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Powering Eugenics through Stem Cell Research

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Abstract:
The field of stem cell research holds immense potential for medical advancements and the treatment of various diseases. The connection between stem cell research and eugenics, the deliberate selection and manipulation of genetic traits in human beings, opens vast avenues. Stem cell research has opened up new and exciting avenues for scientific inquiry, with the potential to cure and treat a range of diseases and conditions. In this paper, we explore the intersection of stem cell research and eugenics. We will examine the evolution of eugenics as well as the ways in which stem cell research can be used to further it. By exploring the connection between stem cell research and eugenics, we hope to create a new form of ethics in this rapidly advancing field. Miscegenation, on the other hand, has hindered evolutionary progress, and science must focus on advancing human evolution via eugenics.

Key Words*: Eugenics, Stem Cell, In Vitro Gametogenesis, In-vitro Fertilisation (IVF), Preimplantation Genetic Diagnosis (PGD), CRISPR-Cas9*

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I. Introduction:

Eugenics is a historical concept that has evolved over time. It is the name given to all prospective studies and purposes to improve, cure and create a race that would be exempt from various diseases and disabilities. The eugenics movement in California in the last century was characterised by sterilisation of those who were deemed unfit or undesirable [1][2]. Historians are drawing connections between the contemporary debate over human embryonic stem cell research and eugenics movements [1]. The old eugenicists' goal was to make humans fit their desired characteristics[2]. However, we take this definition further and extend it towards creating a new race of Ubermensch population.

Over time, the eugenic dream has persisted, with modern eugenicists advocating for reproductive technologies for "liberal eugenics" to allow prospective parents to select improvements for their children [2]. Adolf Hitler gave considerate insights into the notion of creating a "master race" associated with eugenics as well [1]. The history of eugenics has evolved from grandiose projects of transforming the human species to a technocratic set of market-oriented reforms to human reproductive choices [2].

However, it is imperative that we envision the creation of a creed centred on principles of honour, courage, and the pursuit of excellence. This vision entails the transformation of a warrior people through the influence of a stratocratic eugenic state, instilling within them an impassioned dedication to a new eternal mission. It represents a conflict between those who embody beauty, nobility, and truth, the Sons of the Sun and those who are considered hideous and malformed. Historically, these individuals have sought to overthrow the constraints imposed by natural selection through the false notion of humanism whose ultimate goal is the subversion of natural order. But, through eugenics, beauty shall prevail while those deemed dysgenic and deranged will be marginalised from the gene pool.

Prominent biologist Julian S. Huxley too had written about eugenics as a means to improve society by selectively breeding individuals with desirable traits. Huxley argued that by applying scientific principles to human reproduction, society could eliminate undesirable traits and promote desirable ones. He emphasised the importance of selective breeding to enhance human intelligence, physical health, and moral character. Huxley believed that through eugenics, society could achieve progress by producing a more intelligent, healthier, and morally superior population. [17]

II. Methods, Research and Discussion

Recent scientific developments suggest that it may soon be possible to create viable human gametes, such as sperm and eggs, from human stem cells. This technology, known as in vitro gametogenesis (IVG), has the potential to enable what some researchers call "in vitro eugenics." In vitro eugenics involves deliberately breeding human beings in a laboratory setting by fusing sperm and eggs derived from different stem cell lines to

create embryos, from which new gametes can be derived. This process could be repeated across multiple generations in the laboratory, allowing scientists to study the heredity of genetic disorders and produce cell lines with desired traits for medical applications.

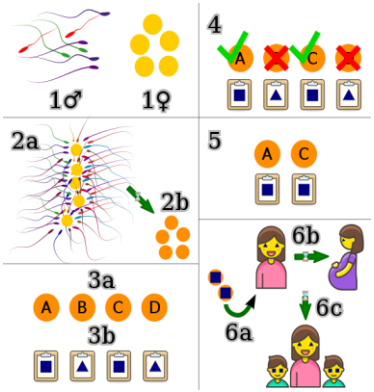
In Vitro Eugenics could be a valuable tool for studying genetic disorders and developing targeted therapies. However, the potential for using this technology for human enhancement, where individuals are selectively bred to possess desired genotypes, is vast. It would create a hierarchy of value among humans based on genetic traits, leading to the highest expression of human life. Repeated iterations of this process would allow scientists to proceed through multiple human generations in the laboratory. It may function as a powerful technology of 'human enhancement' by allowing researchers to use all the techniques of selective breeding to produce individuals with a desired genotype.

