

## HEREDITY AND CRIME: GENEALOGICAL TRACK-DOWN TO ABRIDGE THE EVIDENCE GAP

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### ABSTRACT

One of the most challenging and understudied aspects of genetics and crime is the subject of criminal heredity. Various studies have studied the influence of genetics on crime causation. Genetic mutations can also be regarded in determining the intensity of violence. The ingrained traits in human tendencies strongly influence crime causation. Genetic factors interacts with the environmental factors while commission of crime to enhance the process. This paper analyses family studies, twin studies and adoption studies to determine if there is any heritability of crime with genes that cause criminal behavior. The nature vs nurture debate has been quite a prolonging one with studies proving both sides of the case but on the other hand, it helps to unfold molecular-genetic discoveries that might be incorporated into antisocial behaviour theories.

**Keywords:** Genetics, heredity, crime, family studies, chromosomal mutation

### OBJECTIVE

Molecular-genetic studies and other hereditary studies have facilitated to establish a relation between heredity (genetics) and crime. There have been many researchers studying the criminal

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activity among family members of criminals, between twins who grew together and who grew apart, among biological and adopted children. There has also been studies with respect to genes influence with alcohol, diseases and other variations/mutations in the DNA that escalate the commission of crime. This paper analyses various aspects of genetics that aid in commission of crime and how environmental factors enhance the process. The aim of this paper is to establish whether there is strong concordance with heredity and crime causation and how frequent that is.

## **INTRODUCTION**

Crime may be a genetic disease or an acquired trait during life-time of a person. Inheritance as a factor for causation of criminality has been observed as one of the important influences on the study of crime causation. Genetic factors play a vital role in influence of various mental disorders like ADHD, depression, schizophrenia, anxiety disorder, bipolar disorder, etc. which in-turn triggers the person to cause an offence, sometimes beyond his control. Both genetic and environmental factors together contribute towards anti-social behavior. There are other economical, sociological, environmental and political factors that play an important role in crime causation but recently genetic influence seemed to have found a correlation with crime. The genetic theories help in explaining crime causation in terms of heredity and development.

Genes can be a key predictor to show whether certain traits have been passed down to off-springs from parents, by DNA. Thereby, when such genes are exposed to environmental variables, they tend to induce criminal behavior. Sometimes children of habitual offenders tend to commit crime which may be attributed to heredity. Some of the renowned serial killers also possess genes that

are mutated which trigger the commission of crime. Though it cannot be said always that genetic factors alone cause crime, the infusion of environmental factors are also taken into consideration while evaluating the impact of genetics on crime causation.

### **IS THERE A RELATION BETWEEN HEREDITY AND CRIME?**

A complex combination of social and biological elements leads to criminal conduct. The phrases "biological" and "genetic" are frequently misunderstood. While biological variables, include physiological, biochemical and neurological aspects, genetic factors comprise of inherited biological variables.

Lombroso was the first to even consider the possibility of a link between genetics and criminality in 1918. After conducting hundreds of postmortem examinations on imprisoned criminals, Lombroso concluded that these individuals were true throwbacks to an earlier period in man's development, as shown by their atavistic traits such as slanting foreheads, protruding ears, asymmetric face, thick lips, dark skin, large and projecting jaws. There was a genetic pattern of recurring social transgression in the atavistic theory of crime, over which the criminal had no significant control. Both the medical and sociological professions slammed this initial attempt to investigate the link between criminality and heredity.

Family studies, twin studies, and adoption studies suggests that environmental variables play a crucial role in crime causation and so does the genetic variables. It is a range of phenotypical qualities (which are the observable physical qualities) that are heritable to varying degrees that creates the impetus towards crime, rather than a single gene in itself (Rosenthal, 1975). Such discoveries will force us to reconsider our legal obligations to criminals, including their proper

classification and treatment, as well as their responsibilities to victims. Environmental factors are also studied along with heredity as it is dependent, and the interaction between the two are used to analyze the behaviour.

The genetic disposition of an individual is significant because it establishes a fundamental framework that can serve as a guide for proclivities for certain courses of action. While it is true that some people are born with a higher average intellect, environmental factors have an important influence in how this attribute is expressed. For example, there can be observable differences between a person who grew up in an environment that encouraged pursuation of academic interests and those who don't. An individual who was brought up in an environment that encouraged his/her pursuation of academic interests is likely to express himself more freely than someone who grew up in an environment that did not value learning. This can lead to criminal activity as well as social deviance.

