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## The Legal and Ethical Implications of Biometric and DNA Evidence in Criminal Law

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Himanshu Mishra

### **ABSTRACT**

*By means of biometric and DNA evidence, criminal investigations have transformed forensic science and offered consistent means of suspect identification and exoneration of the accused. Its use, however, raises moral and legal issues particularly with regard to data protection and privacy rights. This paper under reference to criminal law investigates the legislative framework limiting the use of biometric and DNA evidence in criminal law, its consequences on fundamental rights, and the possible hazards related with genetic surveillance. This paper will address three main points: (1) the legal admissibility of biometric and DNA evidence in criminal trials; (2) the junction of such evidence with privacy rights and self-incrimination principles; and (3) the future consequences of developing forensic technologies including familial DNA analysis and artificial intelligence-driven biometric identification.*

*Keywords – Biometric, DNA Evidence, Privacy Rights, Criminal Investigations, Fundamental Rights*

## I. Introduction

Over the course of the last several decades, the Indian legal system has seen a tremendous transformation as a result of the introduction of biometric and DNA evidence, which has brought forensic science into the core of criminal investigations and court procedures. The identification of suspects, the verification of paternity, and the resolution of both criminal and civil problems have all been made significantly more accurate by the technologies that have been developed. Nevertheless, the legal framework in India that pertains to their admittance, ethical use, and issues over privacy is still in the process of developing.

Like a great number of other nations, India has progressively come around to the concept of forensic evidence. Evidence based on DNA was first utilized in the late 1980s, and since then, it has become an essential component in a great number of high-profile criminal cases. In a similar vein, fingerprint evidence has been utilized extensively for hundreds of years, eventually becoming an integral component of forensic investigations<sup>1</sup>. Despite these advancements, the Indian judicial system continues to struggle with inconsistencies in the way it handles such evidence, particularly in the absence of legislation that is specifically devoted to this matter and standards that are consistent across the board.

## II. Evolution and Use of Biometric and DNA Evidence in India

Forensic science in India has only recently begun to incorporate DNA evidence, which is a relatively new addition to the field<sup>2</sup>. In the late 1980s, DNA fingerprinting was used for the first time in India, according to historical records. It is commonly acknowledged that Dr. Lalji Singh, who is frequently referred to as the "Father of DNA fingerprinting in India," was a pioneer in the development of this technology. Beginning in the early 1990s, DNA evidence was being utilized in Indian courts, originally for the purpose of resolving civil cases such as allegations of paternity.

In the case of *Kunhiraman v. Manoj*<sup>3</sup>, which took place in 1991, DNA testing was utilized to settle a dispute regarding paternity. This was one of the earliest occurrences. The use of DNA

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<sup>1</sup> G.K. Goswami, *Forensic Science in Criminal Investigation & Trials*, 6th edn., Universal Law Publishing, New Delhi, 2021.

<sup>2</sup> B.B. Goswami, *Legal Issues Related to DNA Fingerprinting in Criminal Justice System*, Satyam Law International, New Delhi, 2017

<sup>3</sup> *Kunhiraman v. Manoj*, II (1991) DMC 499

profiling in criminal investigations, such as those involving rape, murder, and the search for missing persons, became increasingly important throughout the course of time<sup>4</sup>.

It is important to note that DNA testing was utilized in the case of the **murder of Naina Sahni**, which is widely referred to as the *Tandoor case*<sup>5</sup>. This allowed for the identification of the burned remains of the victim, which ultimately led to a conviction. DNA evidence has also been utilized extensively in other high-profile cases, such as the *Priyadarshini Mattoo case*<sup>6</sup> and the Nirbhaya gang rape case, in order to establish facts and guarantee justice. Due to the fact that these instances established the accuracy and efficacy of DNA evidence, the use of DNA evidence is becoming increasingly accepted in Indian courts.

The incorporation of DNA evidence into legal procedures has not been without its share of difficulties, despite the fact that it is extremely useful. There have been instances in which the courts have voiced uncertainty regarding the accuracy and admissibility of forensic results<sup>7</sup>.

This has been attributed to procedural faults, inadequate sample collection, or the absence of accreditation for forensic laboratories. Furthermore, DNA evidence, despite its strength, is not deemed conclusive on its own. It is frequently required to be backed up by other types of evidence, such as eyewitness reports or testimony that is corroborative.

### III. Legal Framework for Admissibility

It is currently not possible for the Indian legal system to have a statute that is both specific and comprehensive that governs the collection, processing, and utilization of DNA and biometric data. Further legal rules, in particular those found in the Indian Evidence Act of 1872, (Currently Bhartiya Sakshya Adhinyam 2023) are responsible for addressing the issue of whether or not such evidence can be admitted into account.

The Act, namely Section 45 (Currently, Section 39(1) of the BSA, 2023), makes it possible for the opinions of experts to be presented in court in cases involving matters pertaining to science, art, and technical subjects. There have been numerous instances in which this part has been

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<sup>4</sup> Law Commission of India, *271st Report on Human DNA Profiling – A Draft Bill for the Use and Regulation of DNA-Based Technology*, Government of India, New Delhi, July 2017.

