



Human Embryo Genetic Manipulation from the Point of View of Bioethics and Human Rights

Maryam Afshari ^{1,*}, Zamaneh Shahini ², Mohammad Kordkatouli ^{3,4}

¹ Department of Laws, Dam.C., Islamic Azad University, Damavand, Iran

² Department of Laws, Khas.C., Islamic Azad University, Kish Island, Iran

³ Department of Cell and Molecular Biology, Faculty of Sciences, GO.C, Islamic Azad University, Gorgan, Iran

⁴ Medicinal Plants Research Center, GO.C, Islamic Azad University, Gorgan, Iran

*Corresponding Author: Department of Laws, Dmv.C., Islamic Azad University, Tehran, Iran. Email: maryam.afshari@iau.ac.ir

Received: 21 July, 2025; Revised: 23 July, 2025; Accepted: 25 July, 2025

Abstract

Background: Advancements in human embryo genetic manipulation, including eugenics and modern gene-editing technologies such as CRISPR-Cas9, have created new possibilities for preventing hereditary diseases and improving human health. These technologies enable targeted correction of genetic defects and contribute to understanding complex reproductive and developmental processes. However, they also raise profound ethical, social, and human rights concerns, such as genetic discrimination, violation of human dignity, and unpredictable genomic consequences. Bioethical principles and international human rights instruments provide essential frameworks to ensure the responsible and equitable use of such innovations.

Objectives: This study examines human embryo genetic manipulation from the perspective of bioethics and human rights, identifying its scientific advantages, potential risks, and moral implications. The aim is to explore how technological progress can coexist with respect for fundamental human values, including dignity, equality, and integrity.

Methods: Using a descriptive-analytical and applied research approach, this study reviews key literature on gene editing, preimplantation genetic diagnosis (PGD), and relevant international conventions — including UNESCO's Universal Declaration on the Human Genome and Human Rights and the Oviedo Convention. Ethical, legal, and social aspects are comparatively analyzed to assess the boundaries of responsible scientific practice.

Results: Findings indicate that while genetic manipulation can improve diagnosis, prevent hereditary diseases, and enhance quality of life, it also poses risks of genetic discrimination, unequal access, social exclusion, and violation of human rights. Ethical debates emphasize balancing scientific advancement with the preservation of human dignity and justice.

Conclusions: Human embryo genetic manipulation represents a transformative yet ethically sensitive frontier in medicine. Its responsible application requires strict ethical oversight, legal regulation, public awareness, and international cooperation. Ensuring that such interventions respect human dignity, equality, and fundamental rights is vital for achieving sustainable scientific progress that benefits both present and future generations.

Keywords: Biological Ethics, Genetics, Human Fetus, Human Rights

1. Background

Eugenics, or genetic modification, is a scientific discipline focused on studying and altering the genetic composition of individuals, populations, and species. Often termed applied genetics, this field aims to modify the genetic structure of cells and organisms to improve living conditions and prevent or treat genetic disorders.

Eugenics finds extensive application in medicine, agriculture, industry, and environmental management, enabling precise and desirable genetic changes. This technology has significantly enhanced public health and quality of life across diverse societies. The primary objective of eugenics is to improve the genetic quality of individuals and communities (1).

Preimplantation genetic diagnosis (PGD) is an advanced medical and genetic technology that allows prospective parents to screen embryos for genetic disorders or specific genetic traits prior to implantation. This process enables the selection of healthy embryos, preventing the transmission of genetic diseases to future generations and enhancing the quality of life for offspring. The PGD is particularly beneficial for parents with genetic disorders, couples at high risk of passing on genetic conditions, and those facing fertility challenges.

Bioethics, a relatively new field of ethical inquiry, addresses moral issues arising from advancements in biological sciences, medicine, and cutting-edge technologies. Emerging in recent decades due to rapid progress in these areas, bioethics examines topics such as novel biotechnologies, bioinformatics, genetics, regenerative medicine, stem cell research, diagnosis and treatment of genetic diseases, embryonic research, genetic modifications in embryos, clinical research ethics, medical data privacy, emerging medical technologies, and ethical concerns surrounding human life and death. Bioethics plays a crucial role in establishing ethical guidelines and boundaries in medicine and biological sciences, assisting healthcare professionals, researchers, policymakers, and society in navigating the ethical challenges posed by these fields. It seeks to balance scientific and technological progress with respect for ethical principles and human rights.

