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INVITED REVIEW

Male Fertility

Infertility, impotence, and emasculation – psychosocial contexts for abandoning reproduction

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From a Darwinian perspective we live to reproduce, but in various situations genetic males elect not to reproduce by choosing medical treatments leading to infertility, impotence, and, in the extreme, emasculation. For many men, infertility can be psychologically distressing. However, for certain genetic males, being infertile may improve their quality of life. Examples include (1) men who seek vasectomy, (2) individuals with Gender Dysphoria (e.g., transwomen, and modern day voluntary eunuchs), (3) most gay men, and (4) men treated for testicular and prostate cancer. Men who desire vasectomy typically have a Darwinian fitness $W > 1$ at the time of their vasectomies; i.e., after they have their desired number of offspring or consider themselves past an age for parenting newborns. In contrast, prostate and testicular cancer patients, along with individuals with extreme Gender Dysphoria, do not necessarily seek to be sterile, but accept it as an unavoidable consequence of the treatment for their condition undertaken for survival (in case of cancer patients) or to achieve a better quality of life (for those with Gender Dysphoria). Most gay men do not father children, but they may play an avuncular role, providing for their siblings' offspring's welfare, thus improving their inclusive fitness through kin selection. In a strictly Darwinian model, the primary motivation for all individuals is to reproduce, but there are many situations for men to remove themselves from the breeding populations because they have achieved a fitness $W \geq 1$, or have stronger medical or psychological needs that preclude remaining fertile.

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INTRODUCTION

Infertility, according to the World Health Organization and International Committee for Monitoring Assisted Reproductive Technology, is “a disease of the reproductive system defined by the failure to achieve a clinical pregnancy after 12 months or more of regular unprotected sexual intercourse.”¹ The US 2002 National Survey of Family Growth (NSFG) found that 1.2% of men between the ages of 15 and 44 experienced infertility.² Causes of male infertility include poor semen quality and varicocele,² but there are other reasons such as endocrine disorders, genetic factors, cancer treatments, and sexual dysfunction. Treatments such as orchiectomy or chemotherapy for testicular cancer,^{3,4} as well as sexual dysfunction that involves ejaculatory disorders (e.g., reduced or absent ejaculation) can result in male infertility.^{5,6}

Male infertility, as noted above, has a narrow pathophysiological definition within the medical setting, most often referring to problems of sperm quantity, quality, mobility, and survival. In the natural world, infertility has a broader yet simpler meaning in reference to whether an individual has offspring or not. For a population to maintain its size, each individual on average should have at least one descendant in their lifetime, who then survives to reproduce. In other words, the average Darwinian fitness, $W = 1$. When the average $W > 1$, a population will increase in size and when the average $W < 1$, a population is

on a pathway to extinction. However, there are many species with sterile castes, most notably in the *Hymenoptera* (many ants, bees, and wasps with sterile female workers and soldiers) where sterile individuals ($W = 0$) protect close relatives and, through kin selection, the population is sustained.^{7,8} Their inclusive fitness circumvents the absence of any reproduction from sterile individuals by permitting the genes of those individuals to be passed on to the next generation through the kin that they care for and support.

In this paper, we describe a variety of social and cultural situations where male individuals of our species, for reasons other than reproductive pathology, are infertile in the Darwinian sense. Admittedly, human males maintain a primal drive for sexual activity, which need not lead to having offspring. Some cases, where individuals fail to breed, fit a kin selection model, but for others they do not. These cases are considered against the background that the inability to have children can be psychologically distressing for many men. Men who seek help for infertility report a lower quality of life; i.e., they may feel a lack of control, that they are missing something in life, unable to meet life goals, and defective due to their infertility.⁹ Furthermore, they may also have lower sexual satisfaction, more feelings of sexual failure, and less enjoyment from sexual activity.⁹

In addition, male infertility is often not just an issue for men but may be psychologically distressing for their partners as well, prompting

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couples to seek infertility medical services. The US 2006–2010 NSFG indicates that 9.4% of men aged 25–44 years and/or their partners have accessed infertility services, including artificial insemination and the use of drugs to promote ovulation.¹⁰

In contrast, males in some population may have little or no concern about being infertile or may even seek infertility. Elderly men, for example, may not be bothered by infertility because most no longer want to raise children in their old age.¹¹ Infertility may also not be a problem for most men in same-sex relationships, as only a small percent raise children; only about 10% in the USA.¹² Still other examples include males who actively seek medical treatments that explicitly result in infertility, such as vasectomy for birth control purposes,^{13,14} or orchiectomy as part of sex-reassignment surgery in male-to-female transsexuals (MtFs).^{15,16} Presumably, they are fully aware of the impact of such treatment on their fertility, but their reasons for electing the treatment (discussed further below) overrule any perceived burden from the loss of fertility.

