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Designer Babies are No Longer Science Fiction: What are The Ethical Considerations?

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Abstract

Designer babies, a concept once relegated to science fiction, are now a burgeoning topic of discussion and exploration in genetics and bioethics. This paper provides a comprehensive overview of the designer baby phenomenon, examining its definition and evolution from cinematic fantasy to scientific possibility. We delve into the intricate mechanisms behind designer babies, shedding light on the genetic engineering technologies, particularly CRISPR, that underpin this concept. While these technologies hold immense promise, they are still nascent, awaiting rigorous development and ethical scrutiny. The paper highlights the current state of designer baby research, emphasising that successful implementations on human subjects remained unverified as of its writing. Notably, we recount the controversial case of He Jiankui, whose unapproved and ethically questionable experimentation with CRISPR on embryos in China sent shockwaves through the scientific community. The arguments surrounding designer babies are dissected, presenting both proponents' views, such as the potential to eradicate genetic diseases and enhance human potential, and critics' concerns about ethical dilemmas, reduced genetic diversity, social inequality, and unpredictable consequences. Ethical considerations are paramount, touching upon human dignity, social justice, eugenics, unintended consequences, autonomy, and the impact on religious and moral convictions. Once a fantastical notion, designer babies have become a tangible subject of scientific inquiry and ethical discourse. This paper endeavours to provide a comprehensive understanding of the multifaceted dimensions surrounding designer babies, allowing readers to contemplate the ethical, social, and scientific implications of a future where genetic engineering may shape the very essence of human existence. As society grapples with these profound questions, we must navigate this uncharted territory with wisdom, responsibility, and an unwavering commitment to ethical principles.

Keywords: *Designer Babies, Ethical Considerations, Science, Technology*

Introduction: Designer Babies' Definition

Growing up in the 1990s-2000s, the first author of this article has seen many movies showing designer babies' technology. Designer babies are a common theme in science fiction movies, where the idea of genetically engineering babies to have specific characteristics or abilities is explored [1]. These movies often depict a future society in which parents can choose the traits of their children, such as intelligence, physical appearance, and even personality. Among those science fiction movies is "The Island" (2005), whose story is set in a future world where people are genetically engineered to be used as organ donors in case their "real" counterparts need replacement. Another movie is "Jupiter Ascending" (2015), which portrays a society where humans are genetically engineered to be superior, and the main character is a janitor who is revealed to be the genetic reincarnation of the leader of this society. As children, the authors often dreamed of being one of such movie characters. Fortunately (or

unfortunately), designer babies are no longer science fiction. In the near years (or decades), we can probably witness designer babies' applications, at least in research settings.

Designer babies refer to the concept of using genetic engineering technologies to edit the genetic makeup of embryos or eggs before they are implanted in the womb [2, 3]. Among the technologies used in designer babies is the clustered regularly interspaced short palindromic repeats (CRISPR) [4, 5]. The goal is to produce a child with specific desired characteristics, such as intelligence, beauty, or a lack of certain genetic diseases.

The technology for creating designer babies, also known as genome editing, is still in its infancy and is not yet available for widespread use. In recent decades, scientists have made significant progress in understanding the genetic basis of various traits and diseases and have developed powerful tools for genome editing [6-8]. However, many technical and ethical challenges still need to be overcome before the technology can be safely and responsibly used to create designer babies. Additionally, there are concerns about such technology's impact on future generations' welfare and potential unintended consequences.

Currently, genome editing is mainly used in research and only in a few clinical applications, such as treating genetic disorders by editing the genome of cells in adult patients [9, 10]. In addition, genome editing to create designer babies is illegal in most countries and is not considered ethical by most scientists and medical professionals [11, 12]. This article will briefly discuss the designer babies' topic from a bioethics perspective. We cover various issues in this manuscript, ranging from the basic definition of designer babies, their current state, the pros and cons arguments behind them, and examples of controversial designer babies' applications. Finally, we will briefly summarise the current laws and regulations regarding the designer baby.

How Does Designer Babies' Technology Work?

