

Preconception sex selection for non-medical and intermediate reasons: ethical reflections

Guido DE WERT, Wybo DONDORP

Maastricht University, Faculty of Health, Medicine and Life Sciences, Dept. Health, Ethics & Society, Research Institute GROW, P.O. Box 616, 6200 MD Maastricht, the Netherlands.

Correspondence at: g.dewert@hes.unimaas.nl

Abstract

Sex selection for non-medical reasons is forbidden in many countries. Focusing on preconception sex selection, the authors first observe that it is unclear what should count as a 'medical reason' in this context and argue for the existence of 'intermediate reasons' that do not fit well within the rigid distinction between 'medical' and 'non-medical'. The article further provides a critical review of the arguments for the prohibition of sex selection for non-medical reasons and finds that none of these are conclusive. The authors conclude that the ban should be reconsidered, but also that existing societal concerns about possible harmful effects should be taken seriously. Measures to this effect may include limiting the practice to couples who already have at least one child of the sex opposite to that which they now want to select ('family balancing'). Finally, a difficult set of questions is raised by concerns about the reliability and unproven (long-term) safety of the only technology (flow cytometry) proven to work.

Key words: Preconception sex selection, non-medical reasons, flow cytometry, ethics, regulation.

1. Introduction

Since ancient times, prospective parents have tried to influence the sex of their future children. Aristotle, for example, advised those wanting a boy to have intercourse when the wind is in the north. Other people have assumed that special diets, the timing of intercourse in relation to ovulation, binding up one of the testicles during intercourse, or the position during intercourse, might facilitate sex selection. Apparently, every folk culture has its own strategies. Modern science provides people with new, more effective, methods for sex selection. This is widely (though not universally) seen as a welcome development insofar as sex selection for medical reasons is concerned. However, sex selection for non-medical reasons has been the subject of recurrent ethical and public policy debate in many countries. The latest round in this debate was fuelled by the public consultation held in the United Kingdom on the initiative of the Human Fertilisation and Embryology Authority (HFEA) in 2002, and the HFEA's sub-

sequent decision to continue to limit the use of sex selection techniques in licensed centres to cases 'in which there is a clear and overriding medical benefit' (HFEA, 2002; HFEA, 2003). This is now also given a further legal underpinning in the amended British Human Fertilisation and Embryology (HFE) Act of 2008. A recent overview (Darnovsky, 2009) shows that a similar restrictive stance is adopted in all 36 countries with laws and policies on sex selection, including China, India, Turkey, Australia, Canada, and 25 European countries (among which are also Belgium and the Netherlands). In the same vein, article 14 of the European Convention on Human Rights and Biomedicine (Oviedo Convention) of 1997 states that 'techniques of medically assisted reproduction shall not be allowed for the purpose of choosing a future child's sex, except where serious hereditary sex-related disease is to be avoided'. Some countries (in Europe: Austria and Switzerland) go even further and prohibit sex selection for any reason.

Although it may seem that the sheer weight of this prohibitive consensus between jurisdictions, at least

in Europe, has brought the debate about allowing sex selection for non-medical reasons to a closure, and although it is clear (as again confirmed in the consultation held in the UK) that among the public there are strong moral feelings against more liberal policies, we will argue that there are still good reasons for questioning the arguments behind this international consensus.

The focus of this paper is on medical methods for sex selection - not on the 'do it yourself' methods. Some further distinctions and specifications are important. A second distinction concerns the *timing* of sex selection. Sex selection can be performed at three stages:

- before conception/fertilization, where one can make a selection at the level of the sperm using sperm sorting. This strategy is called preconception sex selection, primary sex selection or sex pre-selection;

- just after fertilization, by means of in vitro fertilization (IVF) combined with preimplantation genetic diagnosis (PGD), aiming at a selective transfer of an embryo of the desired sex. This procedure is called preimplantation - or secondary sex selection.

- during pregnancy, where people might use prenatal diagnosis - chorionic villus sampling (CVS), amniocentesis or even non-invasive prenatal diagnosis (NIPD) (Newson, 2008; De Jong, 2009; Wright, 2009) - to decide about continuation or selective termination of the pregnancy in view of the sex of the foetus. This is post-implantation, prenatal or tertiary sex selection.

A third distinction concerns the *reasons* for sex selection. The literature generally makes a distinction between medical and non-medical reasons. Medical reasons are often defined in terms of preventing the conception or birth of a child suffering from a sex-linked disorder, like Duchenne muscular dystrophy or haemophilia. Non-medical reasons are rather diverse; people may just prefer a child of one sex over the other, either for personal reasons or for socio-cultural reasons, or they may want to 'balance' their family if they have one or more children of one sex and would like to have a further child of the other sex. But obviously, a third category of possible reasons should be added, which can be regarded as intermediate between medical and non-medical reasons (De Wert, 1993; De Wert, 2005). Think of males affected with an X-linked recessive disorder, like haemophilia. Some of these patients would prefer to conceive boys only, because sons (inheriting the 'non-affected' Y chromosome from their father) will not carry the mutation, whereas all daughters would be (in principle healthy, but) obligate carriers of the mutation. What, then, if one of these male

patients (and their partners) were to request sex selection in order to avoid the conception or birth of a carrier-daughter? In such cases, the reason for choosing sex selection is not to avoid the birth of a child with a serious disease, but to avoid the birth of a child that later in her life may have to face difficult reproductive decisions herself, given her 1 in 4 risk of having children affected by her father's disease.

