



Evaluation of Criminal Responsibility in Terms of Discipline and Criminal Law in the Neurobiological and Genetic Causes of Violence Behaviors in Children and Adolescents*

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Article Information	ABSTRACT
Received: 24.07.2025	Many factors can be effective in the violent behavior of children and adolescents. The aim of this study is to contribute to the evaluation and prevention of criminal behavior by examining the neurological, biological, hormonal and genetic dimensions of violent and aggressive behaviors seen in children and adolescents. Another aim is to examine studies that support the evaluation of criminal responsibility in children's criminal behavior from a neuro-legal perspective. Another aim of the study is to draw attention to the differences between disciplinary and criminal law in the assessment of children's criminal responsibility. Adolescence is generally a challenging period of life. During this period, many processes such as conscious thinking, decision-making, foreseeing the consequences of actions, impulse control, planning, problem solving, continuity, consistency, behavioral control, and risk assessment are possible with the full maturation of the frontal lobe and prefrontal cortex. Delays in the development of the frontal lobe and lesions in the prefrontal cortex can lead to negative emotional reactions and violent behavior. Violent antisocial behavior and high levels of impulsivity are often associated with the prefrontal lobe region of the brain. Studies have shown that antisocial and criminal individuals have structural and functional abnormalities in the prefrontal cortex, temporal cortex, insula, amygdala and hippocampus. For these reasons, evaluations and regulations regarding criminal responsibility in adolescents' criminal behavior need to be reconsidered. Taking into account the latest developments regarding brain structure and genetics will contribute to the assessment of criminal responsibility of children and adolescents who commit crimes and to the healthy functioning of the juvenile justice system.
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1. INTRODUCTION

Violent behaviors in children and adolescents are shaped by numerous factors that persist from prenatal development to the end of adolescence. Influences such as genetic, neurological, biological, hormonal, environmental, social, cognitive, and psychological factors all play a significant role (Yalçın & Erdoğan, 2013; Yöş, 2020). Research has indicated a link between certain metal levels, such as lead, copper, and zinc, and aggressive behaviors in children (Bogden et al., 1997). Similarly, nutritional deficiencies have been associated with increased aggression and violence (Fishbein, 2001).

This study seeks to explore neurological, biological, hormonal and genetic causes of violent and aggressive behaviors of children and adolescents and to contribute to taking the necessary precautions and preventing crime. Additionally, it investigates studies that will support the determination of criminal responsibility in children's criminal behavior due to neuro-biological reasons from a neuro-legal perspective.

Research on adolescent violent and aggressive behaviors has predominantly focused on psychological and social causes. However, recent studies in the fields of neuroscience and genetics have demonstrated that the structure of the adolescent brain and genetic predispositions play significant roles in violent and aggressive behaviors.

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1.1. Causes of Violent Behaviors

1.1.1. Neurological causes of violent behaviors

Adolescence is a challenging period characterized by significant physical and emotional changes. During adolescence, when sexual and identity development begin, independence becomes prominent, and difficulties in following rules and changes in behavior are often observed (Eagleman, 2015).

Conscious thinking, decision-making, the ability to foresee the consequences of actions, impulse control, planning, problem-solving, maintaining consistency, behavioral control, and risk assessment are all processes that become possible with the full maturation of the frontal lobe and prefrontal cortex (Golden et al., 1996). Delays in the development of the frontal lobe and lesions in the prefrontal cortex can lead to negative emotional responses and violent behaviors (Mendes et al., 2009). Risky behaviors, impulsive actions, and serious criminal conduct may be observed as a result. Based on the understanding that adolescents are unable to assume responsibility or foresee the consequences of their actions like adults, age limits of 18 and above have been established for activities requiring decision-making and self-control, such as marriage, military service, driving, and alcohol consumption. The aim is to protect adolescents from potential dangers and the immaturity of their developmental characteristics.

In Turkey, the minimum age for criminal responsibility in children has been set at 12 years. It is accepted that children under 12 years and those under 15 years old who are deaf and mute do not bear criminal responsibility. However, in some countries around the world, there is no objection to punishing a child under the age of 15 for committing a crime. Advances in medical and technological fields have uncovered many unknown aspects, particularly regarding the brain development of adolescents. These developments have revealed significant differences between adolescents and adults in terms of motivation, impulse control, judgment, criminal responsibility, and neurobiological characteristics (UNICEF & Turkish Bar Association, 2010). Recent scientific studies have shown that the adolescent brain is not fully developed, which limits their ability to establish cause-effect relationships, control impulses, and complete their physical, emotional, and social development (Çelik et al., 2008; Kocaçaya & Ortanca, 2020; Metin et al., 2017).