Designer babies, also known as genome editing, is a process that uses genetic engineering technologies, such as CRISPR, to edit the genetic makeup of embryos or eggs before they are implanted in the womb [8, 12]. The process of genome editing typically begins with identifying the specific gene or genes that are responsible for a particular trait or disease. Once the target gene or genes are identified, scientists use CRISPR-Cas9 to make precise cuts in the DNA at specific locations within the gene. These cuts can then be used to add, delete, or replace particular pieces of genetic code. One way of doing this is using a technique called CRISPR-Cas9 [13], a type of molecular scissors that can be programmed to cut specific sequences of DNA [14-16]. Scientists can add, delete, or replace a specific gene by cutting the DNA at a particular location. This technique has been used to correct genetic mutations that cause certain diseases, such as cystic fibrosis [17], sickle cell anaemia [18], and Tay-Sachs disease [19]. Another way is using the base editing approach, where scientists can change a single letter of the genetic code without cutting the DNA strand, potentially reducing the risks of off-target effects [20, 21].

Current State of Designer Babies

As aforementioned, designer babies (or genome editing, in a sense) are still in their infancy and not yet fully explored on human subjects. However, there have been some implementations of genetic

engineering on animals. Still, they are not considered "designer babies," as the term mainly describes the genetic modification of human embryos or eggs. One example of genetic engineering in animals is genetically modified mice [22-25], which have been used for decades in research on human diseases, such as cancer [22-24] and genetic disorders [25]. Another example is genetically modified farm animals, such as cows and pigs, engineered to produce more milk or grow faster [26]. There are also some cases where scientists have used CRISPR and other genetic engineering techniques to edit the genomes of non-human primates, such as monkeys and apes, but these are mainly for research purposes [27].

When this paper was written, no examples of designer babies have been successfully implemented (yet scientifically proven) on human subjects. However, there have been some controversial cases where scientists have attempted to use genetic engineering techniques to create designer babies. For instance, in 2018, a Chinese scientist, He Jiankui, claimed to have used CRISPR to edit the genomes of embryos that were later implanted in a woman's uterus, resulting in the birth of twin girls [28, 29]. He claimed that the embryos were edited to make them resistant to HIV. This claim was met with widespread condemnation from the scientific community, and the Chinese government later investigated the matter [30].

The study He Jiankui conducted was deemed unethical by many, as he had not sought proper ethical approvals, used untested methods, and misled the public about the nature of the study [31]. As a result, the Chinese government later sentenced He Jiankui to 3 years in prison and banned him from further scientific research. It is worth noting that there is no evidence to support He Jiankui's claim, and, likely, the babies were not born due to genome editing [31]. The suit was met with widespread condemnation from the scientific community, and it's considered to be a gross violation of ethical principles and a misuse of the technology.

Arguments Surrounding Designer Babies' Topic: Views of The Pros

Even though designer babies are highly controversial, several views have been put forward in support of creating designer babies. Some of the main arguments include the following:

1. Preventing genetic diseases: One of the most compelling arguments for creating designer babies is that it can potentially prevent genetic disorders such as cystic fibrosis [17], sickle cell anaemia [18], and Tay-Sachs disease [19]. By identifying and editing embryos with these diseases, parents could have healthy children free of the genetic conditions that would have otherwise affected them.
2. Improving human potential: Another argument favouring designer babies is that they could improve human potential. This could include increasing intelligence, physical abilities, and disease resistance.
3. Reducing suffering: Some argue that designer babies could reduce the suffering caused by genetic diseases, not just for the children born with them but also for their families and society.
4. Personal freedom: Some argue that individuals should be free to use technology to create the children they want, just as they can enhance their bodies or minds.

Arguments Surrounding Designer Babies' Topic: Views of The Cons

Designer babies are controversial and, therefore, sparked criticism from many parties worldwide. There are several arguments against creating designer babies. Some of the main ideas include the following:

1. Ethical concerns: One of the main arguments against designer babies is that it raises several ethical concerns. For example, it could lead to a eugenic society, where specific individuals or groups are deemed more desirable than others. Additionally, there are concerns about such technology's impact on future generations' welfare and potential unintended consequences.
2. Genetic diversity: Another argument against designer babies is that it could reduce genetic diversity. If everyone starts to create babies with the same desired traits, this could result in a loss of biodiversity, which could have negative consequences for the population as a whole.
3. Social inequality: Some argue that designer babies would increase social inequality, as the technology would likely be expensive and only available to a select few, leading to an even greater divide between the haves and the have-nots.
4. Unpredictable effects: The effects of genome editing on human development still need to be fully understood, and it's difficult to predict the long-term impact of designer babies on human health and society.
5. Religious and moral objections: Some may have religious or moral objections to using genetic engineering in human reproduction.

