



REVIEW ARTICLE

Human Germline Genetic Modification: Scientific and Bioethical Perspectives

Kevin R. Smith,^a Sarah Chan,^b and John Harris^b^a*School of Contemporary Sciences, Abertay University, Dundee, United Kingdom*^b*Institute for Science, Ethics and Innovation, Manchester University, United Kingdom*

Received for publication March 16, 2012; accepted September 6, 2012 (ARCMED-D-12-00157).

The latest mammalian genetic modification technology offers efficient and reliable targeting of genomic sequences, in the guise of designer genetic recombination tools. These and other improvements in genetic engineering technology suggest that human germline genetic modification (HGGM) will become a safe and effective prospect in the relatively near future. Several substantive ethical objections have been raised against HGGM including claims of unacceptably high levels of risk, damage to the status of future persons, and violations of justice and autonomy. This paper critically reviews the latest GM science and discusses the key ethical objections to HGGM. We conclude that major benefits are likely to accrue through the use of safe and effective HGGM and that it would thus be unethical to take a precautionary stance against HGGM. © 2012 IMSS. Published by Elsevier Inc.

Key Words: Human germline, Genetic modification, Gene targeting, Gene therapy, Genetic enhancement, Genethics.

Introduction

Once the preserve of science fiction, the idea of genetically modifying humans at the germline level is becoming increasingly plausible as a consequence of recent scientific and technological developments. In this paper we argue that strong ethical grounds exist to pursue the goal of human germline genetic modification (HGGM). In terms of developing the technologies that will be required for effective and safe HGGM, no serious ethical prohibitions pertain. Indeed, the requisite technologies are already under intensive development as part of a) scientific research into fundamental biological process (such as the development of transgenic mice to study developmental processes) and b) applied research for biotechnological and bioscientific purposes (such as the development of vectors for somatic gene therapy). Thus, whether or not society decides to actively pursue HGGM as a specific goal, the tools for achieving it will be constructed anyway. The scientific and technical basis for HGGM is considered in some depth in this paper.

Various objections have been raised against the potential use of HGGM. These objections range from concerns over safety to fears for the welfare or identity of genetically modified individuals, to fears for the future state—or the very existence—of the human species. We examine such objections and conclude that none of them, taken either individually or in their totality, provide good reasons to prohibit HGGM.

The human genome is not perfect, and there exist no good biological reasons to presume that the genome cannot, at least in principle, be improved. By altering the human genome, HGGM offers major future benefits to the population including protection from major diseases (such as cancer and AIDS) that presently afflict the human species. Ultimately, HGGM offers the possibility of genetic enhancement, such that normal or species-typical functioning is enhanced by improved human capacities and abilities. In the future, HGGM could result in the birth of persons who are altogether better: for example, such genetically modified persons might live longer and have improved cognitive and physical abilities.

The common reaction to the notion of human genetic modification is one of rejection: by contrast, we seek to provide good reasons for believing not only that HGGM is ethically acceptable, but that it is ethically imperative to positively support its development.

Address reprint requests to: Kevin R. Smith, Abertay University, School of Contemporary Sciences, Baxter Building, Bell Street, Dundee, DD1 1HG, UK; Phone: +44 (0)1382 308664; FAX: +44 (0)1382 308261; E-mail: k.smith@tay.ac.uk

Dealing with Simplistic Objections to Genetic Modification

HGGM requires two fundamental processes: 1) the deliberate alteration of genetic sequences and 2) the use of human embryos and consequent loss of some of these embryos. Objections are frequently raised against these processes. As such, the arguments commonly deployed amount to rather simplistic assaults on HGGM.

Deliberate Sequence Alteration

HGGM entails the deliberate modification of genetic sequences within the genome. Such alteration of genetic sequences, which we shall refer to here as genetic modification (GM), is frequently viewed with suspicion or considered intrinsically unethical by some. Regrettably, much commentary on GM abounds with rhetorical pleas such as those concerning the claimed reprehensibility of playing God. However, although such viewpoints are not uncommon, they fail to withstand close scrutiny.