<sup>5</sup> *State v. Sushil Sharma (Tandoor case)*, (2007) Cri LJ SC 4008

<sup>6</sup> *State v. Santosh Kumar Singh (Priyadarshini Mattoo case)*, (2007) Cri LJ 964.

<sup>7</sup> “The Importance of Forensic Science in Criminal Investigations and Justice”, IFF Lab (2017), available at: <https://iffllab.org/the-importance-of-forensic-science-in-criminal-investigations-and-justice/> (last visited on Apr. 26, 2021).

utilized to accept forensic reports, including those that involve DNA analysis and fingerprint identification services.

On the other hand, relying on the testimony of experts has its own unique assortment of difficulties. The opinions of experts are merely taken into consideration as corroborative evidence; they are not considered to be conclusive proof. The trustworthiness of the expert, the dependability of the procedures that were utilized, and the overall coherence of the evidence that was presented are all factors that the courts consider when deciding whether or not to accept or reject such conclusions.

The Criminal Procedure Code (CrPC), in particular Sections 53 and 164A (Equivalent to Section 53 and Section 183(6)(a) and 184(6) BNSS), is another regulation that is pertinent to this situation. In accordance with Section 53, the investigating officer has the authority to request that a medical practitioner examine the accused person within the investigation.

The medical examination of rape victims, which involves the gathering of DNA samples, is particularly addressed in Section 164A of the Criminal Code. However, these regulations do not provide clear guidelines on how DNA evidence should be acquired, analyzed, or presented in court. They do, however, indirectly assist the use of DNA evidence.

In 2019, the Government of India presented the DNA Technology (Use and Application) Regulation Bill in response to the recognition of the need for a system that is specifically designed for this purpose. In addition to establishing DNA data banks and a regulatory board to oversee DNA laboratories, the purpose of this bill is to govern the use of DNA technology in both civil and criminal cases.

Although the Bill has the potential to simplify forensic procedures, it has also given rise to substantial concerns around the exploitation of the information and the protection of personal privacy. People who are opposed to the bill claim that it does not provide sufficient protection for the rights of individuals whose DNA is taken and kept, and that it does not have sufficient safeguards to prevent unlawful access to DNA data.

#### **IV. Precedents and Interpretations of the Judicial System**

The Indian courts have been instrumental in determining the admissibility of DNA and biometric evidence throughout the course of many years, as well as the ethical application of these types of evidence. In situations where there are no clear mandates from the legislature, the justice system has frequently served as a guiding factor.

In the case of *Gautam Kundu v. State of West Bengal*<sup>8</sup>, the Supreme Court of India ruled that no individual can be made to undergo a DNA test, and that the court cannot order such testing without proper grounds. This case is considered to be a landmark in this regard. The necessity of striking a balance between the requirements of investigations and the rights of individuals was stressed by this judgment, particularly in the context of civil disputes such as paternity trials.

In the case of *Sharda v. Dharmpal*<sup>9</sup> (2003), the Supreme Court ruled that courts do have the authority to compel medical testing, including DNA tests, if it is essential to arrive at a conclusion that is fair. This perspective was later revisited on the basis of this ruling. It was made clear by the Supreme Court that the ordering of such a test does not constitute a violation of the right to personal liberty according to Article 21 of the Constitution, provided that it is carried out in the interest of justice and with proper respect to the fairness of the procedure<sup>10</sup>.

Another significant case is *Nandlal Wasudeo Badwaik v. Lata Nandlal Badwaik*<sup>11</sup> (2014), in which the Supreme Court of India gave precedence to the outcome of a DNA test over the legal presumption of legitimacy that is established under Section 112 of the Indian Evidence Act (Section 116 of the Bharatiya Sakshya Adhiniyam, 2023 (BSA)). In particular, this ruling indicated a change toward a greater reliance on scientific evidence, particularly in situations where customary presumptions are challenged by factual mistakes.

By highlighting the cautious yet changing stance that Indian courts take towards forensic science, these judicial precedents shed light on the situation. In spite of the fact that the legal system recognizes the importance of DNA and biometric data as evidence, it also places a strong emphasis on the utilization of procedural safeguards, judicial monitoring, and the protection of fundamental rights.

## V. Privacy Concerns and Ethical Considerations

There are major concerns surrounding individual privacy, consent, and misuse that are brought up by DNA and biometric evidence, though essential have become indispensable for criminal investigations. The information included in DNA is not only an additional type of evidence; rather, it is a sensitive repository of an individual's personal and biological information. Information that goes well beyond a person's identity might be uncovered by it, including

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<sup>8</sup> *Gautam Kundu v. State of West Bengal*, (1993) 3 SCC 418

<sup>9</sup> *Sharda v. Dharmpal*, (2003) 4 SCC 493

<sup>10</sup> Innocence Project, "DNA Exonerations in the United States", available at: <https://innocenceproject.org> (last visited on Apr. 20, 2025).

<sup>11</sup> *Nandlal Wasudeo Badwaik v. Lata Nandlal Badwaik* [(2014) 2 SCC 576],

ancestry, health predispositions, and even susceptibility to diseases. In light of this, its management, storage, and access are all subject to stringent supervision.