The concept of human dignity refers to the inherent respect and worth owed to every individual by virtue of their humanity. This principle holds that all individuals, regardless of gender, race, age, religion, or other characteristics, deserve equal respect and recognition of their intrinsic value and rights. Human dignity is a cornerstone of human rights, ensuring equal treatment and protection without discrimination based on race, gender, religion, or other traits. It underscores the importance of treating all individuals as valued members of society and the global community.

The right to life is a fundamental human right, essential to all individuals without exception. It entails the right to live and the preservation of life. The establishment of human rights organizations in the late 20th century and the adoption of numerous conventions to protect the right to life and human dignity highlight the global significance of this principle. These legal frameworks empower governments to safeguard fundamental human rights and prevent violations of the right to life. By

emphasizing the right to life and human dignity, the international community strives toward equality, justice, and sustainable peace, fostering fair and enduring legal and social structures that advance human ideals.

Following the decoding of the human genome, a new phase of research known as genetic manipulation or genetic engineering emerged. As a key branch of biotechnology, genetic engineering employs various techniques to identify, understand, and manipulate genomes. This technology enables precise modifications to an organism's genetic structure, yielding positive outcomes in agriculture, livestock, medicine, and industry. Through recombinant DNA technology, researchers can identify and alter specific genes, allowing modifications to desired traits in plants, animals, bacteria, and other organisms. These changes enhance agricultural yields, disease resistance, and the efficiency of pharmaceutical and biological product development. Genetic engineering is a powerful tool that enables targeted and precise genomic modifications to address diverse human needs (1).

In parallel with these advancements, the genetic structure of human genes has also been studied and manipulated. Human genetic engineering takes two primary forms: Gene therapy and eugenic enhancement. Gene therapy involves modifying the human genome to prevent or treat specific genetic disorders, such as cystic fibrosis, thalassemia, or metabolic diseases, by correcting faulty biological pathways to alleviate or eliminate disease symptoms. Eugenic enhancement, on the other hand, aims to improve traits such as intelligence, immune system strength, or longevity. While widely used in veterinary and agricultural applications, eugenic enhancement in humans raises significant ethical and legal concerns due to its potential to impact human rights and societal values. Both approaches hold immense potential for improving human health and quality of life but require rigorous ethical and legal scrutiny.

Genetic manipulation in agriculture and livestock plays a vital role in producing higher-quality food and improving animal performance, addressing global food security challenges. However, its application in humans presents numerous ethical, social, cultural, and legal challenges. Successful use of this technology requires thorough examination of ethical considerations, human rights, environmental impacts, societal and cultural effects, individual and societal adaptability, public awareness, and other relevant factors to ensure

its benefits to humanity and society. This study aims to explore human embryo genetic manipulation from the perspectives of bioethics and human rights.

2. Objectives

This study aims to:

- Examine the potential benefits and risks of human embryo genetic manipulation.
- Analyze ethical challenges from the perspective of bioethics.
- Assess human rights implications, including the impact on human dignity, equality, and discrimination.

3. Methods

The study is descriptive-analytical and practical in nature, reviewing literature on genetic manipulation, gene editing technologies, and relevant international ethical and legal frameworks. Data were collected from academic articles, international conventions, and bioethics declarations. The analysis focuses on ethical, legal, and human rights perspectives regarding the manipulation of human embryos.

4. Results

In contemporary times, the global rates of miscarriage and infertility have increased significantly, posing a major challenge to reproductive health. The underlying causes of these trends remain poorly understood, involving a complex interplay of genetic, environmental, and lifestyle factors. Research into genetic manipulation and gene editing offers promising avenues for improving diagnostic and therapeutic methods related to infertility and genetic disorders. Such studies have the potential to deepen our understanding of the intricate mechanisms of human reproduction, enabling the development of more effective preventive and treatment strategies. However, the pursuit of this scientific progress must always be balanced with strict adherence to ethical and legal principles, ensuring full respect for human rights, dignity, and bodily integrity. Any form of genetic manipulation or genome editing must prioritize the well-being and safety of research subjects, minimizing potential harm and ensuring informed consent at all stages. Responsible and ethically guided application of genetic technologies can contribute significantly to scientific and medical progress, ultimately improving both individual health and overall quality of life.