Alterations to genetic sequences occur in nature mainly as a result of natural selection during evolution. Sequence alteration is also the outcome of selective breeding of domesticated species such as crop plants and agricultural animals. Modern GM also aims to alter genetic sequences, for example, to create genetically modified crops or transgenic animals. Thus, genetic sequence alteration is the central effect of two processes: genetic selection (in evolution and selective breeding) and GM. In terms of genetic sequence alteration, the only significant differences between these processes is that the latter provides a much faster and more precise means to alter genetic sequences compared with the former process.

It follows that objections to HGGM based on the notion of the intrinsic wrongfulness of genetic sequence alteration would be sustainable only as a subset of a broader rejection of all forms of deliberate sequence alteration (DSA). A coherent anti-DSA argument would necessitate the rejection of deliberate forms of alteration (selective breeding and GM) while accepting natural sequence alterations (from evolution). Thus, to maintain an ethical stance against DSA would be to subscribe to a form of naturalistic fallacy.

There have been no discernable protests against selective breeding *per se*. By contrast, strong objections have been raised against GM. Insofar as such objections are based on a notion of the intrinsic reprehensibility of DSA, this is wholly inconsistent. Somewhat more rationally, other arguments against GM are based upon a fear of negative consequences. However, a consequentialist argument against DSA *per se* would be difficult to sustain, considering the overwhelmingly positive contributions to human welfare that have arisen from centuries of selective breeding of crop plants and agricultural animals. GM technology offers a greatly accelerated pace of DSA not only in terms of improved food supply, but also in the medical

domain where (for example) life-saving therapeutics are being produced by genetically modified microbes, and somatic gene therapy is beginning to show success.

It is true that GM could be used for immoral purposes (for example, to produce biological weapons), but this is also true of any technology. It is also true that accidents with GM could lead to undesirable consequences (such as patient death through adverse reactions to particular gene therapy vectors). But the risk of accidental negative outcomes ought to be assessed and dealt with by a careful appraisal of the science involved. Indeed, issues of safety and risk associated with HGGM are discussed at various points throughout this paper. However, concern over the possible negative consequences of GM cannot amount to a valid objection to DSA *per se*.

Use of Human Embryos

Various perspectives and doctrines, mainly arising from religious dogma or intuitive responses, hold that it is ethically unacceptable to use human embryos in such a way as to result in their death. Central to these claims lies the notion that, as a form of human life, the embryo ought to be accorded the same ethical respect and protection that people (as children and adults) are afforded.

Against the notion that the embryo deserves protection, it can be argued that the embryo lacks key features of ethical significance. An embryo is nonsentient and does not possess personhood. Thus, the embryo can be said to have no interests and, therefore, cannot be harmed (in an ethically meaningful way) by death. It is true that an embryo has the potential to develop into a sentient person complete with interests, but this argument from potential lacks any substantive basis. Logically, where entity *A*, with no interests, has the potential to develop into entity *B*, with interests, it does not follow that *A* ought to be treated as if it already possesses those interests. By analogy, it would be inappropriate to accord environmental protection to an acorn simply because it has the potential to develop into an oak tree.

The foregoing summary of the main counterarguments against perspectives that consider the embryo as having intrinsic moral value is necessarily brief, given the context of this paper. It is true that some people maintain a fundamental objection to any procedures that entail embryo death, regardless of the counterarguments. But it seems unlikely that this perspective is shared by most people. In this respect it is pertinent to compare HGGM with *in vitro* fertilization (IVF). Those who would object to HGGM because it involves embryo death ought also to object to IVF on the same grounds. In fact, relatively few people appear to object to IVF, which has become a front-line treatment for infertility.

However, for those who maintain the view that embryo death is ethically unacceptable, any discussion of the ethics of HGGM is rendered irrelevant because embryo death will

Download English Version:

<https://daneshyari.com/en/article/3446711>

Download Persian Version:

<https://daneshyari.com/article/3446711>

[Daneshyari.com](https://daneshyari.com)