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# CHILDHOOD TRAUMA'S IMPACT ON PREFRONTAL CORTEX: EMOTIONAL READINESS FOR SCHOOL

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**ABSTRACT**

*Childhood trauma can significantly affect the limbic system particularly the amygdala and hippocampus as well as the prefrontal cortex (PFC), which plays a critical role in regulating emotions, decision-making, and behavior. Disruptions in PFC function due to early adverse experiences may hinder a child's ability to manage emotional responses and adapt to the demands of a structured school environment. Emotional unpreparedness in school settings can lead to difficulties in concentration, social interaction, and academic performance. This study aims to examine the impact of childhood trauma on PFC function and its implications for emotional regulation and school readiness, integrating perspectives from neuroscience and counseling. The method employed is a literature review, drawing from scholarly books and peer-reviewed articles published within the last decade (2015–2025). Results indicate that early adversity is associated with reduced PFC and hippocampal volume, heightened amygdala reactivity, and weakened connectivity between the amygdala and ventromedial PFC. These neural alterations impair executive functioning, impulse control, and emotional regulation, which in turn hinder children's ability to follow rules, sustain attention, and manage frustration, all of which are essential components of school readiness. The findings underscore the importance of neuroscience-informed counseling strategies that enhance PFC functioning, improve emotional regulation, and support children's readiness to engage successfully in academic and social contexts.*

Keywords: childhood trauma, prefrontal cortex, emotional readiness, neuroscience counseling.

## INTRODUCTION

Childhood is an important period in a child's development. According to Hurlock, Childhood lasts from around 2 to 12 years of age and is divided into early childhood (2-6 years) and late childhood (6-12 years) (Hurlock, 1980:14; Prasetyo, 2020). During this stage, children experience rapid growth in various aspects such as physical, cognitive, social, and emotional development (Yeti Murniati et al., 2023). Early childhood is crucial for the development of fundamental abilities such as motor skills, language, as well as social and emotional behaviors. Meanwhile, late childhood continues from the early stage with increasingly mature emotional development and readiness to face school tasks and more complex social interactions (Jumadilla Afifah et al., 2023).

The transition from childhood to adolescence is marked by significant physical, cognitive, and psychosocial changes. Adolescence is an important crisis period, during which some individuals experience greater difficulties if they had unpleasant experiences or even trauma during childhood. Traumatic experiences in childhood have the potential to be risk factors that increase the likelihood of post-traumatic stress symptoms when facing subsequent traumatic stressors later in life. According to Substance Abuse and Mental Health Service Administration (SAMHSA) Childhood trauma is a widespread and serious public health concern defined as one or more events perceived as physically or emotionally harmful, which lead to lasting negative effect on an individual's functioning and well-being (Ferrara et al., 2023). Such trauma includes physical, sexual, and emotional abuse, physical and emotional neglects, as well as witnessing violence in their environment. The effects of childhood trauma often manifest as emotional unpreparedness when children enter the school environment, resulting in learning difficulties and challenges in social interaction. This underscores the importance of special attention and appropriate interventions so that children with a history of trauma can receive support to develop optimal emotions (Anggadewi, 2020).

Extensive research over the past two decades has shown that early adversity and trauma such as maltreatment, neglect, or exposure to violence can disrupt the development of key neurobiological systems. These disruptions particularly affect the limbic system, which is the group of interconnected structures deep within the brain that plays a central role in regulating emotion, memory, motivation, and behavior (Pessoa, 2017), including the amygdala and hippocampus, which are involved in emotional processing and memory, as well as the prefrontal cortex (PFC), which is central to executive functioning and regulation of emotion and behavior. Early stress can lead to alterations in the size, connectivity, and responsiveness of these brain regions. For example, studies using structural MRI have shown that children who experienced severe adversity have smaller volumes in the PFC and hippocampus, and functional imaging has revealed heightened amygdala activation to emotional stimuli. These neurobiological changes are believed to underlie many of the emotional and behavioral difficulties observed in individuals with histories of early trauma, including heightened emotional reactivity, impaired decision making, and difficulties with impulse control and social relationships (McLaughlin, Sheridan, & Lambert, 2019).

Traditional counseling focuses on psychological and behavioral aspects, but pays less attention to the Neurobiological development of clients. This has made it less effective in dealing with issues such as emotional regulation and impulse control. The neuroscience-based counseling approach integrates

knowledge about the brain to understand the relationship between neural processes, emotions, and behavior. Adjusting interventions to neurobiological conditions has been shown to help adolescents better control themselves (Duenyas & Luke, 2019). Research also shows that a brief training on brain mechanisms improves empathy, understanding, and communication between counselors and clients, while strengthening competence in handling trauma (Montague et al., 2020). Therefore, counselor education needs to include the perspectives of trauma-informed and neuroscience-based approaches to improve the effectiveness of the services.

