

DESIGNER BABIES

Semester work 4th grade biology

Genetic engineering

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1 Preface

1.1 Motivation

When I was younger I read an article about babies created in test-tubes and really was fascinated. And then there was this thing about designer babies I heard, but I couldn't imagine how this should work. Too young to understand genetic biotechnology I just accepted it as a fact and didn't think much of it. But when my biology teacher told us to write this paper I chose this topic because

- a) I'm interested in how it works to design a baby and in the ethical aspects
- b) I didn't know anything about it but that it existed
- c) I'm generally interested in genetics and genetic disorders because my little brother has the Down Syndrome. Due to this I was faced quite early with people that have genetic disorders. With genetic engineering you could "save" children from getting genetic disorders but exactly this was food for my thoughts. Should you abort babies because you found out they will have a genetic disorder? Don't they have great lives although they have some defects? Aren't they even happier than "normal" people are? Should you "save" them from living a happy life? I couldn't imagine my life without my little brother, he's really great and I would have missed out on many experiences without him that I definitely wouldn't have had with a "healthy" brother.

And I also know a boy that suffers the Duchenne Muscular Dystrophy but he and his family learned to deal with this and even if it's a lot of work and stress they seem to be a happy family. Why do we need a "perfect" world if we can live quite well with the natural world too?

1.2 Questions

I always associated the term "designer baby" with a couple sitting down with a catalogue choosing their baby's traits like hair and eye color, height, weight, talents and definitely not the fathers crooked nose.

But is this whole designing thing only a hypothesis or is this reality? How far got today's scientists with researches concerning this topic? How far might humans influence nature? What might happen in future if everybody starts messing around with their offspring's genes trying to design the "perfect" baby? What are risks in employing pre-implantation genetic diagnosis (PGD) all around the world?

2 Introduction

2.1 Definition

2.1.1 Designer Baby

In 2004 the term “designer baby” made its first way in media. The same year it was defined and printed into the Oxford English Dictionary.

Definition:

“A baby whose genetic makeup has been artificially selected by genetic engineering combined with in vitro fertilization to ensure the presence or absence of particular genes or characteristics”. (Source: Oxford English Dictionary)

The term designer baby doesn't really fit today's scientific capabilities since you're not able to take genes that belong to a certain trait and put them together and then just wait until the perfect baby is born. Nowadays that's only a hypothesis but it's theoretically possible and probably it's just a matter of time.

A more real name would be “selected baby” because you're able to select an embryo with the right chromosomes that e.g. make your child being male or female or to screen the embryo for a potential hereditary genetic disorder or choose an embryo that has the matching genes which can save the life of a sibling which already suffers a genetic disorder.

2.1.2 Pre-Implantation Genetic Diagnosis and In Vitro Fertilization

In Vitro Fertilization is a process by which egg cells are fertilized by sperm outside the body, in vitro (Latin = in test tube) (Source: Wikipedia)

Pre-Implantation Genetic Diagnosis is a procedure used in conjunction with in-vitro fertilization to screen for specific genetic or chromosomal abnormalities before transferring the fertilized eggs into the mother. (Source: About.com)

2.2 History

The entire human evolution our ancestors did nothing else than selecting their offspring's traits. Why do men prefer pretty women? Because they're genetically and developmentally healthier and will be good mothers. But part of the reason is that their children especially daughters will be healthy too. The same with why women prefer strong, tall men. We could even say if you're mating with a beautiful, intelligent, kind person you're sort of creating a “designer baby”.

Nature arranged mating in a way resulting in children with “better” genes than their parents have. Evolution will lead to almost perfect people by itself but that will take many decades. So people tried to make it faster.

In 19th century people didn't have the scientific knowledge as we have so they had to do selective breeding. The Oneida Community an American religious sect performed in 19th century a selective breeding. Only the healthiest and most intelligent males and females were allowed to interbreed. As a result you could see that no defective children were born and no mothers died during or after giving birth.

You see, people always wanted to get more intelligent, healthier, better!

1967 two scientists, Robert Edwards and David Gardner, performed the first successful embryo biopsy on rabbits.

With human beings people once started to help women whose had problems getting pregnant with fertilizing egg cells in test tubes. Then they implanted the best developed ones into the mother's womb. But only few disorders are visible using a microscope to inspect the embryo so people had to find a technique to make genetic disorders visible.

The PGD was developed in mid 1980 in UK. In 1989 physicians PGD was performed the first time in London's Hammersmith Hospital and the first unaffected child following PGD performed for an X-linked disorder was born.

Since this event PGD was used more and more all over the world. The possibility get a healthy child was now available. Some blind parents wanted their child to be blind too. But with PGD you are now able to determine some traits of your child.

2.3 Where techniques are used

The PGD is used in branch of in vitro fertilization in clinics where many egg cells are fertilized and only the healthy ones implanted into the woman's womb. The PGD can be used to avoid especially 3 major groups of diseases:

- 1) Sex-linked disorders (e.g. Duchenne Muscular Dystrophy is X-linked)
- 2) Single gene defects (e.g. Cystic fibrosis)
- 3) Chromosomal disorders (e.g. Down Syndrome)

To figure out whose are the non-affected embryos you screen the DNA but further information about how it works you find later in this paper.