In 2015, Chinese scientists led by Dr. He Jiankui conducted a landmark experiment using CRISPR-Cas9 technology to perform the first genetic manipulation on non-viable human embryos obtained from in vitro fertilization (IVF) procedures. The research aimed to modify genes associated with severe hereditary diseases, marking a major milestone in biomedical science. Despite its potential significance, the experiment sparked widespread ethical controversy across the global scientific community. Critics argued that the procedure was premature, unsafe, and ethically unacceptable, citing concerns over unintended genetic alterations (off-target effects), intergenerational consequences, and violations of human rights and dignity. Nevertheless, this pioneering study demonstrated the enormous potential of CRISPR-Cas9 as a precise and efficient gene-editing tool – provided that it is employed under strict ethical supervision and in compliance with international human rights standards. All embryos used in such research were voluntarily donated by couples with surplus embryos remaining after IVF treatments (2,3).

Following this, British researchers proposed conducting similar studies aimed at disabling specific genes in early-stage human embryos to observe their developmental processes for up to one week, after which the embryos would be ethically destroyed. This approach was intended to enhance understanding of early human embryogenesis and gene function. However, it raised complex ethical, legal, and philosophical questions, particularly concerning the moral status of the embryo, the potential normalization of genetic selection, and the risks of promoting eugenic practices or gender-based manipulation. Thus, researchers and policymakers must ensure that such experiments strictly conform to ethical principles, human rights obligations, and relevant national and international laws, with all research decisions subject to careful review and consultation within scientific and ethical communities (2,3).

Since approximately 2010, gene editing – particularly through CRISPR-Cas9 – has evolved into one of the most powerful and accessible tools in modern biology and medicine. Hundreds of laboratories worldwide now employ this technology for diverse purposes, including genetic research, medical therapy development, molecular biology, and biotechnology. Its simplicity, cost-effectiveness, and precision have revolutionized experimental genetics, allowing scientists to explore gene functions and correct mutations with unprecedented accuracy. However, as this technology

advances, it is crucial to ensure its responsible and ethically sound use, preserving respect for human dignity and human rights in all applications (3).

In practical applications, to disable or modify four specific genes in one-day-old human embryos, researchers may require 20 - 30 embryos per gene to obtain reliable data. This necessity arises from factors such as variability in editing efficiency, genetic diversity among embryos, and the need to minimize potential errors. Ethical and legal oversight is therefore essential to ensure both the scientific validity and moral acceptability of such experiments (3, 4).

The CRISPR-Cas9 system – often referred to as a “molecular scalpel” – represents a groundbreaking advancement in genetic engineering. Inspired by natural bacterial defense mechanisms against viral infections, it utilizes a guide RNA (gRNA) molecule to locate a specific DNA sequence, directing the Cas9 enzyme to make a precise cut at the target site. This allows scientists to remove, insert, or replace defective genes with corrected versions, offering immense potential in gene therapy, disease prevention, and basic biological research.

Beyond human applications, CRISPR-Cas9 has been successfully used in animal models. For instance, in 2015, researchers at Harvard University employed the technique to disable over 60 genes in pig embryos, aiming to make pig organs biologically compatible for human transplantation, thereby addressing global organ shortages (3, 5).

5. Discussion

5.1. Opponents' Views on Human Embryo Cloning

5.1.1. Creation of Defective Humans

Human cloning is a contentious issue, criticized for ethical, scientific, and technical reasons. A major concern is the potential for physical or mental defects in cloned individuals, which could lead to severe human tragedies. Thorough examination of risks and ethical considerations is essential before pursuing human cloning (5).

5.1.2. Use of Cloned Humans as Organ Banks

Proponents of cloning for organ transplantation argue it could improve understanding of bodily responses and enable testing of new transplantation methods. However, ethical challenges include potential

social and cultural disparities and the need to respect the rights and dignity of cloned individuals (6).

5.1.3. Use of Cloned Humans as Modern Slaves

Philosophers like Ryle have depicted cloned beings as powerful entities designed solely for labor, destroyed when no longer needed. This raises ethical concerns about exploitation, the denial of rights, and the power dynamics between humans and cloned beings (7).

5.1.4. Identity and Individuality Issues

Cloned children may face significant identity crises due to their genetic similarity to their source, challenging their sense of individuality (7).

5.1.5. Concerns About Human Manufacturing

Cloned children risk being viewed as products of a manufacturing process rather than unique beings, potentially leading to the commercialization of human creation (7).

5.1.6. Eugenic Enhancement Through Cloning

Cloning for eugenic purposes raises ethical concerns, including preventing genetic defects, preserving specific traits, and ensuring ethical and human-centered approaches to avoid unintended societal consequences (4).

5.1.7. Impact on Family Relationships

Cloning could alter familial dynamics, such as creating genetic twins, leading to ethical questions about psychological, social, and familial impacts (4).