The study aims to explore the relationship between childhood trauma and dysfunction within the limbic system, particularly the amygdala, hippocampus, and prefrontal cortex (PFC), which plays a critical role in regulating emotions and behavior. Trauma exposure in early life can lead to heightened emotional reactivity due to amygdala hyperactivity, impaired memory consolidation from hippocampal dysfunction, and weakened impulse control and decision-making linked to reduced PFC activity (Huffhines, 2024). The study further investigates how such trauma induced limbic system dysfunction directly impacts students's preparedness and responsiveness to neuroscience-based counseling practices in schools. By understanding these neurobiological underpinnings, counselors can design and implement targeted neurocounseling interventions that address emotional barriers and foster resilience, ultimately supporting students in overcoming trauma-related obstacles to learning and personal growth. Additionally, the study aims to examine the relevance of childhood trauma as a cause of limbic system dysfunction in students' readiness in the practice of neuroscience counseling in schools. Thus, through proper analysis, counselors can implement neurocounseling-based interventions to help and assist students facing obstacles in their emotional readiness.

## METHODOLOGY

The method used in this research is narrative literature review with a theoretical descriptive focus, based on the fundamentals of neuropsychology and counseling, This study involves systematically gathering, analyzing, and restructuring relevant literature and scientific articles into a clear and cohesive descriptive narrative. This methodology aims to provide a comprehensive understanding of the relationship between childhood trauma and alterations of these changes on children's emotional readiness within the school environment. The subject of this study is the phenomenon of prefrontal cortex dysfunction associated with childhood trauma and its impact on children's emotional readiness in the educational context. The scope of this research is limited to a literature review addressing the correlation between early childhood trauma, developmental neuropsychology, and the application of emotional aspects in school settings.

Data were collected from secondary sources, including relevant articles and scientific journals from the fields of neuroscience, developmental psychology, and counseling, with publication dates ranging from 2015-2025. Data collection was conducted systematically through a literature review emphasizing both qualitative and quantitative research. Data analysis involved identifying key concepts concerning prefrontal cortex dysfunction and its emotional consequences, followed by thematic synthesis to integrate

in depth findings on the patterns linking trauma, neuropsychological changes, and effective counseling strategies to support students emotional readiness at school.

## RESULT AND DISCUSSION

Early life adversity, including abuse, neglect, and exposure to violence has been associated with changes in several brain systems responsible for emotion processing, regulation, and stress response (Smith & Pollak, 2020). Structural neuroimaging research has identified reduced volumes in the hippocampus, amygdala, and prefrontal cortex among children and adolescents who have experienced significant adversity during early development (McCrory et al., 2010; Teicher et al., 2016). Functional MRI studies have demonstrated increased amygdala reactivity to negative emotional stimuli, along with disrupted functional connectivity between the amygdala and prefrontal regions involved in emotional regulation (Fowler et al., 2017). These neural adaptations are thought to reflect a response to threatening environments, enhancing the ability to quickly detect and react to potential danger. However, such alterations may also increase susceptibility to anxiety, depression, and posttraumatic stress disorder later in life (Tottenham & Sheridan, 2009; McLaughlin et al., 2019). Longitudinal evidence suggests that these brain changes can persist into adulthood, potentially influencing cognitive and emotional functioning across the lifespan.

Lu, Xu, Cui, Hu, Huang, Li, and Zhang (2024) conducted a neuroimaging study titled *"Exploring the association between childhood trauma and limbic system subregion volumes in healthy individuals: a neuroimaging study"* published in *BMC Psychiatry*. The researchers compared 24 healthy individuals with documented childhood trauma to 24 without trauma using MRI and FreeSurfer segmentation to measure hippocampal, amygdala, and cortical limbic subregion volumes. Results showed that participants with trauma histories had smaller volumes in several hippocampal subfields (including CA1 head, subiculum, GC-ML-DG, and CA4), amygdala subnuclei (such as the basal nucleus), and other limbic areas, suggesting structural alterations even in the absence of psychiatric disorders. Some volume changes correlated with specific trauma types, such as sexual abuse and emotional neglect, though these associations were not always statistically significant after correction for multiple comparisons. The authors conclude that childhood trauma leaves measurable neurobiological footprints that may serve as potential biomarkers for vulnerability to later psychiatric disorders and highlight the importance of further longitudinal research to clarify causality and developmental timing effects.

