been proved their effects in treating youths with depression and anxiety disorders [113]. Overall, SSRIs are safe and well-tolerated, but it is important to note that they may increase the risk of suicide

in children and adolescents in addition to the common anticholine side effects [114, 115]. DVP was reported to be effective for treating core PTSD symptoms in a randomized controlled clinical trial (high dose of DVP conditions: 500–1500 mg/day compared with dose conditions: <250 mg/day) [116]. Atypical antipsychotics agents (i.e., risperidone, quetiapine, clozapine) and anti-adrenergic agents (i.e., clonidine) are often used in treating children with PTSD, schizophrenia, bipolar disorder, or psychotic symptoms in children. A study provided preliminary evidence that patients presented rapid and sustained improvement across all symptom clusters of acute stress disorders with minimal to no adverse effects after using moderate dosages of risperidone [117]. Other studies reported that beta-receptor antagonism (propranolol) [118, 119] and clonidine had significant effects on alleviating PTSD symptoms in children [120]. Further, pharmacological treatments are highly suggested to combine with TF-CBT or other trauma-centered therapy [121, 122]. Given methodological limitations, e.g., small sample sizes and few well-designed clinical trials, these findings should be interpreted cautiously.

Some important points when using pharmacological treatments in children and adolescence with PTSD should be noticed. First, are they and their parents willing to take part in pharmacological interventions. Second, those who comorbid with depression or other serious mental illnesses should be highly concerned. Moreover, specific developmental characteristics should be considered when adopting pharmacological treatments. The response effects of pharmacological treatments may vary with age, weight, gender, mental health as well as absorption, distribution, metabolism, and excretion of medication. Taken together, future studies should ideally take into account these developmental factors when applying pharmacological approaches.

## 7. Summary

Taking the Wenchuan Earthquake studies in China as an example, this chapter introduces some current research results about the epidemiological characteristics of PTSD and related mental disorders in children and adolescents, as well as their influencing factors and mechanisms. Important intervention strategies for PTSD in children and adolescents have also discussed. There are some issues that need further research.

First, apart from mental health effects of disasters on children and adolescents, future research should pay more attention to other aspects of their well-being and functioning, such as academic performance and relationship quality. This can provide an important reference for our in-depth understanding of post-traumatic psychological reactions and behavior changes, and also help to develop integrative interventions beneficial for the overall psychological and behavioral improvement of trauma-exposed children and adolescents. Second, considering the possible coexistence of PTSD and PTG, it is necessary to study the relationship between PTSD and PTG within longitudinal data with the aim of clarifying the relationship between these two variables, it is necessary to study the relationship between PTSD and PTG within longitudinal data. As mentioned, previous studies have mainly analyzed the mechanism of PTSD or PTG from a single perspective, ignoring the coexistence characteristics of them, making it difficult to effectively compare the differences between the two mechanisms. Therefore, future research can incorporate PTSD and PTG into a model at the same time, so as to determine the similarities and differences between the two mechanisms. Third, clinical intervention research from the perspective of integrating the remission of PTSD



and promotion of PTG is needed. In the past, traumatic research mainly focused on the remission of individual PTSD, and developed related intervention methods, and also tested its effects through empirical studies. However, overall clinical empirical research on the promotion of PTG in the treatment for PTSD is still very rare. Therefore, research on psychological intervention for PTSD from the integration perspective of PTSD remission and PTG promotion at the same time is an important issue to be explored in the future. Fourth, future research should explore effective genetic, neuroendocrine, and neuroimaging related biomarkers, which may be of utility in developing new treatments and evaluating treatment outcomes.

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