Studies by Charles Goring, Healy and Bronner, Sheldon and Eleanor Glueck, and Cyril Burt, on the other hand, show that there is no solid evidence to suggest that there is a link between genetics and crime causation in a family (Mullins, 1938).

### **GENETIC THEORIES IN CRIME CAUSATION**

There are mainly 3 theories of genetic epidemiological studies [How often a disease occurs in a group of people who are genetically connected]. Epidemiology is the study of how frequently and why illnesses affect various groups of individuals. This study is to study how often diseases occur in people who are genetically linked. The role of genetics in criminal behaviour can be assessed in

the form of family, twin and adoption studies. Due to lack of studies, variation of genetic and environmental studies could not be often varied.

### ***FAMILY STUDIES***

Family studies give useful information regarding the increased likelihood of deviance among family of affected people. Family studies are commonly done to determine the likelihood of relatives getting mental problems that affect other family members. Estimates of relative risk and population relative risk of a mental disease are used in case-control family studies.

Jukes family study was one of the oldest to trace criminality in families as early as 1877. Dugdale investigated the large family of Jukes to find the criminal blood running among the family and discovered that there was an arrest history spanning several generations of blood connections (Walters & White, 1989). Arthur married Ada Jude who later was referred as “mother of criminals” one of the six illegitimate sisters of the family. When Dugdale traced 1000 descendants and relatives of Ana, out of which 280 paupers, 60 habitual thieves, 7 murderers, 140 criminals, 50 prostitutes and other deviants were found (Siddique & Qadri, 2016). So it is clear from this why Ana Juke was called the mother of criminals.

Until Rath in 1914, published his precisely arranged pedigree analysis, there was virtually little subsequent research in this topic (to explore the inheritance of genes in humans) of 98 male recidivists and their families. The findings of this study demonstrated that female

prisoners' families had much greater crime than male convicts' families (Walters & White, 1989).

Guze and colleagues in 1967 investigated the families of 93 convicted male offenders and discovered that, they had more relatives with sociopathy diagnosis than the general population. While these data appear to corroborate the genetic hypothesis, they are constrained by the limitations of the study. Increased attrition may have accounted for the findings observed because Guze did not utilize a control or comparison group (Walters & White, 1989).

In 1912, a research was conducted by H. Goddard, an American psychologist and eugenicist, on the Kallikak family. Goddard's research focused on the inheritance of "feeble-mindedness," a recessive gene (Siddique & Qadri, 2016). "Feeble-mindedness" encompasses a wide range of mental disorders such as mental retardation, learning problems, and mental illness. Goddard argued that a child might inherit feeble-mindedness from their parents, which psychiatrists today refer to as intellectual impairment.

Martin was a military hero who married a Quacker lady and had an affair with a "feeble-minded" barmaid one time. He had impregnated her and then abandoned her. Martin quickly rehabilitated and resumed to his upright life, eventually becoming a respected New England citizen and the father of a large family of wealthy folks. The dalliance with "an

unnamed feeble-minded girl" resulted in the birth of an illegitimate son, Martin Kallikak Jr., who had further line of lineal descendants.

The study traced 480 relatives of the illegitimate son and made a comparative analysis with 496 descendants through his legitimate Quaker wife, who had a good reputation. All of the children born from union of legitimate marriage with the Quacker lady were "healthy" and showed no evidence of developmental problems. Among descendants of his legitimate son, there were 1 mentally abnormal person, 2 alcoholics and no criminals. The illegitimate feeble-minded bloodline had 143 mentally abnormal persons, 24 alcoholics, 36 illegitimates, 33 sexual perverts, 8 brothel keepers, 3 epileptics and other deviants (Siddique & Qadri, 2016).

In a sample of 650 insane and mentally defective prisoners who were under trial, by a researcher Norwood, he found that around 101 reported to have insane, mentally defective or epileptic relatives (East, 1928). Goddard came to the conclusion that a wide range of mental traits were hereditary in nature, and that society needed to put a stop to the reproduction of "unfit" people.