As our contribution was part of a congress on "Artificial Insemination", this paper regards the ethics of *preconception* sex selection. More in particular, this paper focuses on the ethics of preconception sex selection for *non-medical* and *intermediate* reasons, as preconception sex selection for *medical* reasons is widely considered to be acceptable from a moral point of view. In the next paragraph, we will first summarize the normative views of some relevant committees and some (inter-) national legal regulations (section 2). Next, we will provide an ethical evaluation of the main arguments in the debate (section 3). The technology presently available for preconception sex selection will be sketched thereafter, with particular attention to its efficacy and safety (section 4). Finally, we will draw some conclusions and present some recommendations (section 5).

2. Preconception sex selection: highlights from the debate

To give an impression of the reception of preconception sex selection for non-medical reasons this section contains a brief, chronological overview of relevant recommendations of ethics committees, advisory bodies and of some (inter-)national regulations. Clearly, the overview is not exhaustive - but it is, we think, representative.

President's Commission (1983). This American Commission argued that sex selection for non-medical reasons reflects a morally objectionable attitude to the future child, an attitude which, taken to an extreme, treats the child as an artifact and the reproductive process as a chance to design children according to parental standards of excellence (President's Commission, 1983).

The Warnock Report (1984). The British 'Warnock Committee' mentioned possible negative social effects of sex selection for non-medical reasons, like effects on the ratio of males to females. These considerations made the Committee dubious about the use of sex selection techniques on a wide scale, but because of the difficulty of predicting the outcome of any such trend the Committee has not found it possible to make any positive recommendations on this issue. Nevertheless, the Committee considered that

the question of the acceptability of sex selection should be kept under review (Warnock report, 1984).

The Glover Report (1989). According to this report, submitted to the European Commission, it could be argued that there is nothing intrinsically wrong with sex selection for social reasons. But the Committee is 'impressed by the dangers of an unbalanced sex ratio, and inclined to the view that the motives behind the choice of sex will often be ones society would do better to discourage than to satisfy. So we think that sex selection should be strongly discouraged. It would be desirable for clinics to be banned from providing pre-conceptual techniques as a service.' (Glover report, 1989).

The (German) 'Embryo Protection Act' (Gesetz, 1991). This piece of legislation contains a special section on inappropriate sex selection ('mißbrauchliche Geschlechtswahl'): 'Any person who fertilizes a human egg with a sperm cell which has been specifically chosen because of its sex chromosome is guilty of an offence ... This is not the case if the sperm has been specified by a physician in order to protect the child from possible severe, sex linked diseases ...' (Embryonenschutzgesetz, 1991).

The Law Reform Commission (1992). This Canadian Commission states: 'To eliminate the possibility of eugenic practices, the selection of gametes and embryos with specific qualities should be prohibited, except where the objective is to prevent the transmission of serious genetic diseases.' Selection of sex for non-medical reasons is considered to be unacceptable, as 'such practices ... disrupt the demographic and social balance between the sexes for future generations, and could have a tremendous impact on these 'made-to-measure' children. It therefore seems appropriate to limit individual freedoms in the name of respect for human dignity.' (Law Reform Commission, 1992).

Health Council of the Netherlands, Standing Committee Medical Ethics and Health Law (1995). According to this committee, there is no cause to prohibit preconception sex selection in the Netherlands. Governments ought, in principle, to respect the reproductive freedom of parents - any exception to this basic principle can only be justified if the interests of others are harmed. After a review of the scientific evidence, the Committee concluded that 'there is no reason to suppose that this is the case'. However, the Committee did emphasize the provisional nature of this conclusion concerning social implications; it cannot be excluded that the availability of opportunities for sex selection as part of family planning might lead to parents finding the gender of their children to be more important than now appears the case. Developments in this area should, therefore, be monitored very critically (Health Council, 1995).

American Society for Reproductive Medicine, Ethics Committee (2001). This Committee concluded that if trials show that the techniques of preconception gender selection are safe and effective, the most prudent approach at present for the non-medical use of these techniques would be to use them only with the aim of establishing gender variety in a family. If the social, psychological, and demographic effects of those uses have been found acceptable, then other nonmedical uses of preconception sex selection might be considered (Ethics Committee of the ASRM, 2001)

Dutch and Belgian Embryos Acts (2002, 2003). The Dutch Embryos Act prohibits 'performing procedures with gametes or embryos with a view to selecting the sex of a potential child'. An exception to this prohibition is made for cases in which 'there is a risk of a serious sex-linked hereditary disease in the child and the procedures are intended to prevent that disease' (Embryowet, 2002). The Explanatory Memorandum states that this ban was based on the argument that sex selection for non-medical reasons 'reduces children to mere objects of the wishes and preferences of their parents' (Embryowet, 2000). The Belgian Embryos Act contains a similar provision. This forbids 'conducting research or treatments aimed at sex selection, with the exception of selection aimed at preventing sex-linked diseases' (Embryowet, 2003). According to a commentary by Hansen *et al.*, the main motive for not allowing preconception sex selection was the conclusion of the Belgian National Consultative Bioethics Committee in its brief advisory report of 1997, that the then only available method for preconception sex selection ('gradient method') to be combined with artificial insemination, was unreliable (Hansen *et al.*, 2004). A later report from this Committee contained a more comprehensive discussion of arguments both for and against allowing preconception sex selection for non-medical reasons, but without this leading to a consensus view or policy advice.

