

**Aleksandra ILIĆ, PhD\***  
Associate professor  
Faculty of Security Studies  
University of Belgrade

**Original Scientific Article**  
**Received: 28 October 2023**  
**Accepted: 10 November 2023**  
**UDK: 343.94:343.611**  
**<https://doi.org/10.47152/rkkp.61.3.1>**

**Ana STARČEVIĆ, PhD\*\***  
Assistant professor  
Faculty of Medicine  
University of Belgrade

## **THE INFLUENCE OF BIOLOGICAL FACTORS IN GENESIS OF MASS MURDERS**

*In this paper, the authors, starting from the established division of mass murders in the criminological literature, analyze the available research results on cases of mass murders, that is, their etiology. Considering that the analysis of all possible factors that can constitute individual criminogenesis would require much more space, in this paper the emphasis is on the biological factors of crime. The authors start from traditional biological understandings in criminology, such as the study of the connection between physical constitution and crime, or the influence of genetic factors, which they complement with more modern approaches, such as the analysis of neurological, endocrinological and other biologically relevant conditions, i.e. abnormalities while simultaneously investigating their influence on the manifestation of aggression in general but also especially in the context of mass murders. The authors expect the work to be the contribution to the better understanding of the etiology of mass murders and generally violent crimes.*

**Keywords: mass murders, influence, biological factors, criminogenesis, violence**

---

\* E-mail: alex.mag.ilic@gmail.com; aleksandra.ilic@fb.bg.ac.rs

\*\* E-mail: anastarcevic22@gmail.com

## 1. Introduction

Mass murders always attract a lot of attention from both scientific-professional and the general public because of its dramatic occurrence, number of victims and other consequences. Along with serial murders, represent great challenge for explanation in each case. Although rare, especially in small environments like Serbia is, due to their dramatic and severe consequences, they are always the subject of different interpretations, both those that arise from the application of the rules of scientific methodology, and completely arbitrary ones that are unfortunately presented and by those who are expected to draw conclusions based solely on the rules of the profession. Both interpretations mainly refer to the question of the causes of such criminal acts, which are, in the sense of criminal law, classified as form of aggravated murder.

Searching for explanation is understanding of crime etiology which is complex process, not easy to achieve. However, when such event occurs general public expects quick explanation. In such ambient always is present dangerous of exaggerations, even from individuals who are professionals. Media tend to get some exclusives and use their mechanisms to achieve that goal. If the public doesn't have reliable information about an unknown issue, that is usually the case with mass murders, it is expected that different, usually wrong, assumptions will be made. Inadequate assumptions create stereotypes about the individuals who are most likely capable to commit such crime which further produces fear among citizens. In different words, unknown situations create panic reaction (Ilić, 2018: 145) and cases of mass murders are unexplored field so it is understandable why public expects answers on the most important question: why did it happen?

The answer is not easy to be given. As multidisciplinary approach in criminology teaches us, it is necessary to take into account all possible factors, individual and social, to analyze as much as possible the etiology of crime. The aim of this work is to provide the audience the most important findings in the field of biological approach in explanation of the causes of crime with special emphasis on violent crime and particularly mass murder. There wasn't so much research which typically cover issue of mass murder because of its rarity and different difficulties in the process of etiology explanation. These events are so specific and need to be explained individually but of course science provides definition and typology of mass murder that is starting point for further explanation.

Having in mind that there is a gap in domestic literature and scientific research in analysis of etiology of different forms of violent crime, mass murders at the first place, and especially biological factors of crime, the aim of this work is to shed a light to the importance of comprehensive and multidisciplinary approach in this field.

## **2. Definition and typology of mass murder**

Discussion on mass murder as a topic requires at the beginning defining the violent crime as a type of criminal activity in which an attack on the victim or threatened is used to achieve a specific goal. Violent crimes can be divided into two groups: traditional forms and new ones (Ignjatović, 2019: 112). All types of murders belong to traditional forms of violent crime, but within the general scheme, multiple murders (multicide) deserve special attention to be made mostly because of the specificity of offenders who commit such crimes and necessity to understand its etiology. In literature some authors make distinction between: mass murder, serial murder and spree murder, as a different forms of multicide (Hagan, 2008; Fox & Levin, 2012; Siegel, 2008) while some others make distinction just between mass murder and serial murder (Barkan, 2009).

Mass murder as an example of multiple murder implies situation in which several victims die all at once or within a very short time frame (Barkan, 2009: 283). There is no clear definition of how many lives must be taken for an event to be called mass murder. Different approaches exist in this context, but many scholars think that at least four people must be killed for an event to be called mass murder (Alvarez & Bachman 2003; Hagan, 2008; Fox and Levin, 2012; Siegel, 2008). Actually, that definition is exactly the same as definition of the FBI's Behavioral Science Unit (BSU) that is used for defining mass killings (or massacres) (Fox & Levin, 2012: 19). Hagan emphasizes the importance of multiple killing (at least 4 victims) at one location on a single occasion (2008: 211). But for example, some authors prefer using a three-victim threshold (Holmes & Holmes, 2001, according to Fox & Levin, 2012: 19).

Other form of multiple murder is serial murder in which several victims die in a much longer time span, when comparing to mass murder (Barkan, 2009: 283). On the other side, spree murder is like serial murder, also form of repeated murders, where offender launches a swath of destruction, usually over a period of several days, wherein most of his activity surrounds planning or executing his crimes and evading the police (Fox & Levin, 2012: 19).