Jukes family represented inherited criminality and the Kallikak Family inherited mental retardation. All these studies signify that the specific genes with physical and mental traits of criminal behaviour maybe passed down as heredity among the family.

### ***TWIN RESEARCH STUDIES***

Twin studies state that a heritable trait may increase risk of criminal behaviour and to analyze to what extent genetic and environmental factors influence a trait. The significance of environment variables in a genetic makeup can also be analysed in twin studies to compare between monozygotic and dizygotic twins (between those who grew up together and those who didn't). Identical twins, also known as monozygotic twins, are born when a fertilised egg separates and develops into two newborns with the exact same genetic material and are genetically identical. Fraternal or dizygotic twins are formed when two eggs are fertilised by two sperms to produce two genetically unique children and they are genetically non-identical.

Twin studies try to account for the influence of the social environment by assuming that twins' surroundings are similar to each other. Because twins are often reared in the same social setting, the social environment's influence is thought to be equal and constant. As a result, it can be said that there exists a genetic link between identical twins for any higher resemblance that between fraternal twins.

Johannes Lange conducted one of the earliest and simpler twin investigations in the 1929. He looked at 30 pairs of twins of the same sex. There were 17 dizygotic twin pairs and 13 monozygotic twin pairs and it was observed that at least one crime had been committed by each twin pair. Lange discovered that in 10 of the 13 monozygotic twin pairs, both twins were known offenders, compared to just 2 of the 17 dizygotic twin pairs (Criminal Justice, n.d.).



Christiansen discovered through his study that 52% of monozygotic twins were proband wise concordant for criminal behavior, while only 22 % of dizygotic twins were proband wise concordant for criminal behavior in a research done in Denmark using an unselected sample of 3856 pairs (Law.jrank.org, n.d.). In a group of twins in which at least one member of each pair is affected, proband wise concordance is a measure of the proportion of twins with the illness who have an afflicted twin. Thus we can understand from this study that twins share some biological characteristics that put them at a higher chance of becoming involved in criminal activity through their heredity.

The genetic impact appears to be unaffected even when there is a change in criminal conduct criteria and sample composition, implying that criminal behaviour and its correlates of antisocial behaviour which may otherwise be genetically mediated. The limited researches on twin studies is the only shortcoming. If there were a reliable number of studies, it would be easier to affirm the results of a genetic link. Since twins are mostly brought up under same environment, it is difficult to study the influence, when they grew up in different circumstances. According to Dalgaard and Kringlen, monozygotic twins' similarities can be attributed to the same childhood environment. Monozygotic twins are more likely than dizygotic twins to mimic one another, according to Carey, which could lead to an overestimation of inheritance.

***TWINS REARED APART***

Only limited studies were done on twins who were reared apart which limited its scope. A group of 32 pairs of monozygotic twins who were adopted by non-relatives after birth and who grew up in various environments were studied by Grove and his group. There were only limited studies that talked about twins who were reared apart. Since this was a nonclinical sample, only a few responses met the Diagnostic and Statistical Manual-III criteria for antisocial personality.

To address this shortcoming, symptoms that contribute to overall DSM-III diagnoses were tallied in order to screen for subclinical antisocial manifestations. Grove discovered that there is a significant overlap in genetic effects for both childhood conduct problems with a correlation of 0.41 and adult antisocial tendencies with correlation of 0.28 for these twins who grew apart (Tehrani & Mednick, Genetic Factors and Criminal Behavior). Since any correlation with significant value greater than 0.05 is said to have exhibit a strong correlation, childhood behavioural problems and adult anti-social tendencies have a strong correlation with genetics.

A research by Mednick, Gabrielli, and Hutchings in 1984 looked at the role of family psychology and biological heredity in determining criminal behavior. In this study, identical twins were adopted by two different families and raised separately. Adopted children have been discovered to be aggressive in the same way that their adoptive parents were rather than their biological parents. The research findings suggest that the environment and genetic disposition are equally important in influencing human behaviour (Adam Himebauch, 2000).

