The Ethical Considerations Of Human Genetic Engineering

Genetic engineering is the process of directly manipulating an organism's genes in order to modify a desired set of characteristics. Humans have been altering the genome of species for thousands of years through selective breeding and artificial selection, however, it wasn't until the discovery of recombinant deoxyribonucleic acid in 1972 that DNA could be directly manipulated. For several decades, scientists and geneticists experimenting with gene editing saw varying degrees of success; these experiments were also very expensive and took several weeks or months to complete. As a result, genetic engineering showed limited promise as a technology that could disrupt any major industries. This all changed in 2012 when Jennifer Doudna discovered the CRISPR-Cas9 (Clustered Regularly Interspaced Short Palindromic Repeats) genome editing tool and these edits could be made quickly and cheaply; in days rather than weeks or months. The CRISPR-Cas9 system consists of two key molecules that introduce a change into the DNA: an enzyme called Cas9 that acts as a pair of "molecular scissors" and a piece of RNA called guide RNA (gRNA) that consists of a small piece of pre-designed RNA sequence. CRISPR has several potential uses that can significantly advance the human race, but the notion of "designer babies" has come into the picture of genetic engineering and raises several ethical concerns for the future. A designer baby is a baby genetically engineered in vitro for specially selected traits; which can vary from lowered disease-risk to gender selection, eye colour, athletic ability, and height. Though the idea of creating the perfect baby might sound very appealing, genetic engineering must not be used for the physically and mentally enhancing prenatal manipulation of human embryos as the biological and socioeconomic consequences are far too significant. This essay will explore this argument by discussing how genetic engineering can lead to inequality based on wealth, the connection between gene editing and eugenics, and the biological permanency of genetic engineering.

The first idea that must be contemplated in regard to human genetic engineering is that any edits made to our germline DNA will stick with humanity forever. Within the multicellular organisms, such as humans, genetic mutations can be classified as either somatic or germline. Somatic mutations occur in a single body cell and cannot be inherited (only tissues derived from mutated cells are affected). Germline mutations occur in reproductive cells and can be passed onto offspring; this means every cell in the entire organism will be affected. Somatic gene therapy shows lots of promise for new treatments or cures for diseases and presents few problems in regard to human evolution and biology. However, germline gene editing possesses a much more serious threat. Since the human genome is an extremely complex system that we don't fully understand, we cannot predict how editing a certain gene will affect someone. Sometimes multiple genes are required perform a function, and it's possible that a single edit could end up affecting several other genes. We also can't completely guarantee the accuracy of genome editing, so there is always the risk of making unintended changes with unforeseen consequences. Additionally, if a change is made in a germline cell, we cannot reverse it. That change will pass from parent to child through generations and will spread between families, communities, and countries to become part of humankind forever. As the entire effects of a genetic modification may not become apparent for years or even decades, permanently altering the human genome is too big a risk to take. Fortunately, several laws and policies have been put in place by countries with the most fully developed human biotechnology research sectors. Of the thirty member countries of the Organization for Economic Cooperation and Development

(OECD), which includes Turkey, Mexico, Canada, Australia, and the United States, roughly 83% prohibit germline modification. Though this is sufficient for the current state of human genetic engineering, further restrictions will be necessary in the future as the technology develops.

The second consideration for human genetic engineering is the strong connection that exists with eugenics. Eugenics is the science of improving the human species by selectively mating people with specific desirable hereditary traits. The most historically significant example of eugenics in recent history was the Nazis between 1933-1945. The Holocaust was meant to eliminate groups from the gene pool that Adolf Hitler deemed not part of the Aryan race; this included Jews, gypsies, people with physical or mental disabilities, and homosexuals. Though this represents the very extreme of eugenics, one must consider the connection between eugenics of the past and human genetic engineering today. It is entirely possible that by performing eugenics on a small scale through gene editing, society will become more accepting of larger scale, more dangerous examples of eugenics. As the rise of human genetic engineering causes the inescapable desire to create the perfect designer baby to grow, parents will find themselves selecting traits that they deem to align with societal standards of perfection. Based on current demographics, this would likely be a white, straight, handsome, and tall man. This demonstrates how unregulated human genetic engineering has the potential to mirror the Aryan race fantasized by the Nazis, whether or not our society is aware of it. By allowing parents to craft their ideal child, society could be headed towards an intolerance of differences.

The last major issue that arises with designer babies is the increased economic disparity between the rich and poor. Since gene editing is such a delicate and complex task, it requires a significant sum of money. At Yale, it costs as much as $15,000 to fix a single point mutation, and that's before another $2,000 is added for the cost of genotyping, which is needed to investigate the genetic constitution of an organism. Even though a point mutation is a very small mutation involving only a few nucleotides, it is still extremely costly. Given that the average household income in the United States is just above $59,000 and that these procedures are not typically covered by insurance, genetic engineering is financially attainable for only those of the upper echelon of society. The possibility of a world in which people are able to make themselves more entrepreneurial, intelligent, socially adept, and charismatic than others because of money could lead to an increased lack of economic mobility. Eventually it could create an extreme class system seen only in dystopian societies where the wealthy are able to acquire advantages that lead to even greater wealth. Beyond the cost of genetic engineering, designer babies would also be likely to make more money in the future. Time and time again, physical characteristics have been proven to have a great influence on someone's success and productivity. For example, people with greater height tend to be more economically successful in life. According to a study done by the American Psychological Association, on average, someone who is six-feet makes $166,000 more than someone who is five-feet. Furthermore, even though people greater than six-foot-two make up only 3.9% of the world's population, nearly all Fortune 500 CEOs are over six-foot-two inches tall. It is clear to see that access to genetic engineering technologies and services affords those of great wealth an opportunity to outpace the less fortunate classes of society. As the viability of designer babies continues to grow, so does the delineation between enhanced individuals and unenhanced individuals.

In conclusion, the ethical considerations for human genetic engineering are a very complicated issue. Technologies like CRISPR-Cas9 have several potential uses that can significantly advance the human race, such as editing crops to be more nutritious, developing tools to stop genetic diseases, and creating new antibiotics and antivirals. However, such great power requires great responsibility from the individuals who possess it. How can we balance individual rights against what is good for society as a whole? When does avoidance of disease and disability shade into enhancement? Should society be more receptive to disability rather than seeing it as something to be eradicated? These are all questions that can only be answered with time, and if handled correctly, the negative impacts of human genetic engineering will never show themselves to society.