This underdevelopment, particularly of the frontal lobe, contributes significantly to their engagement in risky behaviors. Adolescents often experience what is known as “reward deficiency syndrome,” which leads them to seek out risky environments and engage in risky behaviors. Additionally, a low level of fear observed in adolescents has been associated with physiological and neurological structures, as well as with aggression and violent behaviors (Loeber & Pardini, 2008). Research suggests that a lack of fear suppresses empathy and feelings of guilt, thereby increasing violent and criminal behaviors (Blair et al., 2006).

Violence, antisocial behaviors, and high impulsivity are most strongly linked to the prefrontal lobe region of the brain. It has been suggested that individuals with antisocial tendencies and those who commit crimes exhibit structural and functional abnormalities in the prefrontal cortex, temporal cortex, insula, amygdala, and hippocampus (Yang & Raine, 2009). It has been observed that individuals who commit crimes have reduced gray matter in their brains. For example, a study conducted in Germany found a decrease in gray matter volume in the frontal and occipital lobes of convicted individuals who had committed severe violent crimes. Similar findings were reported in individuals displaying severe psychopathy (Bertsch et al., 2013). Another study conducted in the UK found that prisoners with antisocial psychopathy had less gray matter in their brains compared to control groups. Numerous studies have reported similar findings (Schiffer et al., 2011).

Recent research on adolescent development indicates the need to reassess criminal responsibility for adolescents both in Turkey and globally. Punishing children and adolescents for criminal behaviors that stem from developmental characteristics beyond their control contradicts the principle of the best interest of the child.

1.1.2. Complications during birth and the perinatal period in violent behaviors

The World Health Organization defines the perinatal period as the time between the 21st week of pregnancy and one month after birth. In addition to structural anomalies in the brain, complications that occur during birth and the perinatal period, such as maternal smoking, alcohol, and drug use, have been linked to aggressive and antisocial behaviors in children, beginning in infancy. For example, a longitudinal study found that aggressive and antisocial behaviors were significantly more common in 2,127 boys whose mothers were involved in criminal activities and smoked during pregnancy (Orlebeke et al., 1997; Popova et al., 2019; Subramoney et al., 2018).

Fetal exposure to alcohol has been shown to damage multiple areas of the brain. Children exposed to heavy alcohol use during pregnancy are more likely to experience cognitive and psychosocial impairments, including a loss of social skills, increased impulsivity, hostility, and a greater tendency towards criminal behavior (Roebuck et al., 1999). Similarly, a longitudinal study comparing two groups, one exposed to cocaine during pregnancy (n=201) and one not exposed (n=270), found that children exposed to cocaine exhibited more externalizing behavior problems and criminal behaviors, with boys being more affected (Delaney-Black et al., 2000). However, many confounding factors in these studies, such as inadequate care, other substance use,

poverty, deprivation, unwanted pregnancy, and exposure to violence, pose limitations, making it difficult to establish direct cause-effect relationships.

1.1.3. Genetic causes of violent and criminal behaviors

In recent years, the European Union (EU) has made substantial investments in research aimed at understanding the causes and treatment of aggression. Several EU-funded studies, under the FP7 and H2020 programs, have explored etiological mechanisms related to violent and aggressive behaviors, including neurobiology, neuroimaging, biomarkers, the use of animal models, and the development and evaluation of these models. One such study, conducted by the international consortium www.action-euproject.eu, focused on disentangling the gene-environment interaction in childhood aggression. A study conducted on 1,254 Dutch twin pairs aged 8-10 found that genetic predisposition played a significant role in aggressive behaviors in childhood (Hendriks et al., 2020).

Another EU-supported longitudinal study followed 17,000 twin cohorts from the age of 7 until they were 11-12 years old from the Netherlands and the United Kingdom aimed to evaluate the heritability of aggressive behaviors in childhood. The study concluded that genetic correlations were the main reason for the stability of aggressive behaviors (Asherson & Cormand, 2016).