However, since 1980s some authors dealt with attempts to create typology of multiple murder (Holmes and De Burger, Holms and Holmes, P.E. Dietz) (Fox & Levin, 2012: 22). There is disagreement about the value of creating typologies, theory always try to find some common characteristics between different cases of multiple murders and to create specific type of mass murder or serial murder but on the other side some who take a more investigative or crime-solving approach are not usually satisfied with that typology (Keppel & Birnes, 2003, according to Fox & Levin, 2012: 22). One of the possible classifications means

making distinction between two subtypes of mass murder: classic mass murder and family mass murder. The criterium is relation of the mass murderer to the victims (Douglas et al., 2006).

Despite weaknesses of typology, for example possible overlap between categories because of the dual motivation of the offenders, which is more likely when mass murder is committed by a team or group of offenders (Fox & Levin, 2012: 22), it is very important to have some systematic overview on this problem which is for sure helpful not just for the academics but certainly makes the work easier for practitioners as well. One of the most cited typology of mass murder, as well as serial murder, was given by Fox and Levin (2012) and the main criteria for that division is motivation of the offender. Interestingly, mass and serial murders have the same classification i.e. the same motivation as the basis of the action: power, revenge, loyalty, profit and terror. We won't provide here detailed explanation of all types of mass murder, only some basic features will be pointed out. When power is motivation, offender is a pseudo-commando, dressed in battle fatigues and armed with a semi-automatic weapon, which turns, for example, a shopping mall into a "war zone". Mass murderer whose motive is revenge takes drastic action of violence in order to pay back those who hurt him, for example after being fired from his job, a gunman returns to the work site and opens fire on his former boss and coworkers. Mass murder as act of loyalty is typical for somebody who sees himself as "savior" who undertake act of "mercy"; a depressed husband/father who kills his family and himself to spare them from a miserable existence and bring them to a better life in the hereafter. Profit as a motivation is typical for a band or armed robbers who executes the employees of a store to eliminate all witnesses to their crime. Finally, terror as motivation initiate action of terrorist groups (blowing up a commercial airplane) but it can be also part of some autocratic government's tactic when confronted with political dissenters. In both cases, those actions tend to send a political message (Fox & Levin, 2012: 23). A recent study of 318 public mass murders in the United States between 1966 and 2017 found that ideologically motivated offenders were the most patient, methodical, and thus most lethal, compared to other types of public mass violence, whereas disgruntled employee offenders, motivated by revenge, took the least amount of time in planning their attacks (Capellan et al., 2019; according to: Williams, 2021: 18).

Despite the heavy attention that mass murders receive from the news media, it is actually very rare event all around the world. The most publicized type of mass murder involves indiscriminate shootings of strangers in a public space by a lone gunman, but other kinds of mass killing actually are more common. Most mass killers are quite deliberate, not spontaneous, they do not just explode and

what is very important a majority of them target victims who are specially chosen, not because they are in the wrong place at the wrong time (family members, coworkers, neighbors...) (Fox & Levin, 2012: 136, 142). But despite the obvious connection between offenders (mass murderers) and their victims, in majority of cases mass murderers are unpredictable mostly because the possibility of making conclusion in advance toward future individual behavior is not based on some mathematic or other exact calculation, especially in such extreme cases. It is usually well planned, in secrecy, during a long time, as to prevent the possibility of disclosure. Also, unfortunately in majority of mass murders the officials and scientists are faced with limited availability of primary data, which are essential for understanding of concrete mass murder etiology. That limitation is present mostly because many mass killers do not survive their crimes (slain by his own hand or shot by police), which means lack of collecting data from the first hand (questioning concerning motive and state of mind) (Fox & Levin, 2012: 135).

Nevertheless, regardless of the numerous difficulties in explaining mass murders and their pronounced individuality, despite a systematically developed typology, it is important to point out certain possible explanations for this extreme form of manifestation of violence, which have their basis in human biology, but which certainly must not be viewed in isolation from influence of other possible factors (psychological, sociological...). Palermo (2007) described mass murder as a culmination of a continuum of experiences, perceptions, beliefs, frustrations, disappointments, hostile fantasies, and perhaps pathology, and in similar way, Holmes and Holmes (1998) described the mass murder as a unique combination of biology, sociology, and personal psychology, which accounts for an individual's personality, and thus, his or her behavior (Bowers at al., 2010: 63).

In this work focus is on biological approach which is reviving again in criminological science, based on the knowledge and possibilities of modern medicine and technology, but which traces its roots back to the 19th century (according to some authors even earlier), and the works of positivists, representatives of biological school.

### **3. The first biological explanations of criminogenesis**

At the beginning it is necessary to start with traditional biological explanations in criminology which arise within the frame of positivism which is philosophical approach proposed by French sociologist Auguste Comte who advocated for use of empirical or scientific investigation for the improvement of society. In applying Comte's approach, criminological positivists emphasize a consensus world view, a

focus on the criminal actor rather than the criminal act, a deterministic model (usually biological or psychological in nature), a strong faith in the scientific expert, and a belief in rehabilitation of “sick” offenders rather than punishment of “rational” actors (Hagan, 2008: 117). Focus of the positivists were always on individual or\ and social characteristics that contribute to the commitment of the crime and in connection with that to the process of reducing those factors (Ilić, 2022:102). Positivist approach represents also the answer on the classical approach in criminology and its indeterminism that put at the first place the free will of the individual as the only important thing that influence potential criminal behavior. In other words, according to classicists, committing of crime depends only on individual free will.