The use of stem cell research in furthering eugenic goals has become a topic of enthusiasm. One way in which this is happening is through artificial selection on generations of embryos for traits like intelligence, which is a form of in vitro eugenics [2]. Stem cell research could also be used to select against embryos with potentially cancer-causing variants in the genes that are known to cause cancer, leading to "iterated embryo selection" [2]. However, this process could inadvertently increase the chances that a person develops cancer in the future, as it will eliminate much-needed genetic diversity. Furthermore, reproduction may become more like a manufacturing process with a larger number of embryos subjected to quality control and selection, leading to the discarding of defective or undesirable embryos [2]. If stem cell-derived gametes are used for human reproduction, it may lead to more extreme aspects of IVF, such as "in vitro eugenics" [2]. This technology can function as a powerful tool of human enhancement by allowing researchers to use all the techniques of selective breeding to produce individuals with a desired genotype. In vitro eugenics involves deliberate breeding of human beings in vitro by fusing sperm and egg derived from different stem-cell lines to create an embryo and then deriving new gametes from stem cells derived from that embryo. This process can be used to study the heredity of genetic disorders and to produce cell lines of desired character for medical applications [3]. The potential of stem cell research to enable in vitro eugenics is concerning because this radical change in human procreation is being left up to scientists and professional ethicists rather than elected representatives. Moreover, if stem cell-derived gametes are found to be safe, the FDA may not have the authority to prohibit in vitro eugenics, leading to further ethical dilemmas and violations of human rights [2].

One potential use of in vitro eugenics is to study the heredity of genetic disorders and produce cell lines with desired traits for medical purposes [3]. The use of stem cell-derived human gametes could lead to "in vitro eugenics," where humans are deliberately bred for certain traits, such as intelligence [5][6][2]. Moreover, researchers have proposed using stem cell-derived gametes as part of a strategy to conduct eugenic selection for intelligence over dozens or hundreds of generations [9].

This can include techniques such as in-vitro fertilisation (IVF), preimplantation genetic diagnosis (PGD), and gene editing technologies like CRISPR-Cas9 [10].

IVF involves the fertilisation of an egg with sperm outside of the body, and the resulting embryo is then implanted into the uterus. This technique can be used to screen for genetic disorders and select embryos with desired traits.



1♂□—Sperm is collected from a male.
1♀□—Eggs are collected via in vitro fertilisation from a female.
2a—The sperm and eggs are fertilised.
2b—The resulting embryos are kept safe and watched to see which will thrive.
3a—The embryos are allowed to develop; those that thrive are given identifiers.
3b—A genetic test is run on each embryo for a given trait and the results are matched with the embryos.
4—The embryos without the desired trait are identified and discarded.
5—The remaining embryos are allowed to grow to the point that they can be implanted.