In the case of *Justice K.S. Puttaswamy v. Union of India*<sup>12</sup> (2017), the Supreme Court of India firmly recognized the right to privacy as a basic right. The court acknowledged that the right to privacy is inherent to Article 21 of the Indian Constitution on the basis of this recognition. In light of this, the collection and storage of DNA without the individual's informed agreement or the need of the law can be a violation of the fundamental rights of the individual. This conflict between the necessity for effective crime control and the protection of human liberties is the source of concerns over the DNA Technology (Use and Application) Regulation Bill, 2019, which was introduced in 2019.

It is proposed in the 2019 Bill that national and regional DNA data banks be established. These DNA data banks will not only hold the DNA profiles of convicted criminals, but also of suspects, individuals who are currently awaiting trial, victims, and even relatives of people who have gone missing. One school of thought contends that if there were not appropriate legal safeguards, such a broad categorization could result in surveillance, misuse, and stigmatization of the subject.

According to Srivastava<sup>13</sup>'s review that was published in the Egyptian Journal of Forensic Sciences in 2022, the storing of DNA profiles of innocent individuals is a constitutional concern that has the potential to violate the right to privacy as well as the right to be protected from self-incrimination.

Additionally, it is concerning that the Bill does not contain any effective consent mechanisms. Despite the fact that the Bill permits the collecting of DNA from crime scenes and bodily sources, it does not provide an appropriate explanation of the framework for the withdrawal of consent or the deletion of data once an individual has been found not guilty.

When it comes to a nation that is still in the process of creating its digital infrastructure and data protection, such expansive powers can be considered risky. As a result of the lack of a data privacy law in India, individuals are susceptible to being profiled, having their information leaked, or having their political power exploited. This further validates the suspicions.

## **VI. Judicial Interpretation on DNA and Privacy**

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<sup>12</sup> *Justice K.S. Puttaswamy v. Union of India* AIR 2017 SC 4161

<sup>13</sup> Ankit Srivastava, Abhimanyu Harshey, Tanurup Das, Akash Kumar, Murali Manohar Yadav, and Pankaj Shrivastava, "Impact of DNA Evidence in Criminal Justice System: Indian Legislative Perspectives," *Egyptian Journal of Forensic Sciences*, vol. 12, no. 51, Springer, 2022, pp. 1–12.

The Court underlined the importance of safeguarding individual liberty and made the observation that no one should be compelled to furnish blood samples without first obtaining their agreement. As a result of this verdict, the judicial system has demonstrated a careful attitude to the utilization of scientific data in situations when it may violate personal rights. But this position has changed over the course of time.

A more progressive viewpoint was adopted by the Supreme Court in the case of *Sharda v. Dharmpal*<sup>14</sup> [(2003) 4 SCC 493]. This decision established that a civil court have the right to order a medical examination if it was deemed necessary to achieve the goals of justice.

According to the clarification issued by the Court, such an order would not be in violation of Article 21 or Article 20(3) of the Constitution, provided that it was carried out with the utmost care and was not arbitrary. Although the verdict acknowledged the significance of scientific evidence, it also took into account the constitutional protections that were in place.

Later on, in the case of *Nandlal Wasudeo Badwaik v. Lata Nandlal Badwaik*<sup>15</sup> [(2014) 2 SCC 576], the Supreme Court of India favored the scientific outcome of a DNA test over the statutory presumption of legitimacy that is outlined in Section 112 of the Indian Evidence Act. When scientific evidence, such as DNA testing, contradicts a legal presumption, the Supreme Court decided that the scientific evidence must be given precedence because it is the most accurate representation of the truth.

## **VII. Legislative Gaps and the DNA Technology Bill**

India does not yet have a complete statutory framework to control the collecting, processing, storage, and destruction of DNA evidence, despite the fact that the use of DNA evidence in investigations and courtrooms is rising. Both the Indian Evidence Act of 1872 and the Criminal Procedure Code of 1973 have rules that are restricted in their application to elements of scientific evidence. Expert testimony in scientific topics, such as DNA, is permitted under Section 45 of the Evidence Act. Additionally, medical tests of the accused and victims of rape are permitted under Section 53 and 164A of the Criminal Procedure Code, respectively<sup>16</sup>.

On the other hand, these laws do not set forth any specific standards for the manner in which

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<sup>14</sup> *Sharda v. Dharmpal* [(2003) 4 SCC 493]

<sup>15</sup> *Nandlal Wasudeo Badwaik v. Lata Nandlal Badwaik* [(2014) 2 SCC 576]

<sup>16</sup> Law Commission of India, *185th Report on Review of the Indian Evidence Act, 1872*, Government of India, New Delhi, March 2003.

DNA evidence should be treated. Because of this, practices in different states and forensic labs are inconsistent with one another. As a result of these concerns, the DNA Technology (Use and Application) Regulation Bill, 2019<sup>17</sup>, is working toward the establishment of national norms and accountability systems. Establishing DNA data banks at both the national and regional levels is one of the proposed changes in this bill.

However, as has been demonstrated in a number of studies, including the paper that was published in the *International Journal for Multidisciplinary Research* (2024) and was written by Harnil Trivedi and Dr. Pankaj Chamar<sup>18</sup>, the Bill does not provide solutions to the problems that it poses. It does not contain any thorough regulations regarding the length of time that data is retained, the rights of persons to challenge data input, or the methods for the deletion of records in the event that an individual is exonerated or proven innocent.