HFEA (2003) and amended Human Fertilisation and Embryology Act (2008). In the Authority's view, the likely benefits of permitting sex selection for non-medical reasons in the UK are at best debatable and certainly not great enough to sustain a policy to which the great majority of the public are strongly opposed. Accordingly, the Authority decided that treatment services provided for the purpose of selecting the sex of children, by whatever means this is to be achieved, should be restricted under license to cases in which there is a clear and overriding medical justification (HFEA, 2003). In the amended British Human Fertilisation and Embryology (HFE) Act of 2008 this is defined as cases where there is a particular risk that a woman will give birth to a child

who will have or develop a ‘gender-related’ serious disease or other medical condition (HFE Act, 2008). The notion of a disease or condition being gender-related is further specified as either affecting only one sex or as affecting one sex significantly more than the other. Whereas the corresponding provisions in the German, Dutch and Belgian Embryos Acts can be read as referring only to monogenetic ‘sex-linked diseases’ (the German Act refers to ‘Duchenne Muscular Dystrophy or equally serious sex-linked diseases’), the specification in the amended British Act explicitly also includes non-Mendelian disorders with unequal sex-incidence (Amor, 2008). Parents already having (more than one) children affected by disorders in this category, such as autism, are at a (significantly) higher risk that any further child will also be affected. Whether sex selection to avoid this risk would be legal in Britain may still depend on the interpretation of whether the disease in question would satisfy the requirement of seriousness. Interestingly, the Belgian Act does not require the disease in question to be of a serious or severe nature, whereas the German, Dutch and British Acts do. None of these Acts, nor any of the reports we are aware of, refer to sex selection for intermediate reasons.

On the basis of this short overview, the following conclusions can be drawn:

Firstly, there is wide approval, in principle, of the application of preconception sex selection for *medical* reasons, although both the precise definition of this category and the conditions imposed differ.

Secondly, opinions differ widely with regard to the moral acceptability of preconception sex selection for *non-medical* reasons.

- in many countries this is categorically forbidden, although the reports from ethical committees give a more varied picture.

- the ethical justification of the various positions regarding sex selection for non-medical reasons is often unclear. Indeed, some committees do not or hardly present any arguments in favor of their recommendations. The objections are very diverse and different committees use rather different objections.

Finally, sex selection for what we have called ‘intermediate reasons’ has not yet arrived on the agenda of societal debate and policy making. However, the often quite narrow definition of the category of non-prohibited medical reasons (in terms of avoiding the birth of a child with a sex-linked disease) and the rigid, binary distinction between medical and non-medical reasons, seems to rule out sex selection for intermediate reasons in most if not all jurisdictions with legislation on sex-selection.

In the next section, we will scrutinize the arguments for disallowing preconception sex selection for non-

medical reasons. Where relevant, we will also discuss whether and how these arguments apply to the use of preconception sex selection for intermediate reasons.

3. Ethical analysis

For the sake of debate, we assume, for the moment, that preconception sex selection techniques are completely efficient and of proven safety. That this is not yet an established fact will be addressed in section 4. Several types of moral objections to preconception sex selection for non-medical reasons need to be discerned (Warren, 1985). On the one hand, so-called non-consequentialist or deontological objections refer to what those making such objections regard as morally problematic aspects of the act of sex selection for non-medical reasons taken in itself, that is to say: prior to or apart from any consequences such a choice may have. Consequentialist objections, on the other hand, refer to its presumed adverse consequences. Non-consequentialist objections include the following:

‘Sex selection is unnatural’. Appealing to Nature as a moral norm is quite common in societal debates – but highly questionable. The argument that ‘X is wrong because it is unnatural’ can only succeed if there is an interpretation of the term (un)natural which enables us both to distinguish between natural and unnatural actions, and to understand what there is about the latter which is morally objectionable (Warren, 1985). It is doubtful whether there are any such interpretations which are convincing. Interestingly, proponents of ‘the argument from nature’ are highly selective in their moral reasoning; they regularly object to sex selection for non-medical reasons in particular, but isn’t sex selection for *medical* reasons likewise ‘unnatural’? If valid, therefore, the argument would apply to all forms of sex selection, including medical and what we have called intermediate reasons. However, since it surely is an important part of human nature to be inventive, to intervene in nature, and thus to create culture, we must look elsewhere for criteria to ethically evaluate our actions.

‘Sex selection for non-medical reasons has nothing to do with medicine. So physicians should refrain from this type of sex selection’. This objection implicitly refers to the traditional goals of medicine, namely the prevention of disease, curing the ill, and caring for sick people who can not be cured. Sex selection for non-medical reasons can not be subsumed under any of these traditional tasks of the physician, so there is no medical indication for

this practice (RCO, 1993). This criticism seems to mistakenly suggest that the domain of medicine and health care is surrounded by clear and fixed borders. For a start, one may ask how sex-selection for what we have called intermediate reasons would relate to the goals of medicine as traditionally understood. As in those cases sex selection will not change the health status of the child to be born, reasoning from a strict understanding of those goals would lead to the conclusion that sex selection for intermediate reasons is beyond the scope of medicine. After all, the prospect that a daughter may have to face difficult reproductive decisions later in her life is not in itself a medical condition. So understood, intermediate reasons seem closer to 'social' than to 'medical' reasons. On the other hand, one may reason that what makes those reproductive decisions difficult are health related considerations and that, indirectly, the request for sex selection would still be motivated by the wish to prevent gender-related diseases in one's offspring. From this perspective, a case can be made for regarding those intermediate reasons for sex selection as 'medical' in a wider sense of the word. The further question here is why an appeal to the bounds of medicine as concerned with health related issues would imply that sex selection for what are clearly non-medical reasons is not acceptable. In fact, there are various widely accepted medical solutions for non-medical problems. Classical examples are sterilisation for the purpose of family planning or cosmetic surgery. If these are acceptable practices, one may doubt as to whether the absence of a medical indication as such is a strong moral objection to assisting in pre-conception sex selection for non-medical reasons.