Recent research increasingly suggests that childhood trauma can significantly affect the development of neural systems responsible for threat processing and emotion regulation, thereby elevating the risk for affective disorders. A meta-analysis of structural MRI studies found that individuals with a history of childhood trauma exhibit reduced gray matter volume in the hippocampus and dorsolateral prefrontal cortex (dlPFC) areas involved in contextual threat assessment and emotional regulation, respectively. Functional MRI studies further demonstrate that childhood adversity is associated with heightened amygdala reactivity to negative emotional stimuli, as well as reduced resting state functional connectivity between the amygdala and the ventromedial prefrontal cortex (vmPFC). These neural adaptations may facilitate rapid and automatic threat detection, which can be beneficial in dangerous environments. However, when not adequately balanced by prefrontal regulatory mechanisms, such changes

may contribute to an increased vulnerability to psychopathological conditions, including anxiety and depression (Herringa et al., 2013; McLaughlin et al., 2019).

Childhood trauma has a major impact on brain development, particularly on the systems that regulate threat detection and emotions.Children with a history of trauma frequently have smaller hippocampal and dorsolateral prefrontal cortex volumes and higher amygdala activity, according to magnetic resonance imaging studies. Although it aids in quicker danger detection, this condition raises the risk of illnesses like anxiety and depression because of the weaker connection between the amygdala and the ventromedial prefrontal cortex (Herringa et al., 2013; McLaughlin et al., 2019). The prefrontal cortex is crucial for controlling behavior, making decisions, and managing emotions. The anterior cingulate cortex sustains attention and regulates impulses, the ventromedial part aids in stress regulation, and the dorsolateral part promotes cognitive control (Elfa et al., 2025). Recent research shows that trauma can decrease prefrontal cortex activity, weaken control over the amygdala, and disrupt children's ability to focus, plan, and control themselves. As a result, they are more vulnerable to difficulties in school and in social relationships (Fan & Kang, 2025).

Low emotional regulation skills in children can trigger aggressive or uncooperative behaviors, making it difficult for them to follow rules and maintain positive peer relationships. This condition increases the risk of social rejection, which may develop into antisocial behavior and school maladjustment, such as academic difficulties and a tendency to engage in disruptive behaviors (Al Otaiba & Fuchs, 2002; Malecki & Elliot, 2002; Wentzel, 1993; Masten et al., 2005; Risi et al., 2003). Emotional regulation affects academic achievement both directly and through behavior. Children who struggle to manage their emotions often have difficulty controlling their classroom behavior, focusing attention, and completing assignments (Kuhl & Kraska, 1989). Research on kindergarten students has shown that better emotional regulation is correlated with higher academic performance, mediated by classroom behavior control (Howse et al., 2003).

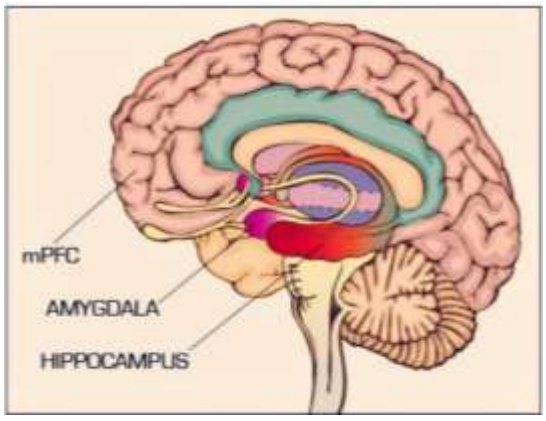
According to Heward & Orlansky cited by Sunardi, 1996, behavioral disorders are characterized by one or more criteria such as an inability to learn not due to intellectual factors, difficulty in forming social relationships, inappropriate behavior or emotions, emotional instability or depression, and physical symptoms or fears related to personal or school problems. Hallahan & Kauffman further note that children with behavioral disorders generally have low academic achievement, with two-thirds failing to meet grade-level standards, 20–25% dropping out, and more than 50% being expelled (Chesapeake Institute, 1994; Valdes, Williamson & Wagner, 1990; U.S. Department of Education, 1998, 1999). Page (2023) showed that these issues remain prevalent highlighting that students with emotional and behavioural disorders still face high dropout rates, lower grades and difficulty in passing grades in school.

Social-emotional characteristics of behavioral disorders may take the form of externalizing behaviors such as hitting, fighting, teasing, or vandalism, as well as internalizing behaviors such as social withdrawal, excessive fear, or depression without clear cause. Neurological factors also play a role, where disturbances in brain neurotransmitter function caused by violence, rejection, or poor parenting can hinder a child's social and behavioral development (Galvin, 1994). Research conducted by (Wibowo, 2017) on neuroscience counseling reveals that individuals who have experienced trauma often find it difficult or are only able to minimally recount their traumatic events, making it difficult for them to communicate their

needs during therapy. While narrating trauma can aid in understanding what occurred, merely discussing the trauma does not lead to forgetting it, as this process struggles to reach the emotional brain and does not sufficiently access the brain regions responsible for survival. Talk therapy primarily engages the neocortex, where language is processed, thus limiting access to the midbrain. Therapies that emphasize verbal or cognitive processes target the neocortex but have very limited reach into the subcortex.