Given the delicate nature of DNA information, the Bill does not provide a clear definition of the idea of "informed consent" nor does it lay out thorough processes for data protection, both of which are important. In addition to this, it gives the government the authority to expand the categories of individuals whose DNA can be gathered without imposing any unambiguous restrictions<sup>19</sup>.

## **VIII. Issues of Reliability and Standardization**

Although DNA and fingerprint evidence are often regarded as reliable, their accuracy is primarily contingent on the fact that they are collected, stored, and analyzed in the appropriate manner. In India, forensic laboratories sometimes encounter obstacles such as inadequate financing, a lack of people who have received adequate training, and a backlog of cases.

Rudra Narayan Sahoo and Dr. Chinmaya Mohapatra<sup>20</sup> conducted a study in 2022 that was published in the journal *Nanotechnology Perceptions*. The authors highlighted that despite the scientific correctness of DNA profiling, the ability to effectively employ DNA evidence is

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<sup>17</sup> DNA Technology (Use and Application) Regulation Bill, 2019

<sup>18</sup> Harnil Udayanbhai Trivedi and Pankaj Kumar Chamar, "The Role of DNA Evidence with Special Reference to Criminal Cases in India," *International Journal for Multidisciplinary Research*, vol. 6, no. 4, 2024, pp. 1–4.

<sup>19</sup> *ibid*

<sup>20</sup> Rudra Narayan Sahoo and Dr. Chinmaya Mohapatra, "A Scientific Perspective on Legal Admissibility of Forensic Evidence in Indian Courts", in *Nanotechnology Perceptions* 2024

hindered by a lack of universal standards, deficiencies in infrastructure, and confusion in the legal system.

Some of the factors that can contribute to erroneous results are the contamination of samples, insufficient recordkeeping, and a lack of chain of custody. The admission of such defective evidence could result in incorrect convictions or acquittals, depending on the circumstances. Because of this, the courts are frequently cautious and require evidence that supports their claims. There have been instances in which even strong DNA matches have been called into question due to procedural errors. It is clear from this that there is an immediate requirement for quality assurance methods, accreditation of laboratories, and consistent procedures across all states and agencies.

When it comes to fingerprint evidence, the scenario is very similar. Despite the fact that fingerprinting is a well-established method, the usefulness of the evidence is contingent upon a number of factors, including the expertise of the forensic expert, the quality of the impressions, and the preservation of the crime scene.

In the article titled "*Evidenciary Value of Fingerprints in the Indian Criminal Justice System*," Aditya Jain<sup>21</sup> makes the observation that fingerprints are generally acknowledged to be permanent and one-of-a-kind as well. However, the legal acceptance of these individuals is contingent upon the proper handling of these individuals by trained staff and the observance of legal processes such as those provided in the Identification of Prisoners Act of 1920.

## **IX. Institutional Issues During the Implementation**

When it comes to the practical application of DNA and biometric evidence in India, there are a lot of hurdles involved in terms of both infrastructure and institutions. These issues are not only technical in nature; rather, they are the result of a mix of factors, including weak legal requirements, a lack of skilled professionals, inadequate forensic infrastructure, and variations in the methods that authorities that are conducting investigations follow.

Even now, the majority of Indian states continue to struggle with a lack of forensic scientists who

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<sup>21</sup> Aditya Jain, "Evidenciary Value of Fingerprints in Indian Criminal Justice System," *International Journal of Law and Legal Jurisprudence Studies*, vol. 8, no. 3, 2021, pp. 45–60.

have received the appropriate training, particularly in rural and semi-urban areas. Srivastava<sup>22</sup> (2022) highlighted in their review of the Egyptian Journal of Forensic Sciences that the quality of evidence analysis is heavily dependent on the availability of modern forensic laboratories and experts who are well-versed in advanced DNA technologies such as STR analysis, PCR methods, and mitochondrial DNA evaluation. This is because the quality of the evidence analysis is very dependent on these two factors.

The lack of a single supervision structure to guarantee that forensic methods are consistent across the country is another issue that continues to be a source of worry. In spite of the fact that they are considered to be the most prestigious institutions for DNA testing, the Central Forensic Science Laboratories (CFSs) that fall under the Ministry of Home Affairs are currently facing a significant backlog of cases. There are a number of State Forensic Science Laboratories (SFSs) that are either lacking in equipment or in personnel, which further delays the transmission of results and has a negative impact on the administration of justice.

The collecting of samples is yet another crucial area in which errors are discovered and reported regularly. According to Aditya Jain's article titled "Evidentiary Value of Fingerprints in the Indian Criminal Justice System<sup>23</sup>," in order to preserve the evidential value of forensic data, it is necessary to verify that the collecting, labeling, storage, and chain of custody of the fingerprints are carried out correctly.

DNA and fingerprint evidence, on the other hand, are frequently obtained under conditions that are above and beyond what is considered acceptable, which raises issues about their admissibility and dependability. This is because police officers and investigative authorities do not receive adequate training. Legal enforcement agencies frequently lack up-to-date expertise on how to handle sensitive forensic materials, and many of them do not adhere to set rules for documentation.