Some authors emphasize that biologically-based explanation of violence began with the work of Lombroso and his focus upon the physical attributes and indicators of criminality (Brookman 2005, according to: Brookman & Robinson, 2012: 575). The others go more back in the past, indicating that one of the earliest biological explanations of crime was given by the phrenologists that concerned the size and shape of the skull and was popular from the mid-1700s to the mid-1800s. One of the representatives of the phrenologists, Franz Gall, thought that three major regions of the brain govern three types of behavior and personality characteristics: intellectual, moral, and lower. Phrenologists thought that skull dimensions provided good evidence of criminal tendencies (Barkan, 2009: 137). Their assumption were wrong of course, but they opened some new field of research that was closed.

Lombroso was representative (and founder) of the anthropological school in criminology (together with Garofalo and Ferri) but his main contribution was foundation of the criminology as a science. That’s why Lombroso is considered more often as a pioneer in biological explanation of crime causes. Lombroso thought criminals were atavists, or throwbacks to an earlier stage of evolution, and said criminal behaviour stemmed from atavism. His evidence for atavist theory came from his extensive measurements of the bodies of men in Italian prisons that he compared to his measurements of the bodies of Italian soldiers, his control group. Lombroso concluded that prisoners (criminals) have abnormally long arms, abnormally large skulls and jaws and their bodies were very hairy (Barkan, 2009: 138).

On the other hand, Hagan provided more detailed clasiffication of early biological explanation, within the framework of positivist theories. First group of theorists consists of Lombroso, Garofalo and Ferri, which were already mentioned, and they represent concepts of „psyhical stigmata, atavism and biological inheritance that cause criminality“. Second is Goring who represented the concept of „mental deficiency, then Goddard with concept of „feeblemindedness“. Hooton represented the concept of „physical inferiority“, Sheldon represented the concept of „somatotypes-mesomorphs“ and finally Moniz, Christiansen and Jacobs

represented the concepts of „brain disorders, twin studies, XYY syndrome and physiological disorders“ (2008: 118). However, some authors separate anthropological explanation in criminal etiology from the pure biological explanation by indicating that anthropological approach studies specific crime conditioning with organic structure of the individual, while on the other side, biological school distinguishes biological traits as a combination of anthropological and psychological traits that are at the base of the bio-psycho-constitutional type of the offender (Ignjatović, 2019: 30). Anyway, Barkan considered that Lombroso left a lasting legacy (2009, 138), to be continued search for biological explanation of criminal behavior which lasts even today and takes on new dimensions.

Unfortunately, at the early stages of researching the causes of crime, the separation of different possible causes of crime and emphasizing only one cause, regardless of whether it is mere anthropological, biological or some other factor, led to the fragmentation of criminal etiology and creation of special criminologies: criminal anthropology, criminal biology, criminal psychology, criminal psychopathology, and finally criminal sociology (Ignjatović, 2019: 30). The weaknesses of such an approach were quickly visible, because it is very hard to prove the influence of just one factor and simultaneously rejecting all others in concluding of causes of crime in individual cases. In other words monocausal approach in criminal etiology was replaced with multicausal. Yet, regardless of all the weaknesses of the monocausal approach, its contribution to the understanding of criminal etiology was important, because with focusing on just one trait (or group of traits) criminology was developing as a science and we became better in understanding the possible influence of each factor to human behaviour, and not only criminal. Bad side of multicausal approach is logically putting aside the investigation of concrete factors of criminal behavior, biological for example. Fortunately, today we have different new approaches and researchings within the framework of so called biocriminology that can shed a better light on understanding the criminal behavior in general or in the context of specific forms of crime, like mass murder or other form of multiple murder.

#### **4. Early twentieth-century biological explanations**

We will start consideration of more specific biological explanations in criminal etiology with traditional theoretical approach which was focused on possible influence of physical constitution of individuals. These approaches appeared at the beginning of the twentieth century. There were two groups of theories which brought together crime and physical constitution: the theory of organically inferior individuals as criminals (E. Hooton) and explanation of individual criminal

activity in connection with human body (physical structure) (Kretschmer & Sheldon). Hooton claimed (*The American Criminal: An Anthropological Study, Cambridge, 1939*) that crime is result of degenerative features of body constitution so he made connection between specific degenerative feature and type of criminal activity (for example: short people are predestined to be fraudsters and forgers, short and fat people on the other side are usually rapists and perpetrators of other sexual crimes and what is the most important for the topic of this work: thin people commit more often murders and robberies) (Ignjatović, 2019: 68). Hooton concluded that the primary cause of crime is biological inferiority but the problem with his research, as well as with Lombroso's approach, is lack of adequate methodology, at the first place the assumption that all of the prisoners had committed crimes and that all control group subjects (free people) hadn't committed crime (Barkan, 2009: 139). Within the second approach Sheldon made his researches (*The Varieties of Human Physique: An Introduction to Constitutional Psychology, New York, 1940*) which resulted in indicating to three types of body builds: ectomorphic (tall and thin people), endomorphic (short and fat people) and mesomorphic (athletic type). Each body build is connected to special kind of temperament which further may lead to specific criminal behavior. Marriage couple of criminologists, Sheldon and Elenor Glueck, in their research (*Physique and Delinquency, New York, 1956*) found that criminal activity, and other forms of delinquency, are present the most in group of mesomorphic (Ignjatović, 2019: 68). Early biological positivism had a lot of weaknesses. For example, they suggest that one can genetically inherit a trait or propensity (to violate criminal law) that is socially defined and culturally relative. On the other hand, not all biological differences are inherited, many may be due to prenatal environment, injury and inadequate diet. Most modern biologists speak against notions of the inheritance of acquired characteristics, emphasizing instead selective adaptation and mutation (Hagan, 2008: 124). However, despite the problems, early biological perspective in criminology was very important for development of future similar approaches. In that sense, modern biological positivism replaces simplistic biological determinism with biological approaches that take into account the interplay of biological and socio-environmental factors (Shah & Roth, 1974, according to: Hagan, 2008: 125).