However, trauma resides in the subcortex, characterized by heightened activity in the limbic system, which governs survival functions. Therefore, to achieve effective therapy, therapists need to implement interventions that access the emotional brain and the limbic system to recalibrate the brain's alarm system (amygdala), which misinterprets neutral stimuli as trauma-related, and restore the normal functioning of the emotional brain. The only way to alter what a person feels is through increasing awareness of internal experiences and learning to accept bodily sensations. The medial prefrontal cortex (mPFC), as the center of self awareness, has direct connections to the emotional brain where trauma is stored. In other words, accessing the emotional brain occurs through self-awareness by activating the mPFC, the brain region responsible for recognizing inner experiences and allowing individuals to become conscious of their feelings. By focusing attention on bodily sensations, individuals can identify the flow and movement of emotions and enhance control over their bodies. Practicing mindfulness alleviates sympathetic nervous system activity, thereby reducing the likelihood of a fight-flight-freeze response. Mindfulness can improve executive control through awareness and acceptance, increase hippocampus activity and volume, thereby supporting memory processing, emotion regulation, and perspective-taking. Awareness of bodily sensations and internal processes serves as a bridge to the present moment and constitutes a crucial initial step in interpreting implicit memories, making it highly significant in trauma therapy.

Figure 1. Limbic System 1 (Wibowo, 2017)




Counselors and teachers can provide psychoeducation about the brain to students as an important component of intervention. Additionally, teaching coping strategies grounded in brain-based understanding, such as mindfulness and relaxation techniques, can help optimize PFC function and enhance students' abilities to manage emotions and impulses in the school environment. Contemporary counselors need to be equipped with an understanding of neurodevelopment and trauma so that case conceptualization and interventions are more targeted; counseling education literature shows that integrating "neuroscience-informed counseling" into the curriculum improves the clinical framework and ethics of interventions,

resulting in more systematic and evidence-based services (Duenyas & Luke, 2019; Field, 2024). The Neurosequential Model of Therapeutics (NMT) emphasizes mapping brain developmental disorders caused by trauma to select the appropriate sequence of regulation relationship reflection strategies based on maturation stage demonstrating that a neuroscience-informed approach leads to symptom improvement in child psychiatry services (Perry, 2009; Perry & Hambrick, 2019; Johannessen et al., 2024).

At the school level, systematic reviews show that a school-wide trauma-informed approach is associated with improvements in the learning climate and supportive practices, while also emphasizing the need for trauma-based training for counselors to lead its implementation (Avery et al., 2020; Perryman, 2025). Mechanistically, the Interpersonal Neurobiology (IPNB) framework explains how the integration of brain-body relationship networks fosters empathy, attunement, and self-regulation in counselors and clients, thereby cultivating empathy and patience that support a safe therapeutic alliance (Siegel, 2023). Thus, incorporating neuroscience-based interventions, such as graded emotion regulation training, relational practices that calm the nervous system, and stress-sensitive classroom design into guidance and counseling programs not only enhances the accuracy of technique selection but also fosters a more empathetic and patient-centered professional attitude aligned with the latest scientific mandates (Duenyas & Luke, 2019; Field, 2024).

## CONCLUSION

Childhood trauma significantly affects brain areas involved in emotion regulation, executive function, and stress response, including the prefrontal cortex, amygdala, and hippocampus. Research shows reduced brain volume, overactive limbic responses, and weaker prefrontal–limbic connections, which impair attention, impulse control, and emotional regulation. These changes increase the risk of anxiety, depression, and behavioral problems, while disrupting learning and social adjustment. Counseling should go beyond talk-based approaches by using strategies that calm the stress response and build emotional awareness, such as mindfulness and body-based techniques. Schools should also provide teacher training in trauma awareness, using simple, low-cost workshops to help teachers recognize signs of trauma and apply practical strategies like consistent routines, calm communication, and de-escalation techniques. Integrating trauma knowledge into counselor training and adopting schoolwide trauma-informed approaches can create safer, more supportive environments where children are able to learn and thrive. These findings highlight the urgent need for schools to adopt trauma-informed policies, integrate neuroscience-based training for counselors and teachers, and collaborate with parents and health professionals. By creating supportive environments and strengthening emotional regulation skills, schools can reduce behavioral problems, improve academic engagement, and foster resilience in students affected by trauma.

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