Ethical Considerations of Designer Babies

When discussing using genetic engineering to create designer babies, several ethical considerations must be considered. Some of the primary ethical considerations include:

1. Human dignity: Some argue that genetic engineering to create designer babies undermines the inherent human dignity of the child, treating them as a product to be designed rather than a unique human being.
2. Social justice: There are concerns that designer babies could increase social inequality, as the technology would likely be expensive and only available to a select few, leading to an even greater divide between the haves and the have-nots.
3. Eugenics: There are concerns that designer babies could lead to a eugenic society, where specific individuals or groups are deemed more desirable than others, and certain genetic traits are considered more valuable.
4. Unintended consequences: There are concerns that designer babies could lead to unintended consequences, such as reduced genetic diversity, unforeseen health risks, and changes to societal norms and values.
5. Respect for autonomy: Some argue that individuals should be free to use technology to create the children they want, just as they can enhance their bodies or minds.
6. Religious and moral objections: Some may have religious or moral objections to using genetic engineering in human reproduction.

7. Unpredictable effects: The effects of genome editing on human development still need to be fully understood, and it's difficult to predict the long-term impact of designer babies on human health and society.

Cases of Designer Babies

A. Savior siblings

Savior siblings refer to using in-vitro fertilization (IVF) to create a child who can provide cells, tissue, or organs to an existing sibling with a life-threatening medical condition. The idea is that the healthy sibling's cells can treat the sick sibling through "cellular therapy." This can include treatments such as bone marrow transplants, cord blood transplants, and even organ transplants. In the savior siblings cases, parents with a child with a life-threatening genetic disorder, such as leukemia, use IVF to create a sibling who is a genetic match for the child to provide the child with a bone marrow transplant or other treatments. This can be done by using preimplantation genetic diagnosis (PGD). This technique allows scientists to identify which embryos carry the genetic disorder and select only the healthy ones for implantation. The Savior siblings' cases raise several ethical concerns. One of the main concerns is that the child is being used as a means to an end rather than as an end in themselves. Additionally, there are concerns about the child's welfare and the child's role as a savior sibling could have on their psychological and emotional well-being. There are also concerns about the implications of creating a child specifically to be a source of cells, tissue, or organs. Molly Nash is a well-known case of a savior sibling [32, 33]. Molly Nash was born in Denver, Colorado 1996, as a savior sibling to her older brother Adam, who suffered from a rare genetic disorder called Fanconi anemia. Molly's parents, Lisa and Jack Nash used preimplantation genetic diagnosis (PGD) to ensure that she would be a genetic match for Adam and could provide him with healthy bone marrow cells. Adam received a bone marrow transplant from Molly when she was five, successfully treating his condition. The case of Molly Nash and her family brought attention to the ethics of creating savior siblings and the potential benefits and risks of the procedure. While the Nash family and many others in similar situations argue that the system saved their child's life, many ethicists and medical professionals are concerned about the ethical implications of creating a child specifically to be a source of cells, tissue, or organs. It's important to note that the Savior siblings' cases are sporadic and complex, and it's essential to approach them carefully. The ethical implications and welfare of the children involved must be carefully considered before any decision is made.

B. Sex selection

Designer babies in sex selection raise several ethical concerns. One of the main concerns is the potential for gender imbalance in specific populations, as parents may prefer one gender over the other. Additionally, there are concerns about the impact of such technology on societal norms and values and the potential for reinforcing gender stereotypes. Another problem is that it could lead to a eugenic society, where specific individuals or groups are deemed more desirable than others, and certain genetic traits are considered more valuable. There are also concerns about the welfare of the children and the impact that being born as a result of sex selection could have on their psychological and emotional well-being. Additionally, the use of genetic engineering for sex selection could perpetuate societal biases,

leading to discrimination and prejudice against certain groups, such as girls, in some parts of the world where they are seen as less valuable than boys.

C. Disabled babies

It is unlikely that someone would deliberately create a disabled child through designer babies, as it raises serious ethical concerns and is not considered an acceptable use of the technology. Most people would want to have healthy children that are free of genetic disorders. However, there may be some cases where parents may wish to have a child with a specific disability for personal, cultural, or religious reasons [34]. For example, some religious communities may consider having a child with a particular disability a blessing. Additionally, some parents may have a personal connection to a specific disability and may want to have a child with that disability to understand and empathize with them better. Another concern is that it could lead to discrimination and prejudice against disabled individuals, as they may be seen as less valuable or less worthy of life than non-disabled individuals. Additionally, there are concerns about the child's welfare, and the impact that being born with a disability could have on their psychological and emotional well-being. Furthermore, using genetic engineering to create a disabled child raises questions about the child's autonomy and the parent's responsibilities to ensure the child's welfare. It's important to note that the scientific and medical communities do not widely accept these reasons. The ethical implications and potential risks of using this technology for such purposes must be carefully considered before any decision is made about using it. Also, it's essential to think that the well-being and autonomy of the child should always be a priority.