The landmark Minnesota Twins Study by Bouchard Thomas in 1979 and continued for decades. The twins were together for around 5 months before being separated and reunited at the age of 30. Identical twins reared apart had the same chance of becoming as identical twins who were raised together, according to the study (Dixon, 2019). This survey reveals that twins who spend more time together after being reunited are more similar. The findings also indicated that the level of resemblance between the twins, predicts how much time they spend together and not the other way.

Bouchard and colleagues came to the conclusion that genetic variables have a significant impact on behavioural patterns, proving the genetic effect on development. Identical twins, whether raised together or apart, will tend to have quite similar personalities. This study also found that genetic variance (70 percent heritability) accounts for around 70% of IQ variations in twins, with environmental variables accounting for the remaining 30%, which is similar to earlier studies (Sahu & Prasuna, 2016). It was also discovered that monozygotic twins raised together have a slightly higher IQ concordance rate than monozygotic twins raised apart.

Since monozygotic or identical twins share 100% of their inherited DNA, the Minnesota Twins Study focused on them. As a result, the researchers hypothesized that any differences between identical twins reared apart were caused by the environment, whereas any similarities were caused by heredity (Wiener, 2021). Bouchard and his colleagues came to the conclusion that genetic variables had a significant impact on behavioural

patterns, proving the genetic effect on development. This study made an important contribution to the debate over "nature vs. nurture." Genetic heredity and other biological variables are thought to impact nature's pre-wiring. Nurture is the term used to describe the influence of environmental stimuli after birth.

### **ADOPTION STUDIES**

Adoption studies are epidemiological studies that are performed to determine whether or not inherited predispositions exist and how strong they are. Adoptees and their biological parents are separated from the moment they are born. As a result, similarities between the adoptee and biological parents can be interpreted as estimations of genetic influences, and similarities between the adoptee and adoptive parents can be interpreted as indicators of environmental influences. Researchers may examine how environmental and genetic factors interact through this adoption design.

The first adoption study was by Crowe in Iowa, for a total sample of 52 adoptees who were born to a group of 41 jailed female criminals between 1925 and 1956. The findings revealed that 7 of the 52 adoptees had a criminal conviction as adults, compared to only one of the control adoptees (Law.jrank.org, n.d.). It can therefore be inferred that though these adoptees were removed from their jailed moms at birth, antisocial conduct is thought to have a heritable component.

Adoptive parent's socio-economic status appears to interact with genetic susceptibility for

crime, according to Cloninger and Van Dusen. Adoptees with criminal biological parents were considerably less likely to become criminals if they were adopted by middle to high socio-economic status families. Adoptive parents on low socioeconomic level, on the other hand, correlated with biological parent's crime to raise the adoptee's likelihood of criminality (Encyclopedia of crime and justice, 2021).

## **GENETIC LIABILITY TO VIOLENCE**

To answer this topic, twin and adoption studies have been used, which yielded only with mixed results. Cloninger and Gottesman in 1987, reanalyzed Christiansen 1977's twin data and classified participants as either violent or property offenders. Violent offences are those that cause injury to body or lead to death or force is used to threaten victim like kidnapping, assault, rape, murder, etc. Property offences are offences committed against any movable or immovable property like theft, robbery, vandalism, arson, etc. Property offences had a heredity of 0.78, whereas a heritability of violent offences was 0.50 (Tehrani & Mednick, 2000). Property crimes showed a greater genetic effect than violent crimes. According to the data, violent crimes may have a heritable component.

However, two separate adoption studies, one conducted in Denmark and the other by Mednick and colleagues, have failed to substantiate the hypothesis that violence is a heritable trait.

Some researchers contended that the twin approach is flawed since Monozygotic twins are more likely to be treated similarly than dizygotic twins, in addition to the monozygotic twins sharing more genetic information.

Heston was especially interested in studying if the kids of schizophrenic mothers who were adopted were at a higher chance of becoming schizophrenic. Surprisingly, an even larger percentage of the biological children of schizophrenic biological moms were imprisoned for violent offences. 11 of the adoptees which is 23.4% had served time in prison for violent crimes (Cade, Wagemaker, & Macgregor, 1982). Because these children were not nurtured by their schizophrenic moms, it was hypothesized that at least some kinds of mental illness and criminal violence may have a hereditary foundation.