However, genetic factors alone are not sufficient to explain the emergence of specific behaviors. As with many diseases and behavioral disorders, the interaction between genetic factors and environmental causes plays a critical role in the development of violent behaviors in children and adolescents. For example, studies on the MAO-A gene have shown that the genetic influence on behavior is only evident in cases of childhood neglect or abuse (Bayhan & Düzgün, 2020; Caspi et al., 2002; Kazantseva et al., 2025; Lagerspetz & Lagerspetz, 2021; Oliveira et al., 2023; Veroude et al., 2016). Consequently, biological and environmental factors interact both independently and together to contribute to the emergence of aggressive behaviors. While adverse environmental conditions can exacerbate genetic predispositions, positive environmental conditions can prevent the emergence of violent and aggressive behaviors, even in the presence of a genetic predisposition.

Studies on identical twins raised in different families support these findings. Research showing a significant relationship between the criminal activities and imprisonment of biological fathers and their adopted sons highlights the importance of both heredity and environment (Coccaro & McNamee, 1998). It has been suggested that genetic structure accounts for approximately 50% of the likelihood of an individual developing personality traits such as aggression, fearlessness, or submissiveness (Gollwitzer, 1996). However, this does not imply that every positive or negative genetic trait will manifest equally in everyone, as the expression of certain genetic codes requires the presence of suitable environmental conditions (Cura & Çankaya, 2017). One of the examples demonstrating the relationship between genetic structure and criminal behavior is the increased crime rate among men with the XYY chromosome. While the typical human chromosome structure consists of XY (male) or XX (female), some men may have an XYY chromosome due to genetic variation. It has been reported that men with this chromosomal structure are more likely to be involved in theft and violent crimes (Ertuğrul et al., 2021).

1.1.4. The role of hormones in violent crimes among children and adolescents

It is well established that elevated levels of androgens, estrogen, and testosterone during adolescence are associated with aggressive and violent behaviors (Book et al., 2001). Similarly, research investigating the serotonin transporter gene in relation to violent behaviors during childhood and adolescence, conducted on 82 children aged 5-15, found that low serotonin levels increased the risk of violent behavior (Beitchman et al., 2006). Studies also demonstrate that as serotonin, oxytocin, and dopamine levels increase, aggressive behaviors decrease, whereas increases in testosterone levels lead to more aggression. These hormonal effects are observed not only in adolescents but also in adults (Yalçın & Erdoğan, 2013).

1.2. The Role Of Parents And Teachers In Preventing Adolescent Violence

Children raised in environments of love, security, and proper nutrition, especially during the ages of 0-6, and whose mothers were not exposed to trauma or harmful influences during pregnancy, may be less susceptible to neurobiological, genetic, and hormonal factors that contribute to violence. Conversely, children raised in adverse conditions may be more vulnerable to these influences, increasing the responsibility of parents and teachers (Comellas, 2010; Song et al., 2019; Yoon & Barton, 2008). Adolescents may exhibit violent behaviors for various reasons. Some issues can be resolved with preventive measures, but when such behaviors stem from causes beyond parental or educational intervention, medical diagnosis and treatment may be necessary. Parents and educators should be made aware of this and informed about when to seek professional guidance. However, not all violent behaviors in adolescents warrant consultation with a neurologist or psychiatrist. If aggressive criminal behaviors persist despite measurements of environmental, social, and psychological factors, consultation with medical experts is recommended.

1.3. Determining Criminal Responsibility for Violent Crimes in Children and Adolescents Due To Neurobiological and Genetic Factors

Under the Turkish Penal Code, children under the age of 12 cannot be held criminally responsible for crimes. Children aged 12-15 who are unable to comprehend the legal significance and consequences of their actions, or who lack sufficient self-control, are also exempt from criminal responsibility, with security measures specific to children applied in such cases. However, children in the 12-15 age group who demonstrate the capacity to understand the legal significance of their actions and control their behavior can be held criminally responsible. In determining culpability, it is legally required for the judge to request an "Forensic Report" and a "Social Inquiry Report" from an expert.

Children aged 15-18 are considered fully criminally responsible, although their sentences may be reduced due to their age. The extent of sentence reductions for specific crimes is specified in the Turkish Penal Code (TPC).

Given the developmental characteristics of children and adolescents, determining their criminal responsibility for any criminal behavior is a critical issue. This requires a multidisciplinary investigation and reportings involving forensic medicine experts, neurologists, psychologists, and forensic psychiatrists.