'Sex selection for non-medical reasons is inherently sexist'. Sexism can be defined as the wrongful discrimination between individuals on grounds of sex. The current objection implies that sex selection for non-medical reasons is nothing but 'an expression of sex prejudice, reflecting an attitude that one sex is in general inferior.' (Glover Report, 1989) or even 'the original sexist sin' (Powledge, 1983). It is obvious that a sexist motivation for sex choice is morally wrong, as it stands in denial of the principle that all human beings have the same worth. This charge is clearly not applicable to sex selection for medical, nor for 'intermediate reasons', but what about sex selection for personal or cultural reasons? Do motives in the 'non-medical' category necessarily presuppose the view that the desired sex is superior or do they necessarily build on stereotyping views of differences between the sexes? If so, that would indeed amount to a strong argument for disallowing sex selection for such reasons. However,

it is far from obvious that it is necessarily sexist for someone to want to select the sex of a child for a non-medical reason. Consider the following examples (Warren, 1985; Health Council, 1995). Firstly, in some subcultures in some countries, a son is an economic asset; a son will earn more money, and parents will have to provide their daughter(s) with a dowry, which might almost ruin their own family. Against the background of such conditions, son-preference is not necessarily a sign of sexism of the prospective parents – even though their preference would be related to sexism at the socio-cultural level. It may even be the case that couples prefer to have sons because they want to spare their daughters the plight of having to live in a sexist society. Of course, the fact that such choices may reinforce sexist structures and institutions is a relevant consideration where the possible social consequences of sex selection are concerned. However, this does not mean that those choices are inherently sexist themselves (Warren 1985). Secondly, what about parents wanting to have a 'mixed' or 'balanced' family? Are those who believe that family dynamics would be enhanced by having children of *both* sexes guilty of a sexist attitude? Think of couples who have one or more sons and prefer their next child to be a girl, or vice versa. Although the preference for a mixed family does not presuppose the view that one of the sexes is superior, it may still be informed by a sexist stereotyping of gender differences. Here again, the issue is that this would not necessarily be the case. The preference for a mixed family is perfectly compatible with respecting and welcoming children as individuals whose worth does not depend on whether they fulfill some preconceived image of what a boy or girl should be (Robertson, 1994; Health Council, 1995).

Obviously, these examples do not suffice to take away concerns that motives for sex selection may still be sexist in individual cases (cf. the concerns of the Glover-Committee, as summarized in section 2). However, the question is whether the fact that some applicants may have morally dubious motives should lead to a categorical rejection of sex-selection for non-medical reasons. An interesting analogy is that some applicants for sex selection for medical reasons (and the same would apply to what we have called intermediate reasons) may be motivated by discriminatory motives regarding people with disabilities. Most commentators and regulators do not think that this possibility should be taken as a reason for prohibiting sex selection aimed at avoiding the birth of a child with a gender-related disease.

'Sex selection for non-medical reasons is an invasion of human dignity'. Another objection

regards human dignity. Some critics, e.g. the (Canadian) Law Reform Commission (see section 2), suggest that non-medically motivated sex selection undermines human dignity. This was also the view of the Dutch government as laid down in the Explanatory Memorandum to the Embryos Act (quoted in section 2). In a related government document it is said that sex selection for non-medical reasons ‘runs counter to the general understanding that children are more than a means to satisfying parental preferences’ (Besluit Geslachtskeuze, 1998). In this connection, the government also referred to the reasoning behind the relevant prohibition in the European Convention on human rights and biomedicine. Implicit in this line of argument is the (anthropological version of the) categorical imperative of Immanuel Kant, which holds that a person should always be treated as an end in himself and never merely as a means to other ends (Kant, 1785; Sullivan, 1989). No doubt, there might be parents who prefer to have a child of a particular sex as mere material to optimally fit their parental gendered expectations. But, here again, non-medical reasons are not necessarily instrumentalising. People who opt for sex selection for non-medical reasons may very well respect their future child as an autonomous agent, as an end in him-/herself.

Consequentialist objections include the following:

‘Sex selection for non-medical reasons will distort the sex ratio’. That sex selection for non-medical reasons may have adverse societal effects is shown by developments in some countries, including India (notably the Indian state Punjab), where this practice has resulted in a substantial increase of males (Patel, 2007). These ‘surplus’ males may not be able to find a mate and some commentators fear a (further) loss of status and rights of females by virtue of their being in the minority – although the reverse might be possible as well (Warren, 1985).

Critics sometimes assume that sex selection for non-medical reasons will likewise distort the sex ratio in Western countries (cf both the Glover Report and the Canadian Law Reform Commission as summarized in section 2). Whether this scenario is realistic, depends on sex selection both becoming widespread here and being used to select mainly for males. Recent surveys in Western countries (Canada, the USA, the UK, Germany and the Netherlands) reveal that most people prefer a more or less balanced family (Health Council of the Netherlands, 1995; Dahl, 2003; Dahl *et al.*, 2006). There seems to be no indication of a strong preference for either sex. Insofar as there still is a preference for boys, this seems to be a marginal phenomenon. Perhaps even more

instructive than surveys are data from so-called ‘gender clinics’ offering sperm sorting and insemination to interested couples in several countries without prohibitive legislation. Apparently, a very large majority of applicants visiting gender clinics in the UK (prior to a recent tightening of licensing requirements; Laurance, 2008) and the USA were seeking preconception sex selection for family balancing (Dahl, 2003). However, this may not apply to applicants from some ethnic minorities. Of the more than 800 couples who visited the London gender clinic in the first two years of its existence, more than 60% were of Asian origin. The large majority of these couples wanted a son (Liu, 1995).