In 1987, Moffit looked at the influence of parental mental illness in the onset of aggressive behaviour among Danish adopted-away boys. She discovered no increase in violent behaviour in adoptees when just the biological parents' criminal history was taken into account. Only kids whose biological parents were seriously criminal (usually the biological father) or those other biological parents had been hospitalized one or more times for a mental ailment (typically the biological mother) shows a substantial increase in the rate of violent offending (Tehrani & Mednick, Genetic Factors and Criminal Behavior). Similar studies suggest that there may be a relation between biological factors and increased risk of violence among children.

"However, there are likely to be hundreds, if not thousands, of genes that will substantially increase your risk of getting engaged in a crime, even if it is only by 1%," scholar Barnes added. "It's still a hereditary factor and it's still crucial." (Beaver & Boutwell, 2012)

## **GENETIC LINK BETWEEN ALCOHOLISM AND VIOLENCE**

According to molecular genetics research, a gene connected to the serotonin system may be linked to an increased risk of violence and alcoholism. It may be said that parents disposed to alcohol maybe prone to violence and that children may be acquire the same. Only half of the alcoholic problem is due to genetic makeup and other environmental factors react with it to enhance the criminal conduct.

As alcohol disrupts normal brain function, it may foster aggressiveness or violence. A variety of cognitive, neurological, and social variables can all have an impact on how alcohol impacts aggressiveness. Since alcohol inhibits cognitive function, it becomes difficult to grasp control over things or solve problems, regulate anger, and make sound judgments. Drinking too much alcohol can lead to more serious types of aggression that can swiftly develop into highly hazardous circumstances. According to Robert O. Pihl, a professor of psychology and psychiatry at McGill University, "alcohol is involved in half of all murders, rapes, and assaults" (T, 2021).

A susceptibility to alcohol consumption and addiction is one of the behavioural characteristics that parents might pass on to their children. Alcoholism is more likely to develop in people who are genetically susceptible to it. Although alcoholic inclinations can be inherited, social and environmental variables have a role in the development of an alcohol use problem (Juergens, 2021). Alcoholism has been responsible for causing many number of crimes including rape, murder, assault, etc. and if this gene causing alcoholic disorder is passed down to children from

parents, then the children might also tend to develop the same aggressive qualities and anti-social or deviant behaviours. It has been an established fact that alcohol consumption has a link to crimes and crimes like robbery and violent crimes frequently entail the use of alcohol. In the United States, alcohol was used in 15% of robberies, 63 % of intimate partner violence episodes, 37% of sexual assaults, 45-46 % of physical assaults, and 40-45 % of homicides (McMurrin, 2012).

Alcoholic biological parents were twice as likely to have a violent adopted-away son, according to the Danish adoption Cohort study (Tehrani & Mednick, Genetic Factors and Criminal Behavior). Adopted-away boys of biological parents with alcohol issues, on the other hand, did not have a significantly higher risk of property crimes. Violent offenders were the ones to have a substantial genetic influence (Philipp-Wiegmann, et al., 2011). Violent offences but not property offences among biological parents was linked to serious alcohol-related issues in males who have been adopted away. All these studies support interpretations from recent molecular genetic studies.

### **GENES LINKED TO CRIME**

Primarily two genes namely MAOA genes and CDH 13 genes are related with crime causation. These genes together are referred to as “serial killer genes” (Gomulka, 2020), where any mutation in these genes may result in violent behavior.

*i. MAOA gene [Codes for monoamine oxidase A enzyme]*

The MAOA gene, which is found on the X chromosome, primarily codes for the enzyme monoamine oxidase A, which regulates the levels of dopamine and serotonin in the brain.



Since mutations or abnormal variations of the MAOA gene frequently result in violent behaviour, it is also known as the warrior gene which is mostly found in males. The subject's genetics and environmental experiences were likely elements in the criminal mentality of Ted Bundy, a well-known serial killer. Bundy has illustrated features of decreased MAOA gene activity (Hernandez, 2015).

MAOA activity deficiencies have been reported to be associated with aggressive behaviour and other behavioural abnormalities, although they are also impacted by environmental circumstances.

*ii. CDH 13 gene [ variant of cadherin 13]*

CDH13 has been connected to the likelihood of attention deficit hyperactivity disorder (ADHD), as well as comorbid issues including drug and alcohol abuse and a number of neurodevelopmental illnesses. (Paul, 2020).