The IVF is used for all couples having problems getting a baby or getting a healthy baby. Reasons might be that both man and woman are affected or carriers of a hereditary disease or that they're infertile. So in most clinics you find a branch for reproduction medicine.

2.4 Alternatives

There are no alternatives on same level to prevent an offspring of congenital affected parents from the same hereditary disease than PGD in combination with IVF if they want to

be the biological parents. If they just want a healthy child they could adopt or use donor gametes. They could also terminate pregnancy if their child gets diagnosis for a disease. This diagnosis can be done in 7th week of pregnancy by a single blood test. But this is a psychological burden for the parents and therefore not capable. It's easier for parents if they don't have to abort an embryo the mother already carried almost 2 months in her body.

3 How techniques work

3.1 How IVF works

If a couple is suspicious to have a hereditary disease they are reviewed.

The woman now needs to inject a hormone that brings as many egg cells as possible in to grow. With another hormone they activate the ovulation.

The man needs to give probation of sperm so that the sperm cells can be reviewed. If the sperm cells are sufficiently present, enough active, not infected and have a normal shape they can be taken for the fertilization if not the man has to follow some rules that should improve his sperm building.

To get the egg cells out of the woman's body she is totally narcotized. With a special precise tool and ultrasonic sound the egg cells are removed.

To fertilize the egg cell there are two different methods

- 1) The egg cell and the sperm cells are put together in a test tube.
- 2) If the mobility of the sperm cells is defective one sperm cell is isolated and then injected with a special needle directly into the egg cell.
(see picture)



1: Sperm cell is inserted into egg cell



2: Seven fertilized egg cells with 2nd method

The embryo transfer into the mother's womb is done either two or five days after fertilization. If parents have no risk to have a hereditary disease the embryo is implanted after 2 days. If there's a risk you do PGD which means that you have to wait to the third day after fertilization.

Mostly two embryos are transferred. Especially if the woman is younger than 35 years the chance to get twins is really high. Fourteen days after implantation you can do the pregnancy test. The success rate of IVF lays around 20%-40%. The whole treatment costs around 6000.-Francs.

3.2 How PGD works

To answer the question of how the best embryos are chosen we take a closer look at PGD.

Three days after fertilization through IVF the embryo reached the stadium of four to eight cells. Now one cell is removed (see picture) and the genome isolated. To find out whether there are genetic disorders there are two methods.



3: Cell of embryo removed

1) The FISH-method:

This method is used to determine the chromosomal constitution of an embryo.

In contrast to karyotyping it can be used on interphase chromosomes.

The extracted genome is fixed on glass slides under microscope and hybridized with DNA probes. These DNA probes are labeled with a fluochrome. Now you're able to compare the chromosomes of the embryo with the chromosomes of the DNA probes.

2) If you know that parents have a high risk to carry the genes for hereditary diseases you may take a closer look at the specific genes that constitute the disease.

An embryo is not tested for all diseases. It depends on what risk the parents have to e.g. carry genes for hereditary diseases. Then the embryo is tested for this disease.

3.3 Law

Most countries allow sperm sorting and PGD if used in medical affairs. Whether sex selection with help of PGD is allowed or not varies a lot around the world but often is legal if a genetic disorder is linked to the sex. This is the case in:

- Switzerland
- United Kingdom
- Denmark
- Italy
- Portugal
- Spain
- New Zealand
- United States of America

In Germany PGD is illegal, but you are allowed to go get the treatment abroad. In India and Australia sex-specific abortion is illegal even if a hereditary disease is linked to the sex.

4 Designer babies in future

Today it's not possible to create your own baby with all traits you would like it to have. Nowadays you may choose one trait only e.g. whether it has the gene for blue eyes or the XX-Chromosomes. Maybe you find a female embryo with blue eyes but you can't create artificially a girl with blue eyes. Anyway, it's not allowed by law to choose the sex of your child in most countries. The only reason why people are allowed to use PGD is to prevent their child from hereditary diseases. In future people that decided to do IVF will probably be able to get solid information about all the embryos. So they may choose which child they want to bring into being.

Traits that affect the personality of the child may only give a possible tendency to e.g. be shy. Personality is influenced by the environment. The same is right for some sorts of cancer. Lung cancer for example seems to depend mostly on environmental influences while prostate cancer is mainly influenced by genetics. Environmental influences may switch genes on and off. And we can shape our environment by making decisions to e.g. not smoke.

To make designing of a "perfect" baby possible scientists had to do much more research on identifying and isolating the specific genes whose are responsible for a trait. And they had to find out how to change DNA what means they need to find enzymes whose you could use to cut out specific genes and other enzymes that insert other genes. That sounds quite easy but only to figure out which gene belongs to what trait researchers had to review ten thousands of people or even more and compare all the genomes etc. And if then you found the gene that affects the shape of your nose how do you know that taking the gene for a crooked nose away doesn't affect the shape of your whole face? How can we be sure taking away a gene and replacing it by another one doesn't affect a second trait?