In the following sections, we explore various contexts where male infertility is not a major concern; i.e., where factors such as age, sociocultural setting, and medical conditions lead to a desire for, or acceptance of, infertility to enhance overall quantity of life and/or survival. We contrast the desire of some patients to cure infertility with that of others, who limit their fertility and, in the extreme, desire or accept castration to eliminate fertility. Evolutionary and psychosocial factors that could account for these divergent perspectives on male reproductive function are discussed along the way.

INFERTILITY

Men seeking vasectomy

Hundreds of thousands of men undergo vasectomy for birth control purposes,^{13,14} and being infertile is their desired state, at least at the time of their vasectomy. Factors that motivate men to be vasectomized include financial burden of having more children, having achieved a desired number of offspring, and preference for vasectomy over other contraceptive methods.¹⁷ The 2002 US NSFG data for over 60 000 men indicated that older men are more likely to be vasectomized than younger men.² In that survey, 18.8% of men between the ages of 40 and 44 years were vasectomized, as compared to only 1.6% of men aged 25–29 years. A higher percentage of vasectomized men were raised in nonreligious families (10.2%) or have had ≥ 3 children (17.6%) than those raised in a religious family (2%–7% depending on religious denomination) or having no children (0.7%).²

Other factors influencing a vasectomy decision include socioeconomic background and race/ethnicity. Having higher income and private insurance are predictors for vasectomy in the USA,² but data on education levels are inconsistent.^{18,19} Typically more Caucasian men undergo vasectomy than Black or Latino men.^{2,18} The difference in the prevalence of vasectomy between ethnic groups may reflect how different cultures define masculine ideals and value the ability to produce offspring, with higher status given to individuals with many offsprings.¹⁷

Interestingly, up to 6% of vasectomized men later seek a vasectomy reversal procedure²⁰ due to various reasons, but most commonly because of postvasectomy pain syndrome or to regain fertility.^{21,22} Potts *et al.*²⁰ examined the characteristics of 290 men who chose vasectomy reversal and found that those vasectomized in their 20s were more likely to want a vasectomy reversal than those who were vasectomized at an older age. For more than 75%

of men in Potts *et al.*'s study, remarriage after divorce was the major reason for seeking vasectomy reversal. Presumably, these men and their new partners shared an interest in producing offspring together. Vasectomy reversal is a relatively cost-effective technique to regain fertility compared to other reproductive technologies for vasectomized males, such as sperm retrieval, cryopreservation, and intracytoplasmic sperm injection.²³

Male-to-female transsexuals

Some genetic males are castrated as part of sexual reassignment surgery to become MtFs or transwomen^{15,16} and are thus infertile. From a survey on over 6000 transgender participants by the National Center for Transgender Equality and National Gay and Lesbian Task Force (47% of whom identified as MtFs), 52% of the MtFs reported that they had children, with 22% parenting children under the age of 18.²⁴ Being aware that many transgender individuals are parenting, the Standards of Care of the World Professional Association for Transgender Health recommend clinicians inform transgender individuals about fertility options prior to sexual reassignment.²⁵ Such counsel is proffered to reduce the risk of infertility regret that may emerge posttransitioning.