## 5. Contemporary biological approaches

The first wave of biological explanations of crime was followed during the 20<sup>th</sup> century by new attempts to link different biological factors and the tendency of the individuals to commit crimes. Some of these explanations have been



specifically used in determining the etiology of mass murders. Hagan as more recent biological approaches included: *brain disorders, twin studies, adoption studies, XYY Syndrome study* and other biological factors through different neurobiological, endocrinology and other studies connected to crime etiology analysis (Hagan, 2008). Barkan (2009) has somehow different classification of contemporary approaches. He also has a few highlights within the division: *influence of family, heredity and genes* (which consist of already mentioned twin and adoption studies, XYY abnormalities but also evolutionary biology approach), *impact of neurochemical factors*: hormones (testosterone and male criminality and PMS and crime by women) and neurotransmitters, *Diet and Nutrition, Pregnancy and Birth Complications* and *Early Puberty*. Also, Ignjatović separates *the influence of genetic factors* and other new approaches (2019:68-70). Within the genetic approach he emphasizes the importance of analyzing the family history (families Juke and Kallikak), especially when violent behavior is about, as well as the study of twins and adoptees (genetic determinism) and finally chromosomal abnormality (XYY). Despite some differences in enumeration of theoretical approaches by different authors, some common points of all the mentioned divisions can be observed. At this point, mentioned approaches will be just briefly explained, except few ones that we assume can be better applied to the explanation of mass murders.

### 5.1. Brain disorder

We will start with the issue of brain disorder. The work of phrenologists, in the context of how brain (i.e. different brain area) affects individual behavior, was continued in 20<sup>th</sup> century which led in 1930s to appearance of infamous lobotomy which means destruction of portions of the frontal lobes of the brain as a last resort for nonresponsive mental patients but it was used also on criminals as to be controlled brain malfunctions, particularly those that may trigger aggressive behavior (Hagan, 2008: 125,126). In some recent cases of mass murder, brain disorder of the offender was part of the discussion. Charles Whitman, the ex-marine who killed 14 and wounded 30 others at the University of Texas suffered from a walnut-sized amygdaloidal tumor, highly malignant tumor of the brain (a glioblastoma multiforme) which was found during the postmortem examination. The medical community started asking question about the connection between Whitman's act of mass murder and his brain abnormality (Fox & Levin, 2012: 228,229). What is it more to be expected with such brain abnormality: sudden, episodic attack of violence or longtime planned act as it was Whitman's act and that suggests maybe the conclusion that tumor changed Whitman's personality? We still don't have an answer.

Some other research indicate that the frontal cortex is likely responsible for certain personality characteristics and regulating socially acceptable behavior. The prefrontal cortex (PFC) has control over the limbic system which regulates emotion. When the PFC is not functioning properly, it results in an inability to control certain emotions, such as rage and anger (Raine, 2014, according to: Marr, 2020: 5).

Somehow connected to brain disorder are results of some research that show a higher prevalence of Autism Spectrum Disorders (ASD) and childhood head injuries among both serial and mass murderers compared to the general population, but such conditions may just have some influence on pathways to behavior but cannot be said to be causal (Williams, 2021: 18). It also might be questionable is there connection between posttraumatic stress disorder (PTSD), as a chronic mental state that possibly emerges after life or body integrity threatening events (Starčević et al., 2015: 78) and antisocial or criminal behavior. The results of some research show certain changes in brain functioning of individuals with PTSD, for example: results provide evidence of an association between a smaller amygdala, hippocampus, and prefrontal cortices volumes and PTSD therapy (Starčević et al., 2014: 4). Some of the most recent research showed a significantly higher risk of violent crime conviction in individuals with PTSD than in individuals without PTSD in general population which is new finding, because earlier research showed risk of violent crime conviction just in veteran population (Paulino et al., 2023: 438).

In the context of brain disorder, or more precisely central nervous system (CNS) functioning and long-lasting negative effects that in turn can lead to anti-social behavior, has to be mentioned problematic behavior of some women during the pregnancy: poor nutrition and the use of alcohol, tobacco or drugs (Barkan, 2009:147). One of the study conducted in Brazil showed that Fetal Alcohol Syndrome is common among criminal adolescents (Marr, 2020:3). Also, prenatal exposure of the brain to high levels of androgens can result in a brain structure that is less sensitive to environmental inputs and affected individual seek more intense and varied stimulation and are willing to tolerate more adverse consequences than individuals not so affected (Ellis, 1990, according to: Siegel, 2008: 101).

On the other side, poor or inadequate diet can lead to violence, according to the attorney of Dan White accused for double murder in late 1978 in San Francisco. The attorney claimed that his client committed murders because he ate too much junk food and because of that the sugar and various additives in the food supposedly deepened his depression and reduces ability to tell right from wrong. This defense tactic was successful, because he was convicted only of manslaughter (Barkan, 2009: 146). Finally, low level of sugar in blood can be dangerous too. When blood

glucose falls below levels necessary for normal and efficient brain functioning, a condition called hypoglycemia occurs. Different research studies linked hypoglycemia to outbursts of antisocial behavior and violence (Siegel, 2008:96).