5.1.8. Societal Impacts

Cloning may influence societal perceptions of children, potentially commodifying human life (4).

5.1.9. Ethical Issues with Cloned Embryos

Some argue that ethical considerations for early-stage embryos differ from those for mature humans, though this depends on philosophical, religious, or cultural perspectives (8).

5.1.10. Exploitation of Developing Life

Creating embryos solely for research, which involves their intentional destruction, crosses ethical boundaries, reducing humans to mere tools (8).

5.1.11. Ethical Harm to Society

Cloning risks normalizing non-sexual reproduction, enabling further ethical violations, and placing governments in the difficult position of sanctioning embryo destruction (8).

5.1.12. Undermining Human Dignity

Respecting human dignity requires fostering values like honesty, courage, and empathy in children, ensuring they grow into responsible citizens without harming others (8).

5.2. Proponents' Views on Human Embryo Cloning

5.2.1. Ethical Evaluation in Biomedical Research

Cloning for biomedical research could improve treatments and deepen understanding of embryonic development and gene functions. However, it raises complex ethical issues, requiring respect for human rights, privacy, informed consent, and animal welfare (9).

5.2.2. Intermediate Ethical Status

Some argue that early-stage embryos do not carry the same ethical weight as fully developed humans, potentially justifying their use in research under strict regulations. Others maintain that embryos deserve respect as entities with inherent rights (9).

5.2.3. Serving Life

Using cloned embryos for medical research could advance treatments and drug development, provided ethical principles and regulations are upheld (9).

5.2.4. Use of Early-Stage Embryos

Employing embryos within the first 14 days, before organ differentiation, may mitigate ethical concerns, though adherence to ethical and legal standards remains essential (9).

5.2.5. Cell Regeneration

Cloning and cellular modeling can regenerate damaged cells, aiding tissue repair and advancing medical and biotechnological applications, provided ethical standards are met (10).

5.2.6. Organ Transplantation

Cloning could enable the creation of transplantable organs, addressing organ shortages (10).

5.2.7. Cell Differentiation and Cloning Technology

Cloning facilitates simultaneous studies of cell differentiation and genetic technologies, advancing scientific understanding (10).

5.3. Perspectives on Genetic Enhancement

Opponents of genetic enhancement highlight several concerns.

5.3.1. Potential Harm

Human traits like intelligence, personality, and creativity result from complex gene-environment interactions. Genetic modifications may lead to unintended consequences, such as unpredictable mutations or adverse biological effects. For example, transgenic animal studies, like those in pigs, have shown weakened or sterile outcomes, while enhanced memory in mice increased pain sensitivity (11-13).

5.3.2. Use of Viral Vectors

Viruses used to deliver new genes can cause uncontrolled cell growth, leading to tumors or other health risks (11).

5.3.3. Psychological and Spiritual Harm

Genetic enhancements may disrupt natural human balance, causing psychological distress or unintended consequences like increased disease risk (13).

5.3.4. Alteration of Human Nature

Rapid genetic changes could lead to identity crises, loss of human character through reduced physical or psychological challenges, or altered perceptions of life's meaning due to extended lifespans (14).

5.3.5. Conflict with Divine Will

Some religious perspectives view genetic enhancement as contrary to divine intent, arguing that humans should respect their natural, God-given state (13, 15-17).

5.3.6. Risk of Abuse

Genetic enhancement could exacerbate social inequalities, enable governmental misuse for military

or political purposes, or lead to unintended societal changes like discrimination (18).

5.3.7. *Undermining Human Dignity*

Treating humans as programmable objects risks reducing their intrinsic worth, violating the principle of human dignity as recognized in international documents and religious teachings (18-21).

5.3.8. *Lack of Necessity*

Enhancements like increased height may not address genuine human needs, potentially leading to societal pressures and wasted resources without tangible benefits (13, 22).

Proponents of genetic enhancement argue that enhancements like increased intelligence or cognitive abilities could significantly improve quality of life and societal welfare, provided ethical and legal safeguards are in place (13).

5.4. *Human Rights and Genome Editing*

5.4.1. *Human Dignity*

As a fundamental pillar of human rights, the concept of human dignity lies at the heart of ethical debates surrounding genome editing. According to UNESCO's Universal Declaration on the Human Genome and Human Rights, genetic research must always uphold the inherent dignity of the human person, ensuring that scientific progress does not compromise respect for human life and identity. Genetic diversity, far from diminishing human worth, enriches the shared heritage of humanity. Therefore, all individuals – regardless of their genetic composition – are entitled to equal respect and protection. Genome editing must never be pursued solely for scientific or economic gain but should always prioritize human welfare, justice, and ethical responsibility (1, 23-34).