Variable levels of quality control have arisen as a result of the absence of statutory certification for DNA testing facilities that are not financed by the government. As a consequence of this, the evidence that is offered in court by such laboratories may be contested on the grounds that it is inconsistent or does not have accreditation.

The existence of these institutional flaws brings to light the urgent requirement for reforms that are geared toward capacity-building.

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<sup>22</sup> Ankit Srivastava, Abhimanyu Harshey, Tanurup Das, Akash Kumar, Murali Manohar Yadav, and Pankaj Shrivastava, "Impact of DNA Evidence in Criminal Justice System: Indian Legislative Perspectives," *Egyptian Journal of Forensic Sciences*, vol. 12, no. 51, Springer, 2022, pp. 1–12.

<sup>23</sup> Aditya Jain, "Evidentiary Value of Fingerprints in Indian Criminal Justice System" 8(3) *International Journal of Law and Legal Jurisprudence Studies* 45–60 (2021)

## **X. Legal Frameworks Comparatively: Lessons Learned from Other Countries**

In order to identify areas of weakness and potential areas for improvement, it is helpful to compare India's approach to DNA and biometric evidence with those of other jurisdictions. Countries such as the United States of America, the United Kingdom, and Germany have, for a considerable amount of time, built comprehensive legal and procedural frameworks that regulate the collection, storage, processing, and presentation of DNA evidence.

When it comes to DNA evidence, the United States of America is governed by a combination of federal and state legislation. The Combined DNA Index System (CODIS) is a national database that contains DNA profiles of individuals who have been arrested or who have committed crimes. It was established by the Federal DNA Identification Act of 1994<sup>24</sup>.

When it comes to expert testimony, the United States adheres to the Daubert Standard<sup>25</sup>, which stipulates that scientific evidence must not only be pertinent but also dependable. This is because the Daubert Standard is based on methodologies that have been peer-reviewed, known error rates, and general acceptance within the scientific community<sup>26</sup>. However, Indian courts generally depend on Section 45 of the Indian Evidence Act, which was enacted in 1872.

This section acknowledges the validity of expert opinion, but it does not have the same stringent standards as the Daubert case<sup>27</sup>. This frequently results in inconsistent decisions on admissibility that are based on the discretion of the judges, particularly in situations where forensic evidence does not agree with oral testimony<sup>28</sup>. While courts in the United States are more likely to give weight to well-established scientific evidence, they are less likely to give weight to anecdotal or subjective statements.

The Police and Criminal Evidence Act (PACE), which was passed in 1984, and the Data Protection Act, which was passed in 2018, together establish stringent regulations for the use of DNA evidence in the United Kingdom. It is required that DNA samples be obtained with the individual's agreement or under the authority granted by statute, and profiles must be removed if the individual is not found guilty, with the exception of certain situations affecting national

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<sup>24</sup> Mike Redmayne, *Expert Evidence and Criminal Justice*, Oxford University Press, Oxford, 2001.

<sup>25</sup> *Daubert v. Merrell Dow Pharmaceuticals*, 509 U.S. 579 (1993)

<sup>26</sup> *ibid*

<sup>27</sup> *ibid*

<sup>28</sup> Law Commission of India, *185th Report on Review of the Indian Evidence Act, 1872*, Government of India, New Delhi, March 2003.

security. To ensuring that forensic practices are up to minimal quality requirements, the Forensic Science Regulator in the United Kingdom is responsible. This not only guarantees a high level of accuracy but also takes measures to safeguard civil liberties, thereby serving as a model for India.

It is possible that India's DNA Technology Regulation Bill, 2019, may take those overseas models into consideration. It is possible, for instance, for India to implement a system that will delete data automatically for persons who have been exonerated or for those whose samples did not produce any evidence of probative value.

In a similar vein, the establishment of an independent Forensic Oversight Board would guarantee that laboratories adhere to standards that are acknowledged nationally and internationally and are subjected to frequent inspections. In order to prevent the exploitation of DNA technology and to ensure that the public has faith in it, these protections are absolutely necessary.

## **XI. The Importance of DNA in the Case of Wrongful Convictions**

It is possible that the possibility of DNA evidence to exonerate the innocent and avoid false convictions is the most compelling argument in favor of this type of evidence being used appropriately. As a result of the reexamination of forensic evidence, a great number of people who had been unfairly condemned have been set free all around the world. The absence of systematic data on exonerations based on DNA testing is primarily owing to inadequate documentation and a lack of transparency in India. However, there is a small amount of data available in India.

Over three hundred and fifty persons, many of whom had been incarcerated for decades, have been effectively exonerated via the use of DNA evidence by the Innocence Project in the United States. India, where the rate of unjust incarceration, particularly among underprivileged people, continues to be an issue, requires programs that are comparable to those used in other countries<sup>29</sup>.