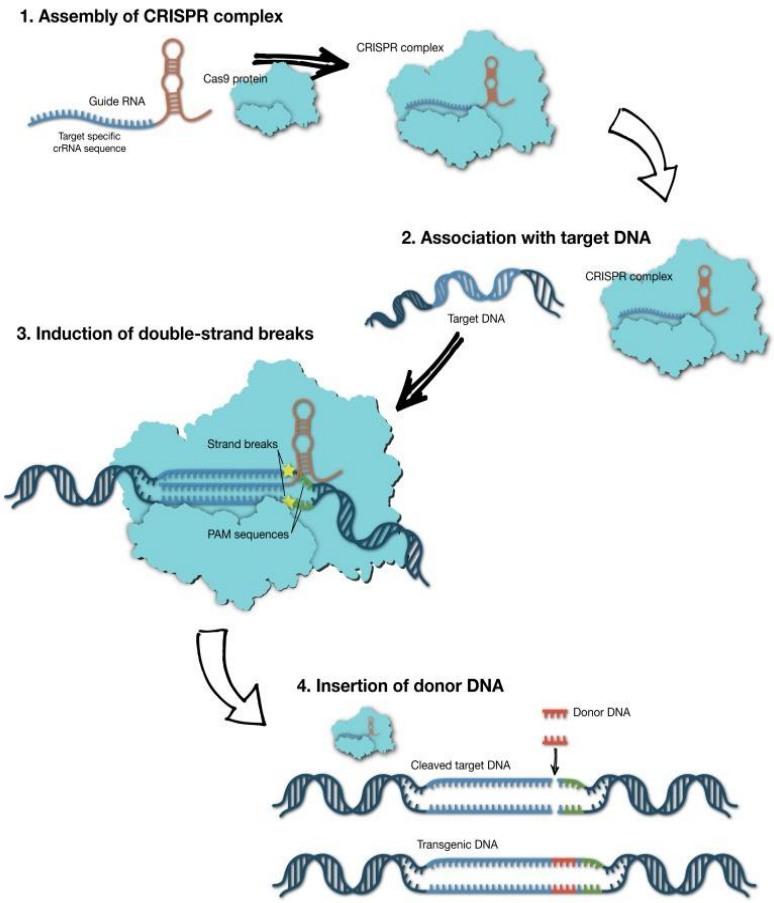
6a—The embryos with the desired trait are implanted.
6b—The embryos result in a healthy pregnancy.
6c—Fraternal twins with the desired trait, not expressed in their mother, are born.

Preimplantation Genetic Diagnosis (PGD) is an integral technique employed in the context of In Vitro Fertilisation (IVF) to meticulously screen embryos for genetic diseases or chromosomal abnormalities prior to their implantation. This method facilitates the careful selection of embryos that are devoid of specific genetic conditions. PGD encompasses three distinct types: PGTa involves screening embryos for aneuploidy, PGTm is applied when one or both genetic parents have a known genetic abnormality, and PGTsr focuses on screening for structural rearrangements of chromosomes like balanced translocations[11].

The significance of PGD lies in its exclusive transfer of unaffected embryos to the uterus for implantation, offering the sole method for pre-pregnancy embryo screening. This serves as an alternative to postconception diagnostic procedures like amniocentesis or chorionic villus sampling, which often prompt challenging decisions regarding the pregnancy's disposition. PGD presently stands as the sole option for averting a high risk of having a genetically affected child before implantation, presenting an appealing means of preventing heritable genetic diseases and eliminating the predicament of pregnancy termination after an unfavourable prenatal diagnosis.

PGTa, a component of PGD, facilitates enhanced embryo selection, thereby improving implantation rates and reducing miscarriage rates with single embryo transfer. Technological advancements in embryo culture, blastocyst biopsy techniques, and screening platforms for 24-chromosome aneuploidy have rendered PGD safe and accessible for all individuals undergoing IVF. The contemporary approach to IVF involves blastocyst culture and biopsy followed by PGD, culminating in a single embryo transfer.

Gene editing technologies like CRISPR-Cas9 allow for precise modification of genes within embryos, potentially allowing for the correction of genetic disorders or the introduction of desired traits. The system is made up of two key parts: a CRISPR-associated (Cas) nuclease, which binds and cuts DNA, and a guide RNA sequence (gRNA), which directs the Cas nuclease to its target. It was discovered in bacterial immune systems, where it cuts the DNA of invading viruses, called bacteriophage, and disables them.



The CRISPR system serves as the foundation of adaptive immunity in bacteria and archaea, employing Cas nucleases, which are enzymes capable of binding and creating double-stranded breaks (DSBs) in DNA. When a bacterium faces viral infection, a Cas nuclease snips off a portion of viral DNA, known as a protospacer, and integrates it into the bacterial genome, forming an immune memory. These viral spacer fragments are arranged between repeated palindromic sequences, giving rise to the term CRISPR.[12]

Upon subsequent infection by the same virus, the bacterium can recognize and neutralise it using Cas9. Cas9 relies on a CRISPR RNA (crRNA) and a trans-activating CRISPR RNA (tracrRNA), forming a guide RNA (gRNA). Cas9 acts as scissors, directed by the gRNA to cut the target DNA. The process involves a search for the protospacer adjacent motif (PAM) and, upon recognition, Cas9 creates a DSB, incapacitating the virus lacking DNA repair mechanisms.