‘Sex selection for non-medical reasons will have negative consequences for the psychosocial development of children’. This argument refers to possible harm that may result from the feeling of being conditionally wanted. However, the knowledge that one’s parents have used sex selection is not enough to generate this feeling. This would seem to very much depend on whether and to what extent the way parents interact with their children is informed by stereotypical ideas about how girls or boys should behave. It has been observed that sex selection may also have the positive effect of reducing the number of children having to bear the burden of being wanted less because of their sex (Health Council, 1995). Without further data, the question whether allowing sex selecting for non-medical reasons would lead to exposing more children to harmful styles of parenting, remains speculative.

‘Sex selection for non-medical reasons will affect the position of women in society’. The presupposition that in Western societies sex selection for social reasons will not significantly affect the sex ratio does not rule out that there may still be effects on the social position of women. It has been suggested that, given a preference for boys, men will profit more from the ‘first-born advantage’ than women. The scenario (not supported by the findings of more recent surveys in Western countries) that most people would want a boy as the first child is alarming to those who support the psychological theory that firstborns are advantaged because parents are apt to concentrate their efforts at providing a stimulating environment on them: ‘with sex selection, boys will monopolize the eldest-child bonuses in addition to other male privileges.’ (Holmes, 1985). The theory of the eldest-child bonuses, however, is controversial. In her overview, Warren concludes that the evidence available appears to support a sceptical view on the intrinsic importance of birth order (Warren, 1985). Anyway, even if it were evidence-

based, the current objection does not in itself imply that all forms of sex selection for non-medical reasons should be discouraged or banned. Indeed, it would only imply that selecting the sex of one's first child should perhaps be prohibited. As such, the argument cannot serve as an objection against sex selection aimed at having a mixed family – the motive that the large majority of applicants of sex selection in gender clinics in Western countries seem to have (vide supra).

'Sex selection for non-medical reasons is a first step on a slippery slope towards morally unacceptable forms of reproductive selection'. This objection holds that allowing sex selection for non-medical reasons will inevitably result in permitting prospective parents to design what they consider to be the perfect child, to conceive a 'designer' baby, whether that involves high intelligence, high musical and/or athletic competencies, or any number of other special qualities. The former (American) President's Commission, for instance, argued that sex selection for non-medical reasons reflects a morally objectionable attitude to the future child, an attitude which, taken to an extreme, treats the child as an artifact and the reproductive process as a chance to design children according to parental standards of excellence (President's Commission, 1983; cf. section 2). As the latter is morally unacceptable, so the argument runs, we should not allow people to select the sex of their child, except for clear medical reasons. The slippery slope argument can likewise be brought to bear upon sex selection for what we have called intermediate reasons. One may argue that with this application, a crucial line is being crossed towards selecting children for characteristics unrelated to their own health. The idea is that after accepting this first step away from a strictly medical justification, it will be impossible not to end up also accepting selection of children for all kinds of non-health related traits. Even if sex selection for non-medical or intermediate reasons need not in itself be morally problematic, it will be impossible not to slide down towards reprehensible practices of commodification and instrumentalisation.

What to think of this objection? Let us first state that, from a scientific point of view, the feasibility of such reproductive selection or 'repro-designing' is strongly exaggerated in the media and in science fiction; in reality, the preferred characteristics are rather complex, co-determined by many genes and (mostly poorly understood) gene-environment interactions. This makes the reprogenetic creation of the perfect child highly unlikely (Human Genetics Commission, 2006). From an ethical point of view, the question is why and when (still futuristic) designing our progeny

would be morally wrong. Some seem to argue that any type of reproductive enhancement (selecting for or designing special qualities) would undermine the autonomy of the future child and would, therefore, constitute an unacceptable violation of the dignity of the child (Habermas, 2001). Others may argue that such enhancement may be morally justified as long as the future child's autonomy is respected (Glover, 2006). Whatever we think of this debate, the current objection is problematic as it presumes that sex selection for non-medical (or indeed: intermediate) reasons will *automatically* lead to reproductive selection procedures or interventions that are intrinsically wrong. The presumed automatism is untenable: if selection for sex is morally acceptable, but selection for X, Y and Z is not, one may simply prohibit the latter and allow the former.

In summary: deontological arguments against allowing preconception sex selection for non-medical reasons (including intermediate ones) are either mistaken or unconvincing, whereas arguments referring to possible negative consequences are speculative at best. However, with regard to consequences, the analysis is not yet complete. So far, we have presumed that for couples wanting to select the sex of their children a reliable and safe sperm sorting technique was available that as such would not give rise to further moral concerns. Whether this is the case, is a question that we will now go on to consider.

4. Flow cytometry: the state of the art and its moral implications

Preconception sex selection involves sperm sorting, i.e. separating sperm cells that carry the X chromosome (gynogenic sperm) from sperm cells that carry the Y chromosome (androgenic sperm). The enriched sperm sample may ideally be used in artificial insemination (AI), which is less expensive and less invasive than IVF. While various methods of sperm sorting have been suggested, studied, and commercially offered, flow cytometry is currently the only option with a demonstrated efficacy. According to an overview of the HFEA, the pros of this technology include that it has a relatively high success rate and that sperm can indeed be used for AI rather than IVF, while its cons include that the technology is not completely reliable and that there are no conclusive studies yet confirming the safety for use in humans, although there are no contraindications from use in domestic cattle (HFEA, 2003). Obviously, both the reliability and safety of the technology used for preconception sex selection is morally relevant, as these relate to the interests of prospective parents applying for this technology, future children thus conceived

and society as a whole. In this section, we concentrate on the interests of the child.