5.4.2. *Right to Bodily Integrity*

The right to bodily integrity, enshrined in multiple international human rights instruments, safeguards individuals against involuntary biological or medical interventions. In the context of genome editing, particularly involving embryos or germline modifications, this right becomes highly contested. Such interventions raise ethical questions regarding consent, autonomy, and the rights of future generations who cannot express consent for genetic alterations that

may permanently affect them. Balancing the potential benefits of genetic advances with the obligation to prevent harm remains one of the central ethical dilemmas in modern biomedicine (31, 35, 36).

5.4.3. *Right to Life*

The right to life represents the most fundamental and universally recognized human right. In discussions of genome editing, this right introduces complex moral and legal questions – particularly concerning the beginning of life and the moral status of embryos. While some ethical frameworks argue that embryos deserve full protection as potential human beings, others view them as biological entities without personhood status. Debates continue over how far genome editing should be permitted in early human development, especially when such interventions might endanger embryonic life or lead to unintended genetic consequences (37-39).

5.5. *Modern Eugenics, Genetic Engineering, and Ethical Revolution*

Since the 1980s, rapid advances in genetic science have reignited philosophical and ethical discussions on human genetic modification. The completion of the human genome project and the emergence of gene-editing technologies such as CRISPR-Cas9 have transformed societal perceptions of genetics and biotechnology. These developments have blurred the boundary between therapy and enhancement, raising questions about what constitutes ethical use of genetic knowledge. Societal, cultural, and religious values strongly influence attitudes toward genetic modification. Many ethical and theological perspectives emphasize that humans should respect their natural, God-given state, cautioning against attempts to redesign human nature (13, 15-17, 40).

5.5.1. *Risk of Abuse*

The potential misuse of genetic enhancement poses significant ethical and social risks. Such technologies could deepen existing social inequalities, enable governmental or military exploitation, or create new forms of genetic discrimination. History has shown that unchecked eugenic ideologies can lead to violations of human rights and dignity (18).

5.5.2. *Undermining Human Dignity*

Treating human beings as programmable biological objects rather than as moral and autonomous persons

fundamentally undermines human dignity. This approach conflicts with the ethical principles established in international human rights documents and religious teachings, which affirm the intrinsic worth of every individual (18-21).

5.5.3. Lack of Necessity

Certain proposed genetic enhancements – such as height, eye color, or superficial traits – do not address genuine medical needs. These interventions risk promoting social pressure, consumer-driven genetics, and wasteful use of scientific resources, with minimal contribution to human welfare or equality (13, 22).

5.6. Bioethics in the Human Rights Council

Ongoing progress in biology, medicine, and genetics underscores the necessity of clear ethical guidelines and legal frameworks to prevent misuse of biological information and to safeguard human dignity. The United Nations' Universal Declaration on Bioethics and Human Rights highlights principles such as non-discrimination, informed consent, privacy, and transparency in genetic research. States and scientific institutions share the responsibility to ensure equitable access to the benefits of biotechnology, protect personal genetic data, and uphold ethical standards in both research and clinical practice. Effective governance must balance innovation with respect for individual rights and moral integrity (41-43).

5.7. Biotechnology, Human Genetics, and the Right to Health

Key international instruments – such as UNESCO's Universal Declaration on the Human Genome and Human Rights and the Oviedo Convention – affirm that all genetic and biotechnological advancements must primarily serve the promotion of human health. Governments have a moral and legal duty to guarantee equitable access to genetic testing, personalized medicine, and therapeutic innovations, ensuring that such services are available without discrimination based on socioeconomic status, ethnicity, or genetic traits. Protecting patient privacy and ensuring informed consent remain cornerstones of ethical biomedical practice. Moreover, genetic technologies must never be used in ways that compromise human rights, equality, or dignity. By aligning biotechnological progress with universal human rights standards, societies can foster scientific innovation while preserving the ethical values that define humanity (44-54).

5.8. Conclusions

Human embryo genetic manipulation, enabled by technologies like CRISPR-Cas9, offers potential benefits such as preventing genetic diseases and improving quality of life. However, it raises significant ethical and human rights challenges, including:

- Benefits: Preventing genetic disorders and enhancing quality of life.
- Challenges: Risks of genetic discrimination, social rejection, unstable genetic changes, and violations of human rights, including gender-based discrimination.