In a survey conducted in the Netherlands, Belgium, France, and the UK,²⁶ 51% of 121 transwomen claimed that they would seriously consider or undertake sperm banking, if they were offered it before the medical and surgical sterilization procedures that are unavoidable parts of sex reassignment. However, 90% of the participants in that survey reported that infertility would not delay them from proceeding with transitioning. This is also evident in that only a small percentage of transwomen store their sperm before sex-reassignment – for example, only 15% at University Hospital Ghent, Belgium, where a large number of individuals were treated for Gender Dysphoria.²⁷

Various factors may contribute to the low number of transwomen choosing sperm banking. For example, sperm storage may psychologically tie them to their male past identity.²⁶ In addition, financial costs may be burdensome for some while others may have difficulty masturbating in laboratory settings.^{26–28} A growing number of MtFs are transitioning at younger ages before they desire or foresee any desire for children.²⁹ Indeed, some of them now seek transitioning before they are capable of producing viable sperm to bank, but usually they do not receive surgical procedures until at least 18.^{30,31} Prepubertal individuals with Gender Dysphoria may delay puberty by taking gonadotropin-releasing hormone analogs, which impede sexual maturity and thus sexual function.^{30,31} For them, the distress of Gender Dysphoria dominates any desire to sire offspring. In addition, a lack of awareness among healthcare professionals about fertility options for transsexuals may be a factor contributing to the low number of transwomen opting for sperm banking.²⁸

Transwomen may also be deterred from having children because of fears of relationship instability and social stigma.³² Relationships of transwomen with female partners may be strained following “coming out” or transitioning. For example, in the National Transgender Discrimination Survey, more than half of the transwomen (57%) end their relationship after transitioning.²⁴ Admittedly, some of them may have already had as many children as they wanted before transitioning, and may not wish to have any more children. However, in terms of having more children, transwomen may also be concerned about how society may perceive them as parents, as well as how people may treat their children.³² It has been suggested that a small percent of transwomen are concerned that they might transmit their “transsexualism” genetically to their children.²⁶ However, no data have

supported that idea^{33–35} and it remains at best an uncommon reason for a transwomen to reject reproducing.

Voluntarily castrated men

A small number of men, largely unknown to the public, desire castration outside of generally accepted medical reasons.³⁶ These individuals are modern day eunuchs, but typically present as males and are thus inconspicuous in society.³⁷ They are clearly not MtFs for they seek emasculation, without feminization.^{38–40}

The reasons these men seek castration are diverse.^{41–43} Many of them, however, find their sex drive conflicting with their religious beliefs. They were often raised in a strictly religious household³⁶ that condemned corporal desires and were enculturated to believe that, if they gained full control of their sexual urges while on Earth, they would be rewarded for perpetuity in a heavenly afterlife. For those men, the perceived cost of being infertile now (i.e., $W = 0$) is outweighed by what they believe they will gain in the future.

Religious asceticism as a transcendent pathway to heaven has a long history in motivating some men to avoid sexual activity and reproduction.^{43,44} In Christianity, the idea of being a eunuch “for the Kingdom of Heaven” is found most clearly in Matthew 19:12. (As an aside, Augustine of Hippo [354–430] argued that Christians should will their way to celibacy, rather than take a surgical shortcut to sexual purity. While Augustinian ethics persist within the modern Catholic Church, there have been some Christian groups, most notably the Skoptsy of Russia, who have favored a surgical solution^{45,46}).

Other voluntary eunuchs may suffer a Gender Dysphoria where they perceive themselves to be not male, but not female either. They seek surgery to attain a neutral gender. Yet others suffer from Xenomelia (referred to as Body Integrity Identity Disorder by psychiatrists), in which certain body parts are not properly recognized by the sensory cortex of the right parietal lobe of the brain.^{47,48} They are perfectly content being male but feel great psychological distress at the presence of their external genitals.^{39,41}

Presumably, for these men, their desire for emasculation supersedes any concerns they might have about becoming infertile. One of us (TJW) monitors an online forum called Eunuch Archive (www.eunuch.org) where voluntarily castrated men, men seeking castration and other individuals with a strong interest in castration, can communicate with each other. A member of the community has recently (in 2015) initiated a discussion there about concerns around infertility in the community. His questions drew 32 responses. Of these, 15 respondents claimed to have been either chemically or surgically castrated (average current age [$n = 14$] was 60 ± 10 years old). Another 12 were not yet castrated but were considering castration, and five did not answer the question on castration status. All castrated individuals were aware that their castration resulted in infertility, but none was concerned about infertility. This could in part be because 10 of them already had children. In contrast, among those who were not yet castrated, only 2 of the 12 were concerned about infertility and still wanted children.

None of the castrated men regretted being castrated because of infertility, but one stated that he would regret it “if my wife were to die in the next 10 years.” That person was 36 years old, and his wife had undergone a hysterectomy. He reported that his wife had repeatedly told him to find a younger woman to have children with, but he elected to be castrated instead of accepting that option.