Although there is a dearth of literature investigating the neuroanatomy of mass murderers, information gleaned from studies on single victim murderers suggests that those committing homicide generally exhibit measurable neuro-anatomical abnormalities (Fox et al., 2016: 97). Some of the research findings indicate that homicide offenders' show reduced gray matter in brain areas critical for behavioral control and social cognition compared with subsets of other violent and non-violent offenders which means that unique brain abnormalities may distinguish offenders who kill from other serious violent offenders and non-violent antisocial individuals (Sajous-Turner et al., 2020). On the other hand, some of the findings from the research that was conducted on mass murders by Fox et al., show that, neurocognitively, mass murderers have better language, processing speed, reasoning, and verbal memory abilities than single victim murderers which means that mass murders are usually premediated crimes (2016: 100).

## 5.2. Genetic factors

The influence of genetic factors was analyzed first in case of rural New York family Juke, because about 140 of 1.000 Jukes were imprisoned during the 200 years. After that, Goddard researched family Kallikak, i.e. the descendants of Martin Kallikak who was the progenitor of the family and very interesting was fact that criminality was present significantly more in one set of Kalikak's descendants than in the other (Barkan, 2009: 141). On the other side, twin studies showed greater concordance (similar patterns with respect to criminality) among monozygotic than among dizygotic pairs of twins (Hagan, 2008: 126). *Chromosomal abnormality* or *XYY syndrom* is genetic anomaly that has been, since 1960s, associated with the aggressive behavior of men. During the time, XYY anomaly became a standard explanation for extreme forms of violence, after it was erroneously reported that mass murderer Robert Speck, who murdered eight nurses in their Chicago apartment, had an XYY anomaly. The truth is that very few violent criminals possess an extra Y chromosome but unfortunately men with XYY chromosome structure are stigmatized in mental and prison institutions (Fox & Levin, 2012: 147, 148).

On the other side, one study from Denmark showed that men with the XYY chromosome committed significantly more non-violent crimes than men without chromosomal abnormality (Ignjatović, 2019: 69), which shed completely

different light on possible connection between XYY chromosome structure and extreme violence. The truth is that XYY men are more likely to have low intelligence and because of that more likely to be arrested or imprisoned, but mainly for petty thefts (Carey 1994, according to: Barkan, 2009:143). *Summa summarum*, it doesn't mean that genetic is not important, the future will for sure bring better ways for researching the role of genetic in human behavior, but things need to be observed broader and what is good, even among biologists, there is an increasing recognition that the way in which genes are expressed depends also on social factors (Rafter, 2008, according to: Brookman & Robinson: 575).

### 5.3. Neurochemical factors

The influence of neurochemical factors is approach that appeared more recently in biocriminology. The human body is filled with many kinds of substances that act as chemical messengers to help its various parts perform their functions. Some of the functions include behavior and that's why biologists have tried to determine the role chemical substances might play in crime (Barkan, 2009: 143). One of the most important substances that can influence the human behavior are *hormones* that can be defined as secretion of endocrine glands that are passed into the bloodstream and are accumulated by target tissues, where they induce particular physiological or behavioral responses (Brain, 1994: 182). One of the hormone that is connected to aggressive behavior and violence is testosterone („male hormone“). Many scholars argue that variation in the amount of testosterone, is an important cause of male criminality and also explanation why men commit more crime than women and why some men commit more crime than other men (Barkan, 2009: 144). The fact is that bodily rhythms can have powerful effects on endocrine functioning and consequently on behavior (Brain, 1994: 221, 222) but of course it's difficult to equate testosterone level or level of some other hormone with amount of aggressiveness and, what is more important, with the way aggressiveness manifests.

In connection with that, some women suffer from the hormonal changes before menstruation appear (premenstrual syndrom or PMS) and because of the fact that this condition might lead to aggression and other offending, some researchers study whether crime by women tends to occur in their premenstrual phase. Because some studies showed connection between PMS and committed crimes, that finding was used in England in 1980s in several cases of murder as a defendant strategy which was successful because accused women received probation instead of imprisonment (Barkan, 2009: 145). It seems that it is too much to

put the blame on PMS when it comes to serious acts of violence, but science has certainly confirmed that the increased hostility and irritability of some females evident in the PMS phase has a hormonal component.

It is important also to be mentioned the role of adrenomedullary hormones (norepinephrine and epinephrine) in aggressiveness. One serious study (Woodman, 1983) found that subjects with convictions for only violent crimes have a higher ratio of norepinephrine (but not epinephrine) than either subjects with a mixed violence and property crime background or those with convictions for sexual offences. In other words, Woodman suggested that increased norepinephrine production is found in more aggressive personalities (Brain, 1994: 223).

*Neurotransmitters* are also form of neurochemical factors, chemical substance, and scientists study the influence some of it on aggression. Neurotransmitters have important role in the process of transmission of impulses between neurons, that consist human nervous system, across synapses (Barkan, 2009: 146). Recent research reviews in the field of behavioral genetics suggest that a propensity for extreme violence, such as homicide, is associated with polymorphisms that involve the detection, transportation, and catabolism of neurotransmitters, particularly dopamine and serotonin, that are manifest within adverse environments (such as family dysfunction) (Williams, 2021: 18). However, mentioned research found the influence of neurotransmitters on impulsive behavior that means it is still very questionable how neurotransmitters influence behavior of mass or serial murderers because such crimes are typically planned and methodical rather than episodic and impulsive (Fox & Levin, 2012: 149).