## **DISEASES LINKED TO CRIME**

One of the technique, which is frequently employed in genetic research, is to apply diagnostic criteria for several personality disorders linked to a higher likelihood of criminal behaviour, such as Antisocial Personality Disorder (ASPD).

- i. ASPD is defined by a consistent disregard for and violation of other people's rights. Only anyone above the age of 18 can be diagnosed with it.

- ii. Attention Deficit Hyperactivity Disorder (ADHD), Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD) are three juvenile diseases that are frequently evaluated because they have been recognized as risk factors for the development of ASPD. Individuals with Conduct Disorder have behavioural features that are similar to ASPD that is violation of society norms or regulations, but those with ADHD have regular inattention or hyperactivity-impulsivity. Oppositional Deficit Disorder is similar to Conduct Disorder. Opposition Deficit Disorder involves disobedient or angry behaviour, however if more significant kinds of such behaviour are present, it is diagnosed as Conduct Disorder (Morley, 2003).

Aggressiveness and impulsivity have been the most studied personality qualities, with personality questionnaires being used to measure them (Rhee & Waldman 2002). Adult hyperactivity, which is sometimes misdiagnosed as ADHD, may be of relevance since people who demonstrate both antisocial and hyperactive behaviour are more prone to commit crimes. When people inherit a large number of variant genes and are exposed to the correct (or wrong) social context, they engage in antisocial behaviour.

### **Tribal Crimes and Heredity**

Several castes in colonial India were targeted by the Criminal Tribes Act of 1871, which was increased in scope into the 1920s. The Criminal Tribes Act of 1871, enacted during British colonial administration, defined certain tribes as hereditary, habitual offenders who were prone to committing minor offences by nature. Due to their reported proclivity for committing crimes they

were subjected to round-the-clock surveillance. It labelled 160 tribal communities as “criminal tribes” (habitual offenders) but was later repealed during 1949 claiming it to be discriminatory (Wikipedia, n.d.). The Habitual Offenders Act, 1952 allowed authorities to harass, imprison, segregate and restrict the movement of tribes which was discriminatory. The act notified certain nomadic tribes as habitual offenders and authorities would frame them for crimes they didn’t even commit just because they belonged to that tribe. According to the National Human Rights Commission, the Habitual Offenders Act of 1952 should be abolished. The United Nations Committee on the Elimination of Racial Discrimination stated in March 2007 that "the so-called de-notified and nomadic people, who are listed for their alleged'criminal tendencies' under the former Criminal Tribes Act (1871), continue to be stigmatised under the Habitual Offenders Act as well". The committee requested that India remove the Habitual Offenders Act and rehabilitate the de-notified and nomadic tribes (HT Correspondent, 2017). According to Simon Cole, a Criminology, Law, and Society professor, the law declared that people from certain castes were born with criminal tendencies (BYJU'S, n.d.).

The Kanjars, Lohars and Baluchis of Rajasthan are nomadic tribes in India who often practice criminal qualities and view crime as a way of life. It should be noted, however, that it is not their hereditary tendency that drives them to do crimes; rather, they are raised in a criminal atmosphere, and the impact of their familial environment is so strong on them that they are unable to refrain from committing crimes. The majority of the crimes are caused by superstitious beliefs in witchcraft, minor quarrels, sexual indulgence, and drunkenness from excessive alcohol use, particularly during festival seasons (Ghosh).

When crime becomes a community's primary source of income, it is viewed as a social obligation on the males. India is a land known for its cultural and religious values with people across the nation worshipping more than thousands of gods. As a result, in India's Pantheon, anything good or wicked appears to have a ruling deity, and members embrace the god or goddess who is said to favour their specific sort of criminal activity, and crime becomes a religious obligation as well. So crime becomes a part of their livelihood and they start to worship certain deities for the same. They idolize the commission of crimes and celebrate festivals in honor of their crime commission making it a superstitious belief that it is an offering to god.