To this end, in 2010, UNICEF and the Turkish Bar Association prepared the Guide for the Assessment of Criminal Responsibility in Adolescents. The guide aims to assist those involved in determining adolescent criminal responsibility and to contribute to the development of the juvenile justice system by establishing common standards. This ensures that children are not held responsible for criminal behaviors stemming from neurobiological and hormonal factors beyond their control, and supports their rehabilitation and reintegration into society. The primary concern is the best interest of the child.

1.4. The Conflict Between Disciplinary Punishments and Criminal Responsibility for Violent Behaviors in Schools

According to Article 55 of the Ministry of National Education's Regulation on Pre-School and Primary Education Institutions, certain student behaviors warrant the penalty of "School Transfer." Consequently, children under the age of 12 may be subject to this punishment, which can negatively affect their psychological well-being and academic performance. This penalty may also lead to school absenteeism or dropouts, significantly altering the child's future. Despite the Republic of Türkiye (Turkish Penal Code, 2004) stipulating that children under 12 cannot be held criminally responsible because they cannot foresee the legal consequences of their actions, the application of disciplinary penalties, which lack an educational component and endanger the child's educational life, represents a significant contradiction (Mertoğlu, 2023). Even if a child under 12 were to commit a serious offense such as murder, they would not be criminally liable under the TCK; thus, instead of imposing a "School Transfer" penalty, the child should be allowed to remain in the school where they can receive the necessary guidance and support without being labeled.

2. CONCLUSION

Advancements in medical imaging techniques have shown that the development of the adolescent brain, particularly the frontal lobe, is not complete until the early twenties. Functions such as establishing cause-effect relationships, adhering to rules, controlling impulses, and predicting the consequences of decisions are all made possible through the development of the frontal lobe. When the frontal lobe's development is incomplete, adolescents are more likely to exhibit high-risk behaviors, including those that involve violence and aggression.

Research on twins has shown that genetic factors play an important role in violent crimes, but that the interaction between genetic codes and environmental conditions significantly influences the emergence of violent behaviors. Studies have also established that high levels of androgens, estrogen, and testosterone during adolescence are associated with aggressive and violent behaviors.

Given these new findings, it is necessary to re-evaluate and revise the regulations regarding criminal responsibility for adolescents. This is particularly important because the coordination of cognitive and behavioral functions relevant to criminal responsibility occurs in the brain's frontal region. Therefore, protecting adolescents from themselves and ensuring the proper functioning of the juvenile justice system are both essential.

Another conclusion is that when evaluating the criminal responsibility of adolescents for disciplinary offenses, the age of criminal responsibility for legal offenses should be taken into account. In other words, children under 12 should not be subjected to disciplinary penalties that could negatively affect their future.

The goal for children accused of committing a crime should not be punishment, but rather rehabilitation and reintegration into society so that they can continue as productive members of the community.

3. RECOMMENDATIONS

The prevalence of violent crimes during adolescence necessitates further research to uncover the causes, preventive measures, and legislative changes needed to address this issue. In evaluating the criminal responsibility of adolescents aged 12-18, courts rely on crucial information provided by "Forensic Reports" and "Social Inquiry Reports." The Guide for the Assessment of Criminal Responsibility in Adolescents, prepared by UNICEF and the Turkish Bar Association in 2010, provides valuable guidance on this matter. In particular, the criteria established for forensic psychiatric evaluation are insightful. However, considering the findings from recent research on the adolescent brain, the criteria for "Neurobiological Evaluation" should also be developed and implemented alongside forensic psychiatric evaluations.

Furthermore, the provision in the Turkish Penal Code (TCK) that children under 12 cannot be held criminally responsible should also be reflected in the disciplinary regulations in schools. The disciplinary penalties outlined in the Ministry of National Education's Regulation on Pre-School and Primary Education Institutions should be revised in accordance with this principle to ensure the best interests and future of the child.

Informing and educating parents and teachers about the neurobiological and genetic causes of violence is crucial for understanding and preventing behavioral problems in children and adolescents.

Research and Publication Ethics Statement

Since the study does not involve human or animal subjects, ethical committee approval was not required.

Contribution Rates of Authors to the Article

The author is solely responsible for all stages of the study, including the design, data collection, analysis, interpretation, and writing of the manuscript.

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Statement of Interest

The author declares no conflicts of interest. This study had no trace of conflict of interest as the researchers personally funded this undertaking

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