Different than neurotransmitters but also from affecting brain chemistry and therefore different behavior (aggressive) are some kind of psychiatric drugs. Present-day researchers continue to look to biology or chemistry in order to explain and predict homicidal behavior and with regard to mass murder, various psychiatric drugs, widely prescribed to treat depression and attention deficit disorder, have been suspected of altering brain chemistry in such a way to trigger extreme violence (the case of mass murder in Louisville, Kentucky, in September 1994, when Joseph Wesbecker killed eight of his co-workers and than committed suicide and the fact that he suffered of depression and was taking anti-depressant Prozac) (Fox & Levin, 2012: 148).

## **6. Special disorders and biological explanations**

Searching for explanation in the context of psychiatric drugs easily can bring into the discussion possible connections between different mental illnesses

and mass murders. There are some findings in the literature on that topic, for example, that many public mass murderers have shown signs of trauma, paranoid thinking, and/or psychopathy and that in general, mass murderers show schizoid personality traits (Williams, 2021: 18,19). One of the cases of mass murder that were the subject of analysis in the context of psychopathology is a mass murder committed after midnight on July 20th, 2012, in Aurora, Colorado, when twenty-four-year-old James Eagan Holmes, dressed in a ballistic helmet, protective gear for his legs, throat and groin, black gloves and a gas mask walked into a crowded movie theater, threw a canister that released some kind of gas, and opened fire. Twelve people were killed and seventy others were injured. Dr. Metzner who did the analyze of Mr. Holmes stated that clinical presentation was consistent with the differential diagnosis of schizophrenia, schizoaffective disorder, bipolar disorder, social anxiety disorder, trichotillomania and obsessive-compulsive disorder. More important, it is emphasized that his depression and psychosis was a cause of substantial distress to him, which contributed to his decision to implement the planned shooting (Allely, 2020).

In analyzing the other case of mass murder (basically family type mass murder<sup>1</sup>), it was concluded that during the incubation phase, a clinical depression and psychopathological symptoms could be assessed and also it was clear that the psychopathological phenomena (depression, paranoid ideation, and symptoms) disappeared after mass murder commission, and the perpetrator itself experienced a relief from the emotional tension (Declercq & Audenaert, 2011: 142). In the most recent case of mass murder (mass shooting) that occurred on October 25<sup>th</sup> 2023 in Lewiston, Maine (USA), the media have been reported about possible medical condition of the suspect Robert Card in the context of psychiatric problems because he was hospitalized in mental institution in mid-July because he was acting "belligerently and possibly intoxicated". In some period before that, the shooting suspect told army personnel at Camp Smith, where he was situated, that he had been "hearing voices" and had thoughts about "hurting other soldiers"<sup>2</sup>. However, this case of mass murder will also be unexplored in the context of crime etiology, due to the lethal outcome (allegedly suicide of the suspect). It fit to the common statistics on mass murders.

---

1 Mass murderer killed five people at their home: four family members and a friend of the family.

2 The gun that investigators believe the Lewiston mass shooting suspect, Robert Card, used to kill 18 people and wound 13 others was purchased legally just days before he was hospitalized and ordered to undergo a psychiatric evaluation. Miller, J. (2023, October 27th) Sources: Gun believed to be used in Maine shootings was purchased days before suspect's mental health episode, CNN, available at: <https://edition.cnn.com/us/live-news/lewiston-maine-mass-shootings-10-27-23/index.html>, accessed on 28.10.2023.

No matter on possible connection between psychiatrics problems and mass murders it would be wrongfull to simplify in that way the explanation of each mass murder case. Unfortunately, very often the general public cannot accept any other explanation for those crimes which then opens a polemic regarding the necessity of timely recognition the "abnormalities" of mass murderers (predators). Misidentification of predators with psychiatric patients brings trouble to individuals with real health problems, because they are stigmatized and perceived by the majority as time bombs that can explode at any moment and commit a predatory crime (Ilić, 2017: 142). Anyway, one of the possible roots of violent behavior and therefore the commission of mass murders is psychopathy as a condition which can be explained even from the biological point of view.

### *6.1. Biological explanation of psychopathy*

One of the main topics that interest neuroscientists is connection between psychopathy and violence i.e. possibilities that provide modern techniques to research that condition. Psychopathy is a developmental disorder that leads to persistent antisocial behavior and one of the most powerful predictor variables for violence risk assessment. Some estimates suggest that psychopathic individuals could nevertheless be responsible for as much as 30% - 40% of all violent crime but only about 0,5 to 1% of the population are psychopaths (Nadelhoffer, 2010: 510).

There were a lot of traditional psychopathic research and scientists came to many important conclusions about the characteristics of psychopaths. Also, they developed and improved tests for assessing the presence of psychopathy, but here we won't analyze that aspect of psychopathy, the focus will be on research that conduct cognitive neuroscientists by using structural and functional imaging to study psychopathy. Some of the findings (manifested functional deficits) are: reduced amygdala and vmPFC activity during aversive conditioning tasks, reduced amygdala activation during emotional memory...but also have been found structural brain differences in psychopathic individuals (reduction in PFC gray matter volume) (Nadelhoffer, 2010: 512). Also, Kiehl claims that all psychopaths share common neurological traits that are becoming relatively easy to diagnose using functional magnetic resonance imaging (fMRI). The fMRI data collected in prisons in New Mexico during 2007, showed a robust and persistent pattern of abnormal brain function in psychopaths: namely, decreased neural activity in the paralimbic regions of the brain. These are the regions generally below the neocortex, including and adjacent to the limbic

structures (Keihl & Hoffman, 2011).

On the other side, some research deal with the issue of the neurochemistry of psychopaths as well as possible heritability of psychopathy. Nadelhoffer indicate some findings from the literature: noradrenaline plays an important role in the deficits associated with psychopathy and administering noradrenaline antagonists reduces the impact of aversive cues when making decisions. Also, according to two studies there is a genetic contribution to the psychopathic disorder (2010:513).