Efficacy

In a recent paper, Karabinus (2009) provides the updated findings of the ongoing clinical trial performed at the Genetics & IVF Institute at Fairfax, USA. According to this study, the MicroSort sperm separation technology effectively increases the percentage of X- or Y-chromosome-bearing sperm in the sorted specimen. Consistent with this finding are the birth sex data: 92% of the babies were female after Xsort and 83.6% of babies were male after Ysort. These data provide evidence, so Karabinus concludes, of the efficacy of the method used for sex selection.

Although one may admit that this method has a relatively high success rate, its efficacy is clearly suboptimal. What happens if things go wrong, and the expected boy turns out to be a girl or vice versa? This is not a theoretical risk, at least for the moment: after using flow cytometry sorted sperm, in 8% of the cases where parents wish to have a girl they will have a boy and in approx. 16% of the cases where they would want to have a boy they will have a girl. One hopes the parents will adjust in such cases, recover from the surprise or shock, and will welcome and love their child for its own sake. But what if parents who have invested a lot in trying to select the sex of their child have difficulty in overcoming their disappointment? Of course, the imperfection of the technology for preconception sex selection is also relevant for its application for medical reasons. Where the use of flow-cytometry to avoid the transmission of a serious sex-linked disease is concerned, a misdiagnosis rate of 8-16% rate may seem dramatic. However, this may still be acceptable if regarded as a preselection step to be combined with further selective procedures, either postconceptionally (through PGD and embryoselection), or indeed prenatally, through prenatal diagnosis and abortion. The combination of flow cytometry and PGD is explicitly envisaged by the HFEA as a conceivable option for 'patients at a significant risk of passing on a serious sex-linked genetic condition to their offspring' (HFEA, 2003). This would have as an advantage over direct PGD that a higher number of embryos of the desired sex will be available for post-conception selection. Whether this step-wise approach should in principle also be available for couples at a higher risk of non-mendelian diseases with an unequal sex incidence (and perhaps also for sex selection for intermediate reasons) is a separate question that invokes considerations of proportionality in the context of the ethics of PGD and is outside the scope of this paper. The same holds for

whether these considerations rule out the use of this combined approach where non-medical reasons are concerned. Even if this need not necessarily be the case, the combined approach will as a matter of fact be out of reach for most applicants wanting to select the sex of their offspring for non-medical reasons. This means that the suboptimal efficacy of flow cytometry remains a challenge given concerns about what it may mean for a child to be born to parents having gone so far in trying to have a child of the opposite sex.

Safety

Ever since flow cytometry has been proposed as a method for preconception sex selection, there have been concerns about its safety, mainly because it requires the staining of spermatozoa with a fluorescent dye (Hoechst 33342). However, the updated results from the MicroSort trial show that the malformation rate among babies conceived using this technology is similar to that of the general population. These data are now based on a total of 760 baby medical records (Karabinus, 2009). Reassuring outcomes were also reported in a recent review of the safety aspects of the same procedure in a large variety of mammalian species, based on data of around a million offspring (Garner, 2009). This review led to the conclusion that there is 'no apparent genotoxic effect from exposure of sperm to Hoechst 33342'. However, the same review also concluded that embryonic development is slower in sorted than in non-sorted sperm and that fertility rates are also lower. Moreover, there are no published data about cross-generational effects on health and fertility (Garner, 2009). Although there are different hypotheses for the effect on the lower fertility following insemination of mammalian females with sex sorted sperm (Grant, 2007), the more likely explanation seems to be that sperm may be damaged by the sorting process, in which the cells are exposed to a number of procedures that may be harmful, including (but not limited to) the fluorescent staining (Bermejo-Alvarez, 2008). Reports on specific effects refer to reduced motility and life-span of sperm. One report also found different expression patterns of developmentally important genes in bovine embryos that have been derived from sorted and non-sorted sperm (Morton, 2007). The clinical implications of these findings, however, are unknown for the moment.

5. Conclusions and recommendations

We conclude that the grounds for the present ban on preconception sex selection for non-medical reasons need reconsidering. First of all, the legislative

delineation of what counts as a ‘medical reason’ tends to be drawn too tightly. This is often defined in terms of avoiding a sex-linked disorder, which is usually understood as referring to a specific category of monogenetic diseases. This narrow definition is problematic, as it excludes sex selection aimed at avoiding the birth of a child with a non-mendelian disorder with an unequal sex incidence. In our view, parents at a higher risk of having a child with such a disorder should be allowed to use preconception sex selection, as is also acknowledged in the new British Act. The requirement that this should be a *serious* disease is too strict here, although it may be in place where postconceptional sex selection (via PGD) is at stake, as that would obviously change the proportionality of the procedure. Moreover, current regulations wrongly ignore the category of intermediate reasons: sex selection to avoid that one’s offspring may have to face difficult reproductive decisions. We contend that like ‘medical reasons’ *stricto sensu* this is a morally unproblematic motive and that preconception sex selection for intermediate reasons should (in principle) be allowed.

With regard to what are clearly non-medical (personal, cultural) reasons things are more complex. As sex selection for non-medical reasons is not inherently sexist nor necessarily instrumentalising, and objections in terms of ‘unnaturalness’ or tensions with the traditional goals of medicine are unconvincing, reasons for a ban must be based on robust indications (rather than speculations) regarding harmful effects that allowing the procedure would have on children, women or society at large. Since, at least in a European context, no such indications have been identified, a categorical prohibition seems difficult to reconcile with the principle of respect for reproductive autonomy (Warren, 1985; Health Council 1995; Dahl, 2003; Robertson, 2004). However, this conclusion should not be read as a call for a ‘laissez faire’-policy. Concerns about possible harmful effects of non-medical sex selection both on the psychosocial development of children and on society at large should be taken seriously (McMahon, 2004). The obvious response to this is indeed to allow preconception sex selection in a regulated setting aimed to strictly monitor its effects at all levels (Pennings, 2004). Whether this should include the condition that preconception sex selection may only be used to allow parents to enlarge their chances of having a mixed family (requiring that they already have at least one child of the other sex) is a matter for debate (Pennings, 1996). As has rightly been argued, it cannot be maintained that setting this condition would rule out the use of sex selection for sexist motives (including gender stereotyping) that may be harmful for the development of

children in those families (Wilkinson, 2008). Even so, setting this condition might be a way of responding to societal concerns without making too large an inroad on the reproductive freedom of those who want to make use of preconception sex selection. After all, research has shown that the larger majority of those couples would want to do so with the aim of creating a mixed family.

