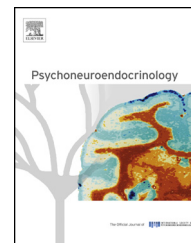




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# Enduring psychobiological effects of childhood adversity



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## KEYWORDS

Childhood trauma;  
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Multi-morbidity

**Summary** This mini-review refers to recent findings on psychobiological long-term consequences of childhood trauma and adverse living conditions. The continuum of trauma-provoked aftermath reaches from healthy adaptation with high resilience, to severe maladjustment with co-occurring psychiatric and physical pathologies in children, adolescents and adults. There is increasing evidence of a strong interconnectivity between genetic dispositions, epigenetic processes, stress-related hormonal systems and immune parameters in all forms of (mal)-adjustment to adverse living conditions. Unfavorable constellations of these dispositions and systems, such as low cortisol levels and elevated markers of inflammation in maltreated children, seem to promote the (co)-occurrence of psychiatric and physical pathologies such as posttraumatic stress disorder, obesity, or diabetes. Although findings from prospective study designs support a deepened understanding of causal relations between adverse living conditions, including traumatic experiences, during childhood and its psychobiological effects, so far, little is known about the temporal coincidence of stress-sensitive developmental stages during childhood and adolescence and trauma consequences. Taken together, childhood adversity is a severe risk factor for the onset of psychobiological (mal)-adjustment, which has to be explained under consideration of diverse physiological systems and developmental stages of childhood and adolescence.

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## 1. Introduction

Although a healthy psychobiological adaptation to severe stress or traumatization in terms of resilience can be observed in children and adults, many suffer from negative short- and long-term consequences. Maladjustment to

childhood trauma is associated with psychopathological consequences of past victimization and physiological dysfunctions during both youth and adulthood. As is known from recent studies, trauma-related psychiatric disorders such as posttraumatic stress disorder (PTSD), depression (with suicidal ideation and suicide attempts), substance abuse, or somatoform disorders are often interconnected with physical diseases (Egede and Dismuke, 2012; Qureshi et al., 2009). Although such complex medical and psychiatric comorbidities are the most problematic consequences of traumatic experience, all forms of resulting (mal)-adjustment can be collocated on a continuum. At the one end, subjects who

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experienced severe stress or were traumatized show good mental and physical health with strong resilience or marginal psychobiological abnormalities, which can be subsumed under variations within the normal range. On the other end, severe comorbid psychiatric disorders, often in co-occurrence with physical complaints such as diabetes, obesity, stroke or heart diseases, are to be found and seem to persist even when life quality improves during later life (Kittleson et al., 2006).

To increase the knowledge about the complex psychobiological mechanisms of (mal)-adjustment to severe stress, recent research uses elaborate methodological approaches at a variety of psychobiological levels in diverse groups of traumatized subjects. Besides cross-sectional studies, an increasing number of studies draw on prospective and retrospective longitudinally assessed data of large community cohorts, or survey high-risk populations for severe stress or traumatization (Erni et al., 2012; Haller and Chassin, 2012). Logistic regressions indicate that a large amount of total variance explaining adolescent or adult psychiatric and physical maladjustment is predicted by early adverse life conditions including pre-, postnatal, or childhood exposure to highly stressful conditions.

The following description of recent research on the psychobiological sequelae of adverse living conditions and trauma during childhood refers to a clear selection of seminal topics of the entire research field. First, the terms childhood trauma and childhood adverse living conditions will be defined in order to clarify whether the adverse conditions result from stress or trauma. It needs to be established whether recent data can be used to confirm or disprove the assumption that traumatic experiences may have more severe or different psychobiological consequences than chronic stress. Second, the interplay of adverse living conditions, lifestyle factors such as unhealthy diet and low physical activity, or genetic dispositions will be demonstrated for selected stress systems such as the hypothalamus–pituitary–adrenal (HPA) axis and its related hormones. As a consequence of methodological advances, recent research indicates the control of the sympathetic nervous system and HPA axis via the immune system (IS) (Chrousos, 2009; Glaser and Kiecolt-Glaser, 2005). This review focuses primarily on the HPA axis and the immune system for two reasons: First, most of the psychobiological studies assessing stress and trauma in childhood refer to the HPA axis. Stress research has been extended to genetic dispositions and epigenetic processes influencing the HPA axis, which may help to explain the diversity of adaptive processes to negative life conditions. Second, since maladjustment may result not only in psychiatric disorders but also in physical disease such as obesity, coronary heart disease or diabetes, it appears to be necessary to elucidate the effects of severe or chronic stress on immune processes, which in turn seem to influence physiological stress systems. These interactive processes and their psychopathological consequences for individual developmental processes will be discussed with respect to PTSD as the most prominent disorder associated with childhood adversity. Finally, some light will be shed on the question of whether child development research provides evidence of specific phases of increased risk onset of pathological processes due to adverse living conditions during these life phases.

## 2. Maltreatment during childhood

Childhood adversity and trauma rarely occur as a single event but seems to consist of continued maltreatment involving one or more malicious acts. At least five major forms of maltreatment during childhood can be classified: physical abuse, physical neglect, sexual abuse, emotional abuse, and emotional neglect (Torchalla et al., 2012). Besides the co-occurrence of at least two types of ongoing primary traumatic experiences such as early physical neglect, maternal emotional unavailability, or incest, secondary traumatization like exposure to inter-parental violence may increase the child's traumatic load.

To assess the features of the maltreatment experience such as onset, duration, type and multiplicity, a number of assessment methods have been developed (Allen et al., 2012). When evaluating the informative value of data collected, it has to be taken into account that the retrospective assessment of life events, including traumatic experiences, is confounded by a multitude of factors. To name only some of these factors, the lacking capacity to remember early childhood experiences in adulthood, or the child assault victim's demeanor, personality traits or intellectual capacities can influence the perceived credibility of the victim as a witness to the trauma (Danielson and Holmes, 2004). Besides this, literature shows that younger children give less reliable reports of life events than adolescents (Feltis et al., 2010). Psychiatric diagnoses such as PTSD influence witness accounts and, as a consequence, the credibility of their narratives (Broennimann et al., 2013). Finally, maternal reports on adverse life events of their children may include the bias of protecting the self or close family members. However, even when these aspects, which may limit some of the findings reported below, are acknowledged, there is a strong awareness of the incredibly high rates of child maltreatment all over the world (Al-Mahroos and Al-Amer, 2012; Ford et al., 2009; Stoltenborgh et al., 2013; Talarowska et al., 2010). Ongoing research about the long-lasting psychobiological consequences of childhood adversity is necessary to gain a better understanding of the interconnection between psychological maladjustment and physical dysfunction and to derive at least secondary prevention strategies to reduce the negative effects of traumatization.

## 3. Recent findings on the interplay between childhood adversity, genes, physiology, and behavior

### 3.1. Hypothalamus–pituitary–adrenal (HPA) axis dysregulation

It is well known that the HPA axis reflects stress reactivity. Under healthy conditions, various forms of physiological and psychological stressors provoke an increase in the production and secretion of corticotropin-releasing hormone (CRH), which is released from the paraventricular nucleus of the hypothalamus into the portal circulation. This stimulates the anterior pituitary gland to release adrenocorticotrophic hormone (ACTH). ACTH activates the adrenal gland to release cortisol. This hormonal pathway is suppressed by the negative feedback inhibition of cortisol on the pituitary and

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