From a bioethics perspective, genetic manipulation may lead to unintended genetic changes or societal inequalities. From a human rights perspective, it risks creating unjust disparities and undermining women's rights. Thus, human embryo genetic manipulation must be conducted with strict adherence to ethical principles and human rights to ensure its benefits outweigh its risks.

Footnotes

Authors' Contribution: Study concept and design: M. A.; Acquisition of data: M. K. and Z. S.; Analysis and interpretation of data: M. A., M. K., and Z. S.; Drafting of the manuscript: M. K. and Z. S.; Critical revision of the manuscript for important intellectual content: M. A.; Statistical analysis: M. A., M. K., and Z. S.; Administrative, technical, and material support: M. A., M. K., and Z. S.; Study supervision: M. A.

Conflict of Interests Statement: The authors declare no conflict of interests.

Data Availability: The dataset presented in this study is available from the corresponding author upon reasonable request during submission or after publication. The data are not publicly available due to privacy/ethical restrictions or institutional regulations.

Funding/Support: The present study received no funding/support.

References

1. United Nations Educational. *Universal Declaration on the Human Genome and Human Rights*. Paris, France: United Nations Educational, Scientific and Cultural Organization; 1997. Available from: <http://www.unhcr.org/refworld/docid/404226144.html>.
2. Rafiei MR, Kalhor HR, Marandi SM, Moula SJ. [Strategies for reprogramming of adult cells: from nuclear transfer to induction of