As a result, they are the product of unique socio-cultural conditions in tribal life, and the reasons are frequently minor and the objectives trivial. Blaming tribal crime on a genetic element is incorrect. The pre-conception that people of tribal origin tend to commit crime just because they were born in that community and inherit it can therefore be negated. The state is doing its best to uplift the lives of the tribal community by providing them with reservation, job opportunities, a place to settle, imparting education, etc. The National Commission for Denotified, Nomadic, and Semi-Nomadic Tribes (NCDNT) has been established by the Central government to specify the economic interventions necessary to raise their living conditions through asset development and self-employment possibilities (HT Correspondent, 2017).

### **Chromosomal mutations and crime**

Humans have 23 pairs of chromosomes out of which 22 pairs are the autosomes which are present similarly in both male and female while 23<sup>rd</sup> pair of chromosomes is called sex chromosomes namely the X and Y which differ between males and females. Females have a pair consisting of

two X chromosomes in their cells, while males have a pair consisting of both X and a Y chromosomes.

Geneticists discovered that typical human men had an XY sex chromosome, an additional Y chromosome was frequently detected in violent male criminals in the late 1960s (Jeffery & Jeffery, 1975). The XYY (supermale) chromosomal syndrome may work on the limbic system of the brain (which controls man's most primal desires, including his violent impulses) and assists to trigger violent criminal acts.

It's also true that genes regulate behaviour indirectly via the endocrine system and the brain's behaviour mechanisms (i.e. receptors, integrators, and effectors). Nonetheless, the XYY syndrome (which is accompanied by abnormal electroencephalographic and electrocardiographic readings, as well as physical abnormalities like body size, thyroid dysfunctions, and sensory alterations of taste and smell) is common enough for objective criminologists to recognise it, especially when developing crime prevention strategies (Jeffery & Jeffery, 1975).

There have been researches looking at the possibility that chromosomal abnormalities may be the trigger for serial killers. Bobby Joe Long and Richard Speck, were two serial killers who were found to have had some chromosomal abnormalities. Long was born with an extra X-chromosome while Speck's karyotype was incorrectly reported as having an additional Y chromosome (Brogaard, 2018). Studies still continue to prove the relation between chromosomal aberration or chromosomal mutation and crime causation.

The study of criminology requires an interdisciplinary approach, with an emphasis on the relationships between genetics, brain functioning, and the environment. Violent offenders who are

also XYY carriers must be closely examined to see how much genetic instructions impact their conduct against the learning process and cultural and environmental influences.

### **Neurocriminology**

Neurocriminology is a study that applies brain imaging techniques to understand the principles of neuroscience, to predict and prevent crime. It is a blend of biocriminology (*crime and anti-social behaviour*) and criminology.

Adrian Raine, a well-known psychologist and neurocriminologist, used Positron Emission Tomography (PET) to examine 41 killers and 41 law-abiding control subjects. When the activity in brain regions was measured, it was discovered that murderers in the frontal lobe had lower activity and asked different questions than the control group. The frontal brain lobe of the control group showed a lot of activity in response to the experimenters' inquiries (Vilks, 2019). According to the findings, emotionality promotes non-motivated and raised aggression due to a lack of brain activity, inactivity of control systems, greater reliance on instincts and external irritants, and increased reliance on instincts and external irritants.

Adrian Raine also came to the conclusion that a brain scan can identify children who may grow up to be killers based on a study conducted in Philadelphia's children. A diet rich in omega-3 fatty acids and calcium was prescribed to Philadelphia youngsters with delayed physical reactivity linked and deviant conduct in their trial. He concedes that genetics is responsible for at least half of the important patterns (Vilks, 2019).

## **CONCLUSION**

Though several studies and researches have been made to establish the relation between genetics and crime, there has still not been any concrete evidence to prove the same. Sometimes exposure of a particular gene to a specific environment may cause criminal behaviour and so does chromosomal aberrations. This may not be entirely true in all cases. When one criteria applies for a group, the same does not tend to work for others. For example, family studies prove that there is a hereditary relation with crime and that it is passed down to generations. When considering some of the notorious serial killers, this theory doesn't apply to all. Say, Ted Bundy the notorious serial killer was brought up in a well-settled, disciplined family and no close relatives of him showed any deviant behaviour yet he went on to become a murderer. Similarly there are serial killers who don't possess any MAOA genes and the CDH-13 genes or their variants. So there are different genetic reasons for which crime maybe committed and it doesn't have a limited scope as such.

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