The findings from research conducted so far on the psychobiological bases of psychopathy reinforce the idea that psychopathic traits are associated with abnormalities in the way the brain processes emotional information collected from the environment, as well as which cognitive properties may help maintain these abnormalities or, in some contexts, explain them completely (Anderson et al., 2017 according to: Moreira et al., 2019: 157).

## **7. New approaches in bio-criminology**

Research on the relationship between neurobiological factors and antisocial behavior has grown exponentially in recent decades. As a result, criminal behavior has been related to impairments in different (neuro) biological systems, such as genetics, hormones and brain functioning. The development of innovative techniques, for example brain imaging techniques and physiological measurements, can partially explain the increase in neurobiological studies on criminal behavior. Furthermore, a recent zeitgeist change seems to have led to a greater acceptance of neurobiology as an additional approach for the study of criminal behavior (Cornet, 2015).

Some new advances in data collection, for example: functional magnetic resonance imaging (fMRI), data analysis and pattern classification have put scientists in a better position to comprehend the complex relationship between brain deficits and violence, impulsivity, and other antisocial behavior (Nadelhoffer, 2010: 509). Yang and Raine conducted the first brain imaging meta-analysis of antisocial behavior, evaluating the relationship between prefrontal impairment and antisocial/violent/psychopathic behavior across 43 independent studies. Results demonstrated that antisocial behavior was significantly associated with reduced prefrontal structure and function. Specifically, increased antisocial behavior was particularly associated with structural and functional reductions in the right orbital frontal cortex (OFC), left dorsal lateral prefrontal cortex (DLPFC), and right anterior cingulate cortex (ACC). They also noticed that the reduction in the right prefrontal cortex (OFC and ACC) is associated with emotional deficits and poor



decision-making in antisocial individuals, while the reduction in the left DLPFC is more linked to antisocial features of impulsivity and poor behavior control (2009: 86). One of the most recent research in the context of biological explanation of crime is within the genetically informed neuroimaging. In concrete, it is about relationship between violence and the MAOA gene<sup>3</sup> which is in turn partly responsible for the catabolism of serotonin (5-HT) and norepinephrine (NE). Some studies showed that mutation of the MAOA gene may influence hyper-aggression and elevation of serotonin and in conjunction with certain environmental catalysts such as childhood abuse – confers an added risk in males for both antisocial behavior and reactive or impulsive violence (Nadelhoffer, 2010: 513-515).

## 8. Conclusion

Although biological explanation of crime and especially violent crime is just one possible way of understanding the complex question of crime etiology, it is necessary to take it into account as to better understand criminal behavior. The most popular approaches in analyzing the criminogenesis in contemporary criminology are dominantly oriented on social factors but results of such research cannot provide complete picture of individual etiology of crime. In contrary, human biology is something that can be explored in many ways, by using different modern devices. In connection with that, it seems that the long-standing fear of the misuse of science for the purpose of crime control has subsided significantly, opening the door to the accelerated development of various research approaches within bio-criminology that could help in better understanding of human behavior. Different authors still warn that biological approaches are extremely limited in their explanatory capacity due to a failure to acknowledge the interactional nature of much violence and the power of the situation (Brookman & Robinson, 2012:575) but beside that we cannot ignore the fact that biology influence our behavior. Neurological factors, genes or body chemistry, everything has to be considered in each case as to better understand the core of criminal behavior and find the best way of treatment the offenders.

Mass murders are even more complex for understanding. These events are fortunately rare but in many cases scientists cannot explore etiology of such extreme crimes because the offenders don't survive. But just because of their rarity and mortality of offenders, each case of mass murder has to be analyzed in unique way, every possible aspect that might be important. According to findings

---

3 MAOA gene encodes the enzyme monoamine oxidase A

that we have tried to represent in this work, bio-criminology can provide possible answers on many questions. Authors in the field of criminology have to be open-minded for such research that can be complete when combined with other factors (psychological and social).

Finally, what is the most important outcome of dealing with biological causes of crime (mass murders)? In some cases, usually when offence is committed, but sometimes even before it, by the process of correcting some biological deficiencies the society could make progress in crime prevention. Preventive activity has to be the most important task of all subjects which job is dealing with crime issue. It is much better to prevent than to treat.

## References

- Allely, C.S. (2020). The contributory role of psychopathology and inhibitory control in the case of mass shooter James Holmes. *Aggression and Violent Behavior*, 51. <https://doi.org/10.1016/j.avb.2020.101382>.
- Barkan, S. E. (2009) *Criminology: a sociological understanding*. New Jersey: Pearson Prentice Hall.
- Bowers, T. G., Holmes, E. S. & Rhom, A. (2010) The Nature of Mass Murder and Autogenic Massacre. *Journal of Police and Criminal Psychology*, 25(2), pp. 59-66, <https://doi.org/10.1007/s11896-009-9059-6>
- Brain, P. F. (1994). Hormonal aspects of aggression and violence. In: Reiss, Miczek, Jr., K. A. & Roth, J. A. (eds.) *Understanding and preventing violence, Volume 2: Biobehavioral influences*. Washington, USA: National Academy Press, pp. 173–244.
- Brookman, F. & Robinson, A. (2012) Violent crime. In: Maguire, M., Morgan, R. & Reiner, R. (eds.) *The Oxford Handbook of Criminology*. Oxford, United Kingdom: Oxford University Press, pp. 563-594.
- Cornet, L. (2015) Using basic neurobiological measures in criminological research, *Crime Science*, 4:7, <https://doi.org/10.1186/s40163-015-0018-5>
- Declercq, F. & Audenaert, K. (2011) A case of mass murder: Personality disorder, psychopathology and violence mode, *Aggression and Violent Behavior*, 16, pp. 135-143. <https://doi.org/10.1016/j.avb.2011.02.001>
- Douglas, J. E., Burgess, A. W., Burgess, A. G. & Ressler, R. K. (2006) *Crime Classification Manual: A standard system for investigating and classifying violent crimes*. San Francisco: Wiley. <https://doi.org/10.1016/j.avb.2007.02.003>
- Fox, J. A. & Levin, J. (2012) *Extreme killing: understanding serial and mass murder*. Los Angeles: SAGE Publications.
- Hagan, F. E. (2008) *Introduction to Criminology: Theories, Methods, and*