- pluripotency using specific transcription factors]. *Pathobiol Res (Modares J Med Sci)*. 2008;**10**(3-4):19-30. FA.
3. Naderi M, Zamani SG. [Human genome modification from a human-rights perspective]. *Public Law Stud Q*. 2024;**54**(2). FA. <https://doi.org/10.22059/JPLSQ.2021.314750.2648>.
 4. Ghafoori F, Vedadhir A, Golian Tehrani S. [Ethical Issues of Embryo Genetic Manipulation]. *Med Ethics*. 2016;**10**(36):35-45. FA. <https://doi.org/10.21859/mej-103635>.
 5. Esfandani S, Emam M, Nosrat Kharazmi H. [The study of soul in human cloning]. *Relig Anthropol*. 2015;**12**(33).
 6. A'lamolhoda M. [Legal challenges of pre-implantation genetic diagnosis of embryos from the perspective of international human rights law and Islamic jurisprudence (Thesis)]. Qom, Iran: University of Qom; 2013. FA.
 7. Allison L. *Fundamental molecular biology*. 1st ed. Malden, USA: Wiley-Blackwell; 2007. p. 30-5.
 8. Basrur PK, Stranzinger G. Veterinary cytogenetics: past and perspective. *Cytogenet Genome Res*. 2008;**120**(1-2):11-25. [PubMed ID: 18467822]. <https://doi.org/10.1159/000118737>.
 9. Alidoosti M, Mardani F. [Responsibility of medical team towards human embryo cloning]. *Iran J Forensic Med*. 2014;**20**(2). FA.
 10. Aghayan HR, Arjmand B. [Human cloning: history and religious perspective]. *Ethics Med*. 2023;**3**. FA.
 11. Dabiri H. [Genetic revolution]. Tehran, Iran: Fan va Honar Cultural and Publishing Institute; 2019. FA.
 12. Boroujeni SV, Ronaghi M. [Introduction to genetic engineering]. Iran, Isfahan: University of Isfahan Press; 2013. FA.
 13. Vidalis T. Genome Editing in Human Gametes and Embryos: The Legal Dimension in Europe. *BioTech*. 2022;**12**(1). [PubMed ID: 36648827]. [PubMed Central ID: PMC9844473]. <https://doi.org/10.3390/biotech12010001>.
 14. Ghaffari SR, Rafati M. [Enhancing human capabilities: genetics - law, ethics, psychology]. 1st ed. Tehran, Iran: Avicenna Research Institute, ACECR; 2010. FA.
 15. Behzadi AS. [Playing God]. 2nd ed. Tehran, Iran: Ney Publishing; 2018. FA.
 16. Rahnama H. [Introduction to bioethics]. 1st ed. Tehran, Iran: Avicenna Research Institute, ACECR; 2009. FA.
 17. Coady CAJ. Playing God. In: Wong J, Tong RK, editors. *Human Enhancement*. 2009. p. 155-80. <https://doi.org/10.1093/oso/9780199299720.003.0008>.
 18. Nobahar R. [International Declaration on Human Genetic Data: Concerns, Approaches, and Its Compatibilities with Islamic Perspectives]. *J Comp Law*. 2005;**0**(7):61-98. FA.
 19. Makarem Shirazi. [Surah Al-Isra, 17:70]. *The Holy Qur'an*. Qom, Iran: Office of Islamic History and Education Studies; 1994. FA.
 20. Fayz Kashani MM. [Rasa'il Fayz Kashani]. 2. Tehran, Iran: Shahid Motahari Higher Education Institute; 2008. 31 p. FA.
 21. Makarem Shirazi. [Surah Al-Mu'minun, 23:14]. *The Holy Qur'an*. Qom, Iran: Office of Islamic History and Education Studies; 1994. FA.
 22. Jafari MT. [The human genome project]. 1st ed. Tehran, Iran: Institute for Compilation and Publication of Allameh Jafari's Works; 2002. FA.
 23. United Nations Educational. *Universal Declaration on the Human Genome and Human Rights*. Geneva, Switzerland: United Nations Educational, Scientific and Cultural Organization; 1997. Available from: <https://www.unesco.org/en/legal-affairs/universal-declaration-human-genome-and-human-rights>.
 24. United Nations Educational. *Universal Declaration on the Human Genome and Human Rights*. Geneva, Switzerland: United Nations Educational, Scientific and Cultural Organization; 1997. Available from: <https://www.unesco.org/en/ethics-science-technology/human-genome-and-human-rights>.
 25. United Nations Educational. *Declaration on Science and the Use of Scientific Knowledge*. Geneva, Switzerland: United Nations Educational, Scientific and Cultural Organization; 1999. Available from: <https://unesdoc.unesco.org/ark:/48223/pf0000116994>.
 26. World Health Organization. *Declaration of Alma-Ata International Conference on Primary Health Care*. Geneva, Switzerland: World Health Organization; 1978. Available from: <https://www.who.int/publications-detail-redirect/declaration-of-alma-ata>.
 27. United Nations Educational. *Universal Declaration on Bioethics and Human Rights*. Paris, France: United Nations Educational, Scientific and Cultural Organization; 2006. Available from: <https://unesdoc.unesco.org/ark:/48223/pf0000146180>.
 28. United Nations Educational. *Universal Declaration on Bioethics and Human Rights*. Paris, France: United Nations Educational, Scientific and Cultural Organization; 2006. Available from: <https://unesdoc.unesco.org/ark:/48223/pf0000146180>.
 29. United Nations Educational. *Universal Declaration on Bioethics and Human Rights*. Paris, France: United Nations Educational, Scientific and Cultural Organization; 2006. Available from: <https://www.unesco.org/en/ethics-science-technology/bioethics-and-human-rights>.
 30. European Union. *Commentary of the Charter of Fundamental Rights of the European Union*. Brussels, Belgium: European Union; 2006. Available from: [efaidnbmnnpbpcjpcgclefindmkaj/https://sites.uclouvain.be/cridh/o/documents/Download.Rep/NetworkCommentaryFinal.pdf](https://sites.uclouvain.be/cridh/o/documents/Download.Rep/NetworkCommentaryFinal.pdf).
 31. Federal Constitutional Court of Germany. *Abortion Decision, BVerfGE 88-203*. Karlsruhe, Germany: Federal Constitutional Court; 1993. Available from: https://www.bundesverfassungsgericht.de/SharedDocs/Entscheidungen/EN/1993/05/fs19930528_2bvf000290en.html.
 32. Federal Constitutional Court of Germany. *Abortion Decision, BVerfGE 39-1*. Karlsruhe, Germany: Federal Constitutional Court; 1975. Available from: https://www.bundesverfassungsgericht.de/SharedDocs/Entscheidungen/EN/1975/02/fs19750225_1bvf000174en.html.
 33. Viljoen F, Odinkalu C, Anselm. *The prohibition of torture and ill-treatment in the African human rights system: a handbook for victims and their advocates*. Geneva, Switzerland: World Organisation Against Torture; 2006.
 34. Abtahi H, Webb P. *The Genocide Convention: The Travaux Préparatoires (2 vols)*. Leiden, Netherlands: Martinus Nijhoff Publishers; 2008. <https://doi.org/10.1163/ej.9789004164185.i-2236>.
 35. Triffterer O, Ambos K. *The Rome Statute of the International Criminal Court*. Munchen, Germany: Verlag C. H. Beck oHG; 2016. <https://doi.org/10.5771/9783845263571>.
 36. Javid E, Niavarani S. [The Scope of The Right to Health in International Human Rights Law]. *Public Law Res*. 2014;**15**(41):47-70. FA.
 37. Babaei N, Zamani G. [Right to life in the light of the meaning of life: possible or impossible]. *Public Law Stud Q*. 2021;**51**(3). FA. <https://doi.org/10.22059/jplsq.2018.237622.1545>.
 38. Mohammadi Alamooti M, Jalali M, Shoushtari M. [Islam and international law of human rights on the right for life and opposing it]. *Relig Anthropol*. 2017;**14**(37):143-65. FA. <https://doi.org/10.22034/ra.2017.27739>.
 39. Cattell RB. *Beyondism: religion from science*. New York, USA: Praeger; 1987.