Current Law and Legal Regulations

Currently, the use of genetic engineering to create designer babies is not widely available and needs to be considered ethical by most scientists and medical professionals. Most governments have yet to approve the use of genetic engineering to create designer babies, and the technology is currently illegal in most countries. Each government has its policy regarding the use of genetic engineering in human reproduction, and the policies can vary widely from country to country.

The United Kingdom is one of the countries where scientists are actively researching genome editing technologies, such as CRISPR, in human reproduction. The UK government has approved limited use of genome editing in research and clinical trials but has yet to support the use of the technology for creating designer babies. The Human Fertilization and Embryology Authority, the regulatory body that oversees fertility treatments and research in the UK, has stated that using genome editing in human reproduction is not currently allowed [35-37].

In the United States, the National Academy of Sciences and the National Academy of Medicine issued a report in 2017 that recommended that genome editing should be allowed in human embryos, but only for certain, specific uses, such as preventing the transmission of genetic diseases, and only if the procedure is proven to be safe and effective, and if there is no reasonable alternative [37]. In Canada, the use of genetic engineering in human reproduction is regulated by the Assisted Human Reproduction Act, which prohibits the creation of "designer babies" and the genetic modification of sperm, eggs, and embryos [38]. In Australia, the National Health and Medical Research Council has released guidelines for using genome editing in human reproduction, stating that the technology should be limited to treating

genetic diseases and not be used to create "designer babies" [39]. In many European countries, the use of genetic engineering in human reproduction is regulated by the European Union, which has banned the use of the technology for creating "designer babies" and has set guidelines for the use of the technology in research and clinical trials [40]. In China, the government has banned the use of genome editing for reproductive purposes and has called for stricter regulations on genetic analysis after the announcement of He Jiankui, the scientist who claimed to have created the world's first gene-edited babies [41]. Additionally, many governments have set up a regulatory body that oversees the use of genetic engineering in human reproduction and have set guidelines and laws to ensure that the technology is used responsibly and ethically.

Remarks and Conclusion

The concept of designer babies, often referred to as genetically engineered infants, has ignited extensive discourse within the scientific and ethical circles. This term pertains to using genetic engineering methodologies to tailor babies with specific desired traits, encompassing attributes like intelligence, physical appearance, and personality. While the technology to actualize designer babies remains unrealized , the strides made in genetic engineering render it a conceivable prospect for the future.

A primary argument favoring designer babies revolves around their potential to eradicate genetic afflictions and maladies. To illustrate, genetic engineering can eliminate the peril of hereditary conditions such as cystic fibrosis and sickle cell anemia. Furthermore, it could enable the creation of infants endowed with augmented physical or intellectual capacities, ushering in a generation of individuals characterized by increased robustness, swiftness, and intellect compared to prior generations.

Nevertheless, many ethical apprehensions are inexorably intertwined with the creation of designer babies. Foremost among these concerns is the possibility of precipitating a society where individuals are assessed and esteemed solely based on their genetic composition. Such a scenario could foment a community where genetic status becomes the basis for discrimination, with those deemed genetically "superior" enjoying preferential treatment. Additionally, the capability to fashion "flawless" offspring raises profound questions about the essence of individuality and the fundamental definition of humanity.

Another disquieting consideration pertains to the potential misuse of the technology for eugenics, wherein governments or other entities employ genetic engineering to foster a purportedly "superior" race or eradicate specific population segments. This could lead to a societal landscape where particular individuals or groups are devalued or eradicated based on their genetic constitution.

Furthermore, concerns regarding the enduring repercussions of genetic engineering on the human species abound. While the technology holds promise in terms of conferring manifold advantages, it also harbors the potential for unforeseen consequences, such as heightened susceptibility to particular diseases or environmental factors. Consequently, although the prospect of designer babies tantalizes the possibility of eradicating genetic maladies and cultivating individuals with heightened abilities, it

concurrently begets substantial ethical misgivings. Therefore, it is incumbent upon society to contemplate the potential ramifications of this technology before its advancement and application.

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