Should we make attempts to change the human genome?

Following the announcement of the birth of the twin girls who had their genomes modified to decrease their susceptibility to HIV infection, the discussion on whether the human genome ought to be modified was brought to light. After the disaster of selecting only babies considered ideal to grow up in Germany during World War II, are governments actually willing to allow embryos to be altered to have certain desired characteristics? This long debate relating science and ethics will be delved into in this essay, and many different perspectives will be raised to question the possibility of a worldwide consensus on this topic.

Due to all the scientific and technological advances of the past few decades, changing the human genome has become a possibility. With the discovery of restriction endonucleases and their possible uses, as well as the greater understanding of the structure and functions of the human DNA, and more recently with the new CRISPR-Cas9 technology that has been revolutionising genetic engineering, this can now be considered a reality. And advances in this growing field will surely continue in the near future, as it has multiple significant applications in many fields, particularly in medicine.

Modifying a genome nowadays is something that can be achieved relatively rapidly. Firstly, the gene of interest to be altered has to be thoroughly researched. Sequencing the nucleic acid sequence, for example with next generation sequencing, followed by bioinformatics analysis is crucial for identifying the change that will lead to the aimed outcome. Secondly, a new artificially made gene can be created, then amplified by polymerase chain reaction and placed into a vector, which is usually a bacterial plasmid, a bacteriophage or a yeast artificial chromosome. This vector is then often inserted into a liposome, an artificial cell, and then put into the organism, where it will enter a cell and, hopefully have the desired effect.

The method described is carried out regularly in somatic gene modification, which has a multitude of medical uses. However, this is only temporary, so patients need this to regularly occur, as their cells will die and be replaced with new ones, which do not contain the desired mutation. One current example is the use of this technology in the treatment of cystic fibrosis and sickled cell anaemia. In both cases, the patients have life-long conditions caused by mutations, and the insertion of cells without these disastrous mutations greatly improves their lifestyle, besides having been proven a medical success. Perhaps in these cases, for a better lifestyle, the continuous treatment is greatly beneficial.

CRISPR-Cas9 technology is being highly researched and it does seem to bring a new hope for the future. CRISPR-Cas9 is a nuclease system which is RNA guided. It was first discovered in E. coli over three decades ago, and now these nuclease systems have been identified in many bacteria and archaea. This scientific breakthrough allows genome editing to be programmed, and it seems as though rapid genomic modifications will come as a result of such technology very soon. Not only can it aid in disease treatment, but also in agriculture and research.

Additionally, in light of the SARS-CoV-2 pandemic, possibly using this technology to decrease susceptibility to infection by this disease could have profound effects. Some of the vaccines recently developed against this new coronavirus used

genetic engineering techniques to curb citizens from getting infected by the virus. The ChAdOx 1 vaccine, developed by Oxford university the pharmaceutical company AstraZeneca, for example, makes use of adenoviruses as vectors for cloning DNA. Therefore, genetic engineering techniques are contributing for many important developments that are crucial for the whole world to overcome the effects of such a devastating disease.

In spite of all of these benefits to genome modification, the ethical issues are crystal clear. Alterations can also be carried out in embryos, as described at the start with the twin girls. The question many researchers and politicians ask themselves is whether it is correct to create what some would consider designer babies. This is where the ethics comes to light, due to the fact that not only one person's genetic material is modified for their lifetime, but the change will also be present in future generations. Germline modifications have been debated for many years, as well as been portrayed in many films and documentaries. In vitro fertilisation already does raise some of these issues, considering in some cases parents can choose particular embryos to be implanted and, therefore, to become their children, eliminating those that could have certain characteristics considered undesirable. Would society be willing to allow only those considered perfect to be born?

Very early in this field of biotechnological research, this dangerous application of techniques being developed became clear. Published in 2017, a report on human genome editing, including germline modification, was written by a multidisciplinary committee that thoroughly considered many aspects of gene editing in research and medicine. This prevents many of these negative uses that could impact society as a whole, possibly leading to a future that has long been portrayed by many dystopian novels. Despite the likely intriguing nature of this area of research, germline editing ought to be avoided.

In light of all benefits modifying the human genome can bring to medicine, and possibly other areas of research, it cannot be ruled out. On the contrary, research in this area is vital for future scientific developments and, possibly, to bring a better lifestyle to many who suffer from genetic disorders. What needs to be done is to prevent any sort of modifications on human embryos, and new treatment to such diseases has to become available to all of those in need, as scientific developments must improve society as a whole. All in all, for the benefit of many, as well as for more possible scientific breakthroughs, the human genome should be changed with care for specific justified purposes that can help create a better future.