40. Brownlie I. *Basic documents on human rights*. 3rd ed. Oxford, UK: Clarendon;1992.
41. Ghorbannia N. [Considerations on Universal Declaration on Bioethics and Human Rights]. *Ethics Sci Technol*. 2009;**4**(1-2):131-9. FA.
42. Marks S. Tying Prometheus Down: The International Law of Human Genetic Manipulation. *Chi J Int L*. 2002;**3**(1):115-36.
43. Yamin A. Not Just a Tragedy: Access to Medications As a Right Under International Law. *Boston Univ Int Law J*. 2003;**21**:325-7.
44. Council of E. Convention for Protection of Human Rights and Dignity of the Human Being with Regard to the Application of Biology and Biomedicine: Convention of Human Rights and Biomedicine. *Kennedy Inst Ethics J*. 1997;**7**(3):277-90. [PubMed ID: 11660359]. <https://doi.org/10.1353/ken.1997.0021>.
45. Nyrhinen T, Hietala M, Puukka P, Leino-Kilpi H. Privacy and equality in diagnostic genetic testing. *Nurs Ethics*. 2007;**14**(3):295-308. [PubMed ID: 17459814]. <https://doi.org/10.1177/0969733007075864>.
46. Balding DJ, Bishop M, Cannings C. *Handbook of Statistical Genetics*. Chichester, UK: John Wiley and Sons; 2007. <https://doi.org/10.1002/9780470061619>.
47. Brown K. Genetic counseling: legal issues surrounding nondisclosure of paternity. *J Leg Med*. 2008;**29**(3):345-61. [PubMed ID: 18726759]. <https://doi.org/10.1080/01947640802297587>.
48. Spector-Bagdady K, Prince AER, Yu JH, Appelbaum PS. Analysis of state laws on informed consent for clinical genetic testing in the era of genomic sequencing. *Am J Med Genet C Semin Med Genet*. 2018;**178**(1):81-8. [PubMed ID: 29566453]. [PubMed Central ID: PMC5994926]. <https://doi.org/10.1002/ajmg.c.31608>.
49. Klein E. Human Dignity in German Law. In: Kretzmer D, Klein E, editors. *The Concept of Human Dignity in Human Rights Discourse*. Leiden, Netherlands: Martinus Nijhoff Publishers; 2001. p. 145-59. https://doi.org/10.1163/9789004478190_011.
50. Burke K, Clarke A. The challenge of consent in clinical genome-wide testing. *Arch Dis Child*. 2016;**101**(11):1048-52. [PubMed ID: 27127186]. <https://doi.org/10.1136/archdischild-2013-304109>.
51. Council of Europe. *Additional Protocol to the Convention on Human Rights and Biomedicine, concerning Genetic Testing for Health Purposes*. Strasbourg, France: Council of Europe; 2008. Available from: [efaidnbmnnnibpajpcglclefindmkaj/https://rm.coe.int/1680084824](https://rm.coe.int/1680084824).
52. Motaghi S, Seifi A, Doroudian M. [The Nature of the Right to Health and The Situation of The Government in Its]. *Islamic Law Res J*. 2018;**18**(2):123-48. FA.
53. World Health Organization. *Laboratory biosafety manual*. Geneva, Switzerland: World Health Organization; 2004. Available from: <https://www.who.int/publications/i/item/9241546506>.
54. Council of Europe. *Report on Human Artificial Procreation: Principles set out in the report of the Ad Hoc Committee of Experts on Progress in the Biomedical Sciences (CAHBI)*. Strasbourg, France: Council of Europe; 1989. Available from: <https://rm.coe.int/16803113e4>.