Because of the inherent subjectivity of eyewitness testimony, forensic analysis is frequently given less weight in India than it does in other countries. Because of the fact that memory can be imperfect and witnesses are sometimes affected by fear, suggestion, or societal bias, this imbalance presents a potentially dangerous situation. When DNA evidence is available, it should

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<sup>29</sup> R. Gupta, S. Gupta, and M. Gupta, "Journey of DNA Evidence in Legal Arena: An Insight on Its Legal Perspective Worldwide and Highlights on Admissibility in India," *Journal of Forensic Science and Medicine*, vol. 2, no. 2, 2016, pp. 102–106.

be used to either support or contradict the testimony that is being presented. In cases of sexual assault, for instance, if the DNA retrieved from the victim does not match the DNA of the accused, this should be taken into serious consideration before determining whether or not the accused is guilty<sup>30</sup>.

Additionally, DNA evidence has the potential to play a significant role in cold cases, which are cases in which the convicted individual continues to assert their innocence even after the verdict has been rendered. In the case of *Shraddhananda*<sup>31</sup>, for example, DNA evidence was utilized in order to establish the identity of a woman who had been missing for a considerable amount of time. In a similar manner, DNA analysis of shattered body parts proved extremely helpful in identifying the suicide bomber and other suspects in the case of the assassination of Rajiv Gandhi.

The absence of legislative rights in India that permit convicted individuals to obtain post-conviction DNA testing is, nevertheless, a significant problem in the country. The United States of America permits convicted individuals to submit an application for DNA retesting under certain circumstances, typically at the expense of the state. The law in India is not uniform in any way. It is possible that judicial errors may be corrected and public confidence in the criminal justice system could be strengthened if such access were made available through legal aid programs or judicial discretionary authority.

## **XII. A Precarious Balance Between Abuse and Excessive Conduct**

There is a significant risk that law enforcement and political authorities may misuse DNA and biometric data, despite the fact that these types of evidence can be used to serve justice. DNA data can be used to target political dissidents, communities that are marginalized, or even for commercial profiling if there are no legal constraints on its usage. Particularly in a sociopolitical setting where accountability mechanisms are lacking, the establishment of huge DNA databases without sufficient regulation presents avenues for abuse. This is especially true in the context of the United States.

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<sup>30</sup> Deepali Sharma, “Admissibility of Genetic Evidence in Indian Courts,” *Uttarakhand Judicial and Legal Review*, vol. 5, no. 2, 2020, pp. 112–128.

<sup>31</sup> *Shraddhananda @ Murali Manohar Mishra v. State of Karnataka*, (2008) 13 SCC 767.

As an illustration, the DNA Bill allows for the collection of DNA from "volunteers" or members of the families of individuals who have fallen missing. On the other hand, this could result in discriminatory profiling of individuals based on factors such as religion, caste, or other factors. Furthermore, because the Bill permits the collecting of DNA even from individuals who are simply under investigation and have not yet been convicted, it may encourage the assumption of guilt rather than innocence.

Furthermore, the practice of familial DNA searching, in which police identify suspects by discovering partial matches to relatives in a DNA database, presents further obstacles to the protection of personal privacy. Despite the fact that it can assist in the resolution of criminal cases, it also violates the privacy of individuals who are not directly involved in any criminal activity. If this behavior is allowed to continue unchecked, it may result in unwarranted surveillance as well as significant societal stigma.

When adopting modern forensic technologies, India must emphasize the protection of individual freedoms and the implementation of procedural checks, as Rudra Narayan Sahoo and his colleagues point out in their essay published in the year 2024 in the journal *Nanotechnology Perceptions*. Under the absence of judicial or regulatory oversight, law enforcement agencies have the potential to exceed their authority, so undermining the idea of due process.

### **XIII. DNA Evidence in the Context of Gender Justice and Sexual Offences**

In the Indian criminal justice system, one of the most significant changes that has occurred is the incorporation of DNA evidence into cases that include sexual offenses. The testimony of the victim and circumstantial evidence are frequently the deciding factors in cases of crimes such as rape, which now receive a large amount of support from scientific research. In situations like these, the utilization of DNA profiling can either establish contact with the victim or corroborate the presence of the accused at the site of the crime. This can either strengthen the evidence presented by the prosecution or safeguard an innocent person from being wrongfully convicted.

The landmark *Nirbhaya* case<sup>32</sup>, which occurred in 2012 and rocked the nation's conscience, served as a demonstration of the transformative power that forensic evidence, particularly DNA, is capable of exhibiting. In order to provide the victim with substantial scientific support for their statement, forensic professionals gathered and analyzed DNA samples from the victim. These

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<sup>32</sup> *Mukesh & Anr. v. State for NCT of Delhi & Ors. (Nirbhaya case)*, CrI. App. No. 1398/2013 (Delhi HC)

samples were then compared with those of the accused. In its decision, the Delhi High Court stressed the probative importance of DNA evidence in addition to eyewitness reports and confessions, thereby providing the story with scientific accuracy and bolstering its credibility<sup>33</sup>.

Moreover, delays in forensic investigations can result in the loss of essential evidence. The strength of the evidence can be diminished if there are delays in the gathering of samples, inappropriate storage, or contamination. This is because DNA is extremely sensitive to the degradation that occurs in the environment. In spite of the fact that there are clear procedural mandates, the gap between legal laws and practical implementation impairs the efficiency of DNA evidence in serving the purpose of carrying out gender justice.