Drs. Doudna and Charpentier unveiled the molecular mechanism behind CRISPR-Cas9's DNA-cutting ability, leading to groundbreaking results. The natural gRNA complex was engineered into a chimeric single guide RNA (sgRNA), enabling a simple and cost-effective genetic manipulation method. By providing a different guide RNA, generated with relative ease, Cas9 could be employed to create cuts at various target sites in any organism's DNA.

CRISPR-Cas9 gene editing induces DSBs in DNA, leveraging cellular DNA repair pathways, primarily non-homologous end joining (NHEJ) for gene knockout (KO) and homology-directed repair (HDR) for gene knock-in (KI). Gene knockouts result in non-functional genes, while gene knock-ins involve inserting new genes or genetic material, offering breakthroughs in biotechnology, disease modelling, and therapeutic applications.[13] Compared to gene knockouts, gene knock-ins present challenges due to the less common HDR repair pathway. Overcoming this obstacle involves experimental optimization, cell cycle synchronisation, and treatments enhancing HDR or disabling NHEJ. CRISPR-Cas9 is versatile, facilitating gene deletion (KO), insertion (KI), activation (CRISPRa), interference (CRISPRi), and offering powerful tools for diverse research applications in genetics.

The development of programmable site-specific nucleases, including the zinc-finger nuclease (ZFN)[14], transcription activator-like effector nucleases (TALENs)[15], and the CRISPR/Cas9 system[16] has improved gene editing efficiency in human ESCs and iPSCs substantially by inducing DNA double-strand breaks at the site of gene modification. The CRISPR/Cas9 technology in particular has attracted much attention and gained wide usage in gene editing of human ESCs and iPSCs due to its simplicity in design and ease of use. This gene editing technology allows researchers to introduce disease-causing mutations to WT iPSCs and eliminate such mutations in patient iPSCs to create isogenic controls for iPSC-based disease modelling.

The Hardy-Weinberg formula indicated that more than ten percent of the population carried the gene for feeblemindedness. With G. H. Hardy's help, he also estimated the rate at which a population could be freed from mental defects by segregating or sterilising the affected. Even under the unrealistic assumption that all the feebleminded could be prevented from breeding, it would take more than 8000 years before their numbers were reduced to 1 in 100,000. Even under Punnett's assumptions of a single gene for mental defect and of random mating, substantial progress could be achieved in the first few generations if affected individuals were prevented from breeding. In the first generation alone, the reduction would be more than 11 percent. [18] We believe that in the East and Global South, this may take even more time. By 2100, the prevailingly onerous African population is set to breach the 4.2 billion mark [19], which is an alarmingly ominous statistic for the civilised world. Thus it may be noted that advancing this novel concept of new eugenics cannot be fully materialised unless it is substituted by a robust sterilisation mechanism. And considering the observations of Punnet, it gives us more impetus to embark upon this project if civilizations and the human race are to thrive.

Additionally, this new eugenics project would propose that the unique genetic information of every human being be stored in secure databases and selections be made on the relation amongst them, further charting multiple relational databases wherein 'favourable' traits are observed and selected. A probability distribution table is thus obtained, furnishing the most probable phenotypes of upcoming progeny for a number of upcoming generations, from which selections on the basis of 'favourable' phenotypes, resolving outbreeding depression and even disease mitigation can be made. This project shall help overcome the most prominent predicament of Punnet's research and correct evolutionary progress by addressing the core concerns of miscegenation. As scientists make greater advancements into stem-cell research, it provides broader inspiration to man in realising these prospects.

Disclosure Statement

No potential conflict of interest was declared by the authors.

Data Availability

The data that support the findings of this study are available from the corresponding author upon request.

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