- Criminal Behavior - 6<sup>th</sup> Edition*. Los Angeles: SAGE Publications.
- Ignjatović, Đ. (2019) *Kriminologija*. Belgrade: University of Belgrade, Faculty of Law.
  - Ilić, A. (2017) *Media and Crime: Criminological Aspects*. Doctoral dissertation. University of Belgrade: Faculty of Law.
  - Ilić, A. (2018) Media Reporting on Refugees and Related Public Opinion in Serbia. In: Kury, H. & Redo, S. (eds.) *Refugees and Migrants in Law and Policy: Challenges and Opportunities for Global Civic Education*. Cham, Switzerland: Springer, pp. 137-161. [https://doi.org/10.1007/978-3-319-72159-0\\_6](https://doi.org/10.1007/978-3-319-72159-0_6)
  - Ilić, A. (2023) The analysis of some problems in achieving the rehabilitation purpose of punishment. *Journal of Criminology and Criminal Law*, 61(1), pp. 93-115. <https://doi.org/10.47152/rkkp.61.1.5>
  - Keihl, K. A. & Hoffman, M. B. (2011) The criminal psychopath: history, neuroscience, treatment, and economics. *Jurimetrics*, pp. 355-397.
  - Moreira, D., Azeredo, A. & Barbosa, F. (2019) Neurobiological findings of the psychopathic personality in adults: One century of history. *Aggression and Violent Behavior*, 47, pp. 137–159. <https://doi.org/10.1016/j.avb.2019.03.005>
  - Nadelhoffer, T. (2010) Brain and crime – what neurosciences teach us. In: Herzog-Evans, M. (ed.) *Transnational Criminology Manual, Volume I*. Nijmegen, Netherlands: Wolf Legal Publishers (WLP), pp. 507-523.
  - Paulino, A., Kuja-Halkola, R., Fazel, S., Sariaslan, A., Du Rietz, E., Lichtenstein, P. & Brikell, I. (2023) Post-traumatic stress disorder and the risk of violent crime conviction in Sweden: a nationwide, register-based cohort study. *Lancet Public Health*, 8(6), pp. 432-441, [https://doi.org/10.1016/S2468-2667\(23\)00075-0](https://doi.org/10.1016/S2468-2667(23)00075-0)
  - Sajous-Turner, A., Anderson, E. N., Widdows, M., Nyalakanti, P., Harenski, K., Harenski, C., Koenigs, M., Decety, J. & Kiehl, K. A. (2019) Aberrant brain grey matter in murders. *Brain Imaging and Behavior*, 14(5), pp. 2050-2061. <http://doi: 10.1007/s11682-019-00155-y>.
  - Siegel, L. J. (2008) *Criminology: The Core*, Third Edition. Belmont: Thomson Learning, Inc.
  - Starčević, A., Postić, S., Radojičić, Z., Starčević, B., Milovanović, S., Ilanković, A., Dimitrijević, I., Damjanović, A., Aksić, M. & Radonjić, V. (2014) Volumetric Analysis of Amygdala, Hippocampus, and Prefrontal Cortex in Therapy-Naive PTSD Participants. *BioMed Research International*, pp. 1-6. <http://doi.org/10.1155/2014/968495>
  - Starčević, A., Dimitrijević, A., Aksić, M., Stijak, L., Radonjić, V., Aleksić, D. & Filipović, B. (2015) Brain changes in patients with posttraumatic stress disorder and associated alcoholism: MRI based study. *Psychiatria Danubina*,

27(1), pp. 78-83.

- Williams, D. J. (2021) Forensic Behavioral Science of Serial and Mass Murder with an Addition of Leisure Research: A Descriptive Synthesis. *Forensic Sciences*, 1, pp. 16-24. <http://doi:10.3390/forensicsci1010004>
- Yang, Y. & Raine, A. (2009) Prefrontal Structural and Functional Brain Imaging findings in Antisocial, Violent, and Psychopathic Individuals: A Meta Analysis. *Psychiatry Research: Neuroimaging*, 174(2), pp. 81-88. <http://doi:10.1016/j.psychresns.2009.03.012>

#### *Online Sources*

- Marr, C. (2020). Neurological Abnormalities' Impact on Crime and Behavior. *UTSA Journal of Undergraduate Research and Scholarly Works*, 7. Available at: <https://rrpress.utsa.edu/server/api/core/bitstreams/7f4a2f8b-9acc-433c-920b-a8fc3a20462f/content>, accessed on 4.09.2023.
- Miller, J. (2023, October 27<sup>th</sup>) Sources: Gun believed to be used in Maine shootings was purchased days before suspect's mental health episode, CNN, Available at: <https://edition.cnn.com/us/live-news/lewiston-maine-mass-shootings-10-27-23/index.html>, accessed on 28.10.2023.