Monitoring of effects should include long term follow-up of children born after preconception sex selection. In this connection, psychosocial research is needed to clarify issues such as possible pressures on the child to conform to gender stereotypes, effects on family dynamics and child development, uptake in and effects on ethnic communities, the position of women, etc.

Finally, a difficult set of questions is raised by concerns about the imperfect efficacy and unproven (long-term) safety of the technology. How should these concerns affect the debate over the acceptability of preconception sex selection for non-medical reasons? If the practice as such is acceptable in principle, is this still the case if the only technology – flow cytometry – that may presently work has these features? With regard to effects of failed sexing on the psychosocial development of the child: this is a further concern that we think should be closely monitored, but that as such is no less speculative than those listed before. Whether the fate of children in this situation would be worse than that of children of non-congruent sex whose parents have not attempted sex selection – cases of which would be prevented by allowing sex selection for non-medical reasons – is unclear (Health Council, 1995; Pennings, 2004). But what about possible (long term) health risks of flow cytometry? Although any remaining safety concerns are relevant for all clinical applications of the technology, accepting these is more difficult to justify where the procedure is carried out to satisfy a mere parental preference than where the aim is to avoid the birth of a child with a serious disease. We see two possible lines of reasoning here. Given the debate about the need for the field to proceed with greater care when introducing new reproductive technologies into clinical practice (Pennings *et al.*, 2007), one might argue that as long as safety concerns cannot be fully answered, flow cytometry may indeed only be used for medical reasons. The alternative is to say that this is too strict, given the extensive amount of reassuring data from the use of this same technology in cattle and other animals over more than 20 years, and that any remaining safety concerns should be addressed by careful monitoring rather than by imposing limitations on clinical use. We will not argue here for either of these positions. However, we do want to stress

that this issue should be on the agenda of the urgently needed reopening of the debate about pre-conception sex selection for non-medical reasons.

Why would this be urgent? Firstly, because unjustified limitations of reproductive freedom cannot be accepted in a liberal society (Dahl, 2004). But there is a second reason that is both morally relevant and of practical importance. In the coming years, new techniques allowing non-invasive prenatal diagnosis will become available for routine applications in early pregnancy (Wright, 2009). This will allow easy and risk-free testing for fetal aneuploidies, but also for fetal sex. In the light of the current ban on pre-conception sex selection for non-medical reasons, a possible consequence of this development may well be that interested couples will use information on fetal sex obtained from early fetal diagnosis for sex selective abortion (Newson, 2008; de Jong *et al.*, 2009). Not only would this amount to a form of sex selection that (unlike the use of a technique such as flow cytometry) is impossible to regulate and monitor, but also would the use of abortion as a means be morally more problematic than the forms of sex selection that are currently prohibited.