5 Pros and Cons

5.1. Pros and cons for PGD

Pro PGD:

- Children might be cured from blood disorders, if they get a designer-baby-sibling with the "right" stem cells.
- No babies with hereditary diseases, chromosomal disorders, single gene defects or sex-linked diseases.

Cons PGD:

- The technique might also be used to choose a baby's cosmetic properties. It is not allowed but the possibility is available and just because it's illegal to consume drugs people get them anyway. Why should it be another affair with PGD?

- Global and/or local gender imbalance. In countries like China or India already today most aborted embryos were females. How will this change if you can determine the sex even earlier?
- How does a child feel if it's just born to save a siblings life?
- Infanticide or sex-specific abortion
- Disabled people are segregated. Disabled people will be removed from earth...at least a big part of them. Should disabled people really be eliminated?
- People with some conditions could live a good, happy life with some medical care.

I think PGD is a really good invention if used reasonable. Of course you might abuse it but generally I think it's good to save a child from a bad disease. And that a child is born to save a siblings life: I guess there will be no parents that won't love that child too.

5.2 Pros and cons for designer babies

Pro Designer Babies:

- People would live longer, be healthier and more intelligent what enables them to have two or more educations, multiple careers and be more knowledgeable and experienced than today's people.
- Designing people might lead to a better problem solving, more efficient organization and maybe ending war, hunger and diseases.
- You could eliminate all the bad traits humans possess and replace them by good traits.

Cons Designer Babies:

- Biodiversity of human could decrease if people could determine almost every property which leads to a long-term disaster. Probably all people would choose similar traits for their offspring depending on what is fashion. The gene pool would get smaller.
- In extreme people will create a perfect stereotype race of human.
- Someone might abuse techniques to create a lot of designed people that have almost no intelligence, a lot of muscles and no emotions. This designed people could be used for a troupe of soldiers making wars. The same with prostitution: A pimp could design a lot of woman with big breasts...
- The gap between rich and poor will get bigger. Only rich people are able to afford the designing of their offsprings. Will this lead to new speciation of humans? The poor, not perfect ones and on the other hand the rich, perfect ones?
- If you are a carrier of the sickle cell anemia gene you're resistant to malaria. To remove the sickle cell anemia gene completely of the gene pool would result in more people dying because of malaria.
- When all people are healthy they will probably get older. All the babies that would have died during pregnancy will survive now. How to deal with overpopulation?

- Can appearance be “defect”? Are you defect if you have a gummy smile, a big nose or too small breasts?

6 Discussion

What about the “normal” children in a future of designer babies? If a normal child is talented in playing piano it will probably like playing piano because everyone tells him how beautiful it plays. But if all parents start making their children being little Mozarts the normal children can’t compete and will lose courage playing piano. In general normal people couldn’t compete with designed people. So only designed humans will get good jobs etc. because they actually are better. Will there be a hierarchy like in folks of ants? A queen, soldiers and workers?

If we could influence the IQ and make everybody hyper intelligent...isn’t that a risk too? We could observe many geniuses being not able to tie their shoes. Who ensures us that our intelligent designed children won’t be like this too?

An Idea I read about was to add a pair of chromosomes (numbers 47 and 48). This would open us a new possibility to do genetic manipulation. With 24 chromosome pairs it would be easier to regulate the genes, to remove and replace genes and to make them function correctly.

Experts agree that rich parents will be able to mess around with their offspring’s genes in future. They disagree how long it will take but they’re sure it’ll come.

But do we really need “perfect” people? Aren’t we already perfect with our defects?

Maybe human in 100 years will be able to create with genetic manipulation a child which is designed to live in outer space?!

7 Summary

You could compare the invention of designer babies with the invention of atomic force. Both can be helpful if used reasonable but can be badly abused. The atomic bomb killed thousands of people and so will maybe the designing of babies. But shouldn’t we have learned something out of the event of the atomic bomb? That big steps into future sometimes are big steps backwards if abused? I think the idea of designer babies in general is good but I think it’s too dangerous to really use because it can be badly abused.

I have to admit that I’m happy not living in a time of designer babies. I think right now we live in an almost perfect time already. We have the possibility to use PGD to make our children not suffer a disease but we aren’t able yet to design every single trait of our children. The designing thing will come sooner or later! And whether that fact is good or bad only depends on world population, whether they know or just think what is good for them. But about one thing I’m sure you can’t stop science from getting deeper and deeper to source of creation of life.

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Pictures:

Picture 1:

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Picture 2:

<http://www.google.ch/images?um=1&hl=de&biw=1120&bih=495&tbn=isch&sa=1&q=IVF&aq=f&aqi=g3&aql=&oq=>

Picture 3:

<http://www.google.ch/images?hl=de&q=pgd&um=1&ie=UTF-8&source=og&sa=N&tab=wi&biw=1120&bih=495>