Building capacity among healthcare practitioners and law enforcement agencies to handle sexual offense cases with the requisite forensic and legal understanding is vital for strengthening this field. This capacity must be built in order to strengthen this area. In the case of minors and survivors of repeated attacks, it is especially important to ensure that evidence collecting is carried out with complete permission and dignity. It is also essential to teach victims about their rights and ensure that they are aware of their rights.

#### **XIV. The Intersection of Technology and Forensics: New Frontiers**

Because of the enormous advancements that have been made in genetic technologies, India is on the verge of entering a new age in the field of forensic science. In addition to the traditional method of DNA profiling, cutting-edge methods such as next-generation sequencing (NGS), epigenetic markers, and DNA phenotyping are gradually making their way into the conversation about forensics around the world. Using these methods, it is possible to ascertain not only an individual's identification but also their physical attributes, health predispositions, and even behavioral characteristics.

The ability to predict eye color, hair color, skin pigmentation, and ancestry is one example of how DNA phenotyping can be applicable. Especially in situations when there is no match in the DNA database but there is some biological material available at the crime scene, this can be an extremely helpful tool. On the other hand, these advances also bring up problems of ethics and law. The question is whether or not law enforcement should be permitted to build a facial

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<sup>33</sup> K.V. Krishnaswamy, *Scientific Techniques in Criminal Investigation*, Eastern Book Company, Lucknow, 2018

approximation of a suspect based on genetic data. Is it possible that this could result in the practice of racial or caste-based profiling in India's socially sensitive environment?

In the field of forensic analysis, India must also make preparations for the legal issues that may arise from the application of artificial intelligence (AI) and machine learning. For the purpose of automating DNA matching, analyzing vast genetic datasets, and even predicting the possibility of repeat offenses based on genetic markers, artificial intelligence systems are currently being created on a global scale. Even if they are handled in a responsible manner, these developments have the potential to assist in the management of India's massive case backlog.

## **XV. Reform Pathways and Policy Recommendations**

In light of the numerous obstacles that are associated with the legal admissibility and ethical utilization of DNA and biometric evidence, India has to implement a reform strategy that incorporates multiple approaches. A modified and rights-sensitive version of the DNA Technology (Use and Application) Regulation Bill is an urgent necessity that must be urgently passed. This is the first and most important requirement. Although it shows promise, the current version has to be revised so that it incorporates more stringent safeguards for privacy, more transparent permission methods, and restrictions on the amount of data that may be stored.

It has been pointed out in the article titled "The Role of DNA Evidence in Criminal Cases in India (2024)" written by Harnil Udayanbhai Trivedi and Dr. Pankajkumar Chamar that the proposal of the Bill to include profiles of not only convicted individuals but also suspects, detainees, and relatives of missing persons may be excessively broad. On the other hand, a more effective strategy would be to differentiate between those categories and implement tougher consent and judicial control for persons who have not been convicted.

Furthermore, legislation pertaining to data protection must be accompanied with legislation pertaining to DNA control. Currently, India does not have a legislation that is specifically devoted to data protection; in the absence of such a regulation, the establishment of huge DNA databases could potentially breach the privacy of individuals. India could incorporate principles like as data reduction, purpose limitation, and the right to be forgotten into its legal framework for DNA evidence by learning from the General Data Protection Regulation (GDPR) that was implemented by the European Union under the General Data Protection Regulation.

In order to improve their operational efficiency, forensic laboratories all around the country need to be updated and accredited. In accordance with the DNA Bill, a central certifying authority that is analogous to the Forensic Science Regulator in the United Kingdom might be established. The public should be able to file complaints or appeals against lab malpractice, and this authority should ensure that regular audits are conducted, as well as establish minimum standards for analysis.

The education and training of law enforcement officials, including detectives, prosecutors, and judges, is another essential aspect of reform. In light of the increasing complexity of DNA technology, the legal community is required to remain current with the latest scientific breakthroughs. Awareness of the general population is also very crucial. A significant number of people, particularly those who come from underrepresented communities, are not aware of the ways in which forensic data might be acquired or exploited against them.

## **XVI. Regulatory Oversight and Institutional Mechanisms**

In order to guarantee that forensic science is conducted in accordance with the rule of law, it is essential to have robust institutions. It is imperative that India establish a legislative regulatory agency in order to supervise all areas of DNA and biometric evidence, including the collection of samples, the management of databases, the training of laboratories, and accreditation of laboratories.

As an additional requirement, the Board is required to keep a public dashboard on DNA usage across states. This dashboard should include a description of the number of profiles gathered, cases solved using DNA evidence, and investigations that are still ongoing. In this way, transparency would be maintained, and accountability would be encouraged across the system.

## **XVII. Building Public Trust and Long-Term Resilience**

The legal framework that pertains to DNA and biometric evidence is still being shaped by the Indian judiciary's ongoing efforts. The decisions of the courts in the past were cautious, but more

recent rulings have shown that there is a growing willingness to depend on scientific methods, given that they adhere to specific ethical and procedural criteria. The importance of this ever-evolving body of law cannot be overstated when it comes to bridging the gap between legal tradition and technological progress.