References

- Amor DJ, Cameron C. PGD gender selection for non-Mendelian disorders with unequal sex incidence. *Hum Reprod.* 2008; 23:729-34.
- Bermejo-Alvarez P, Rizos D, Rath D *et al.* Can bovine in vitro-matured oocytes selectively process X- or Y-sorted sperm differentially? *Biol Reprod.* 2008;79(4):594-7.
- Besluit van 26 mei 1998, houdende een verbod op geslachtskeuze om niet-medische redenen. *Staatsblad* 1998-336 (*in Dutch*).
- Dahl E. Procreative liberty: the case for preconception sex selection. *RBM Online.* 2003;7(4):380-4.
- Dahl E. The presumption in favour of liberty: a comment on the HFEA's public consultation on sex selection. *RBM Online.* 2004;8(3):266-7.
- Dahl E, Beutel M, Brosig B *et al.* Social sex selection and the balance of the sexes: empirical evidence from Germany, the UK, and the US. *J Assist Reprod Genet.* 2006;23(7-8):311-8.
- Darnovsky M. Countries with laws or policies on sex selection. Memo for the April 13 New York City sex selection meeting. (Marcy Darnovsky, Center for Genetics and Society, April 2009) (accessed April 25, 2010).
- De Jong A, Dondorp WJ, de Die-Smulders CE, Frints SG, de Wert GM. Non-invasive prenatal testing: ethical issues explored. *Eur J Hum Genet.* 2010;18(3):272-7.
- De Wert G. Boy or girl? – that's the question. *Het Britse debat over seksselectie.* *IGE Bulletin* 1993;7(1):9-10 (*in Dutch*).
- De Wert G. Preimplantation genetic diagnosis: the ethics of intermediate cases. *Hum Reprod.* 2005;20:3261-6.
- De Wert G. Preimplantation genetic testing: normative reflections. In: Harper J, ed. *Preimplantation genetic diagnosis.* Cambridge, etc.: Cambridge University Press, 2009 (second ed.), pp. 259-273.
- Embryowet. Explanatory Memorandum to the Dutch Embryos Act (2000). Tweede Kamer der Staten Generaal; vergaderjaar 2000-2001, 27 423, nr. 3 (*in Dutch*).
- Embryowet. Belgian Embryos Act (2003): (*in Dutch*) (accessed April 25, 2010).
- Embryowet. Dutch Embryos Act (2002): (*in Dutch*) (accessed April 25, 2010).
- Embryonenschutzgesetz. German Embryos Act (1991): (*in German*) (accessed April 25, 2010).
- Ethics Committee of the American Society for Reproductive Medicine. Preconception gender selection for nonmedical reasons. *Fertil Steril.* 2001;75:861-4.
- Garner DL. Hoechst 33342: The dye that enabled differentiation of living X- and Y-chromosome bearing mammalian sperm. *Theriogenology.* 2009;71:11-21.
- Glover Report. Ethics of New Reproductive Technologies: The Glover Report to the European Commission (Studies in biomedical policy). Northern Illinois Univ Press, 1989.
- Glover J. Choosing children. The ethical dilemmas of genetic intervention. Oxford: Clarendon Press, 2006.
- Grant VJ, Chamley LW. Sex-sorted sperm and fertility: an alternative view. *Biol Reprod.* 2007;76(2):184-8.
- Habermas J. Die Zukunft der menschlichen Natur. Auf dem Weg zu einer liberalen Eugenik? Frankfurt am Main: Suhrkamp, 2001.
- Hansen B, Schotsmans P, Nys H. De Belgische embryowet. Ethische Perspectieven 2004;14:55-69 (*in Dutch*).
- Health Council of the Netherlands. Standing Committee on Medical Ethics and Health Law. Sex selection for non-medical reasons. The Hague: Health Council of the Netherlands, 1995; publication number 1995/11E.
- Holmes HB. Sex preselection: eugenics for everyone? In: Humber JM, Almeder RF (eds.), *Biomedical Ethics Reviews.* New Jersey: Humana Press, 1985, pp. 39-71.
- Human Fertilisation and Embryology Act 2008: (accessed April 25, 2010).
- Human Fertilisation and Embryology Authority. Sex selection: choice and responsibility in human reproduction. London: HFEA, 2002.
- Human Fertilisation and Embryology Authority. Sex selection: options for regulation. A report on the HFEA's 2002-2003 review of sex selection including a discussion of legislative and regulatory options. London: HFEA, 2003.
- Human Genetics Commission. Making babies: reproductive decisions and genetic technologies. 2006.
- Kant I. Grundlegung zur Metaphysik der Sitten. 1785 (*in German*).
- Karabinus DS. Flow cytometric sorting of human sperm: MicroSort clinical trial update. *Theriogenology.* 2009;71:74-9.
- Liu P, Rose GA. Social aspects of > 800 couples coming forward for gender selection of their children. *Hum Reprod.* 1995;10(4):968-71.
- Laurance J. It's a boy! The science of gender selection. *The Independent*, 24 April 2008.
- Law Reform Commission. Medically Assisted Procreation. Ottawa: The Commission, 1992.
- McMahon CA. Community concerns about sex selection: research as a way forward - response to Edgar Dahl's 'The presumption in favour of liberty'. *Reprod Biomed Online.* 2004;8(3):272-4.
- Morton KM, Herrmann D, Sieg B *et al.* Altered mRNA expression patterns in bovine blastocysts after fertilisation in vitro using flow-cytometrically sex-sorted sperm. *Mol Reprod Dev.* 2007;74(8):931-40.
- Newson AJ. Ethical aspects arising from non-invasive fetal diagnosis. *Sem Fetal Neonat Med.* 2008;13:103-8.
- Patel T, ed. Sex-selective abortion in India: gender, society, and the new reproductive technologies. New Delhi: Sage Publications, 2007.
- Pennings G. Ethics of sex selection for family balancing. Family balancing as a morally acceptable application of sex selection. *Hum Reprod.* 1996;11:2339-45.
- Pennings G. Sex selection, public policy and the HFEA's role in political decision making – response to Edgar Dahl's 'The presumption in favour of liberty'. *RBM Online.* 2004;8(3): 268-9.

- Pennings G, De Wert G, Shenfield F *et al.* ESHRE Task Force on Ethics and Law 13: the welfare of the child in medically assisted reproduction. *Hum Reprod.* 2007;22:2585-8.
- Powledge T. Toward a moral policy for sex choice. In: Bennett NG (ed). *Sex selection of children.* New York: Academic Press, 1983:201-212.
- President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research. *Screening and counseling for genetic conditions.* Washington, D.C.: U.S. Government Printing Office, 1983.
- Report of the Committee of inquiry into human fertilisation and embryology. ('Warnock Report') London: HMO, 1984.
- Robertson JA. Gender variety as a valid choice: a comment on the HFEA - response to Edgar Dahl's 'The presumption in favour of liberty'. *RBM Online.* 2004;8(3):270-1.
- Royal Commission on New Reproductive Technologies. *Proceed with Care. Final Report.* Ottawa: Communications Group Publishing, 1993.
- Sullivan RJ. Immanuel Kant's moral theory. Cambridge University Press: Cambridge, etc.: 1989 (esp. Chapter 14).
- Warnock report. *Report of the committee of inquiry into human fertilisation and embryology.* London: Her Majesty's Stationary Office, 1984.
- Warren MA. *Gendercide. The implications of sex selection.* Totowa, New Jersey: Rowman & Allanheld, 1985.
- Wilkinson S. Sexism, sex selection and 'family balancing'. *Med Law Rev.* 2008;16(3):369-89.
- Wright CF, Burton H. The use of cell-free fetal nucleic acids in maternal blood for non-invasive prenatal diagnosis. *Hum Reprod Update.* 2009;15:139-51.