According to Deepali Sharma's<sup>34</sup> observation in Chapter 3, Indian courts have frequently held that expert testimony must only be deemed corroborative. It has been maintained by the judicial system that the purpose of the expert is not to pass judgment on the case, but rather to provide assistance to the court in arriving at a decision that is informed. This circumspect approach is especially noticeable in the context of criminal proceedings, where the courts have on occasion given more weight to credible eyewitness statements than they have to equivocal forensic investigation findings.

In spite of this, courts are beginning to take DNA evidence more seriously as technology and understanding continue to advance. In some cases, they are even going so far as to overrule long-held presumptions. According to the decision that was handed down by the Supreme Court in the case of *Nandlal Wasudeo Badwaik v. Lata Nandlal Badwaik*<sup>35</sup> DNA evidence triumphed over the presumption of legitimacy that was established by Section 112 of the Indian Evidence Act. This was a change away from a rigorous interpretation of the statutes and toward an approach that is more evidence-based. It was an acceptance that forensic validity must be given serious consideration in situations where legal presumptions are shown to be erroneous.

When the Supreme Court of India ruled in *Sharda v. Dharmpal*<sup>36</sup> [(2003) 4 SCC 493] that ordering a medical examination, which may include DNA testing, does not violate the fundamental rights of an individual, provided that it is done in the pursuit of justice and with procedural safeguards, this was another significant moment in Indian jurisprudence. These rulings are a reflection of a growing acknowledgment of the vital role that forensic science plays in maintaining legal truth, particularly in situations where factual disputes cannot be resolved by conventional means.

As time goes on, it is highly probable that the courts will play a crucial part in determining the limits of the ethical use of DNA and biometric evidence. Among these are the determination of whether or not evidence obtained without authorization is admissible, the establishment of boundaries for the disposal of data that has not been utilized, and the interpretation of whether or

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<sup>34</sup> Deepali Sharma, "Admissibility of Genetic Evidence in Indian Courts," *Uttarakhand Judicial and Legal Review*, vol. 5, no. 2, 2020, pp. 112–128.

<sup>35</sup> *Nandlal Wasudeo Badwaik v. Lata Nandlal Badwaik* [(2014) 2 SCC 576]

<sup>36</sup> *Sharda v. Dharmpal* [(2003) 4 SCC 493]

not the utilization of such technology infringes fundamental rights such as individuals' right to privacy and bodily autonomy.

## **XVIII. Access to the Justice System and Application of Equal Respect**

The benefits of DNA and biometric technologies are not equally available to all individuals, despite the fact that these technologies have the potential to improve the delivery of justice. When it comes to the judicial system in India, forensic science, like many other areas of the system, frequently gives preference to individuals who have access to resources, legal knowledge, and institutional backing. This leads in a justice divide, in which underprivileged people, particularly the poor, rural populations, and communities that are excluded, do not benefit equally from gains in scientific knowledge<sup>37</sup>.

It has been stated by *Aditya Jain*<sup>38</sup> in his book "The Evidentiary Value of Fingerprints in the Indian Criminal Justice System" that the overworked forensic laboratories, particularly those located at the state level, are the cause of the delay in test results that can last for many months. These delays can result in an extended period of incarceration without conviction for an individual who is currently awaiting trial and is depending on DNA evidence for exoneration.

Furthermore, specific legislation provisions are required to be developed in order to permit DNA testing after a conviction has been handed down. Such methods are available in countries such as the United States, where individuals who have been convicted have the ability to request that biological evidence be reexamined if it has the potential to show their innocence. The judicial system in India does not provide a consistent path for this, despite the fact that there is the chance of unjust convictions. According to a rights-based approach, it is imperative that all individuals, regardless of the stage of their case, be have access to scientific data that has the potential to vindicate against them. Stigma, surveillance, and discrimination are all things that have societal implications.

## **XIX. Conclusion and Recommendations**

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<sup>37</sup> Law Commission of India, *271st Report on Human DNA Profiling – A Draft Bill for the Use and Regulation of DNA-Based Technology*, Government of India, New Delhi, July 2017.

<sup>38</sup> Aditya Jain, "Evidentiary Value of Fingerprints in Indian Criminal Justice System," *International Journal of Law and Legal Jurisprudence Studies*, vol. 8, no. 3, 2021, pp. 45–60.

Evidence based on biometric characteristics and DNA has developed as important weapons within the Indian legal system. These methods offer an unparalleled level of accuracy in the context of criminal investigations, civil disputes, and the identification of individuals who have gone missing. Over the course of the last three decades, there has been a consistent increase in the utilization of these scientific methods. This growth has been facilitated by the progression of technology, the rising acceptance of these methods by the judiciary, and the growing knowledge among the general public of the probative value of these methods.

On the other hand, as demonstrated by this research work, the road toward the utilization of DNA and biometric evidence in India that is practical, ethical, and egalitarian is yet not yet complete. The absence of a comprehensive legal framework, the absence of forensic infrastructure, issues regarding privacy, and the possibility of misuse all highlight the urgent need for reform. In spite of the fact that it is a start in the right direction, the DNA Technology (Use and Application) Regulation Bill that is now being presented needs to be changed in order to incorporate more robust data protection methods, enhanced consent protocols, and independent oversight.

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