TJW has also conducted in-person interviews with several of the voluntary eunuchs who post on the Eunuch Archive. While anecdotal information, none has expressed any regret over not having biological children, although some noted that postcastration, they were more

concerned about the welfare of children and animals than before their castration. For example, a retired military officer, who claimed to hate children before his castration, became, to his own satisfaction, a middle school science teacher after castration. Another, a US postal worker, became deeply involved in animal rescue efforts. Others have become involved in helping siblings raise their children. These examples suggest a change in personality with castration⁴⁹ and an increase in eusocial behavior. Although anecdotal, some such cases may fit a kin selection model.

IMPOTENCE

Men in same-sex relationships

Many men in same-sex relationships are not concerned about parenthood, but there is a subset who do desire children. Gates,¹² who summarized data from Census 2010 and the Gallup Daily Tracking Survey, found that 10%–11% of male same-sex couples are parenting children under the age of 18. These data imply that a majority of men in a same-sex relationship may not wish to have children, and thus infertility may not be a bother to them. Unlike for heterosexual couples, the process of having children for same-sex couples is more complex. For example, they would need to find a surrogate mother, and possibly an oocyte donor as well.⁵⁰ The process of surrogacy can be expensive, increase the risk of ovarian hyperstimulation syndrome for the female donor, and access for gay men to the technologies for assisted reproduction varies greatly among jurisdictions.⁵¹ Furthermore, some couples may have concerns about their ability as males to fill the maternal role, though many gay men easily fulfill such role and can even be more nurturing than heterosexual men.⁵² In addition, same-sex couples may be deterred from having children because the social environment they are in is not accepting of parenting by same-sex couples. Despite increased acceptance of same-sex couples in the industrial world and scientific evidence that same-sex parenting does not negatively impact children’s psychosexual development,⁵³ many heterosexual individuals may still hold negative views toward same-sex parenting.⁵⁴

As an aside, interesting data from Samoa^{55,56} show that androphilic men – i.e., men sexually attracted to and aroused by men – have a higher tendency for avuncularity (uncle-like altruistic care) than do gynephilic men in the same culture. That suggests that androphilic men, though not reproducing themselves, are more likely than gynephilic men to maintain Darwinian reproductive success through a kin selection model. However, similar avuncularity for androphilic men has not been reported in the literature for other countries, such as Japan,⁵⁷ the USA,⁵⁸ and the UK.⁵⁹

Impotence and monogamy

What is clearly of greater worry than infertility for the majority of men, gay or straight, is impotence; i.e., erectile dysfunction (ED). Independent of sexual orientation, the enormous success of phosphodiesterase type 5 inhibitor drugs (such as Viagra and Cialis) in the modern industrial world,^{60,61} and the plethora of aphrodisiac potions around the world, suggest that for most men the desire for erections⁶² – and ideally ones firm enough for penetration – is a more immediate and pressing concern than maximizing their fecundity. Furthermore, ED may lead to psychological distress,^{63,64} feeling of sexual failure and lower self-esteem⁶⁵ as well as impacting men’s sense of their masculinity.^{66–68}

Evolutionary biologists credit our ancestral mating system for our great desire for sex in general, and our interest in multiple sexual partners. Evolutionarily, prehistoric humans were not monogamous, nor for that matter are most other primates^{69,70} including our

closest anthropoid ape relatives in Africa. Where species are strictly monogamous and remain pair-bonded through the reproductive life of the female, a male has some assurance that the children his partner births are, in fact, the ones he sired. Without monogamy and strong pair-bonding, the best opportunity a male has to maximize *W* is to copulate with as many females as possible. Many men can legitimately claim hundreds of sexual partners in their lifetime. Few can be sure that the offspring born to those females are the ones they sired.

AGING AND DISEASE

Delayed childbearing is becoming more common in many countries. Data from the National Vital Statistics Reports 2013⁷¹ indicate that the highest birth rate in the US was 101.8 per 1000 for men aged 30–34, but many men still become fathers in their 40s or later. Infertility may be an issue for many of those younger men, but for most men older than 55-year-old, infertility may not be a major concern. Admittedly, some men father children in old age (such as the 94-year-old male reported by Seymour).⁷² Data from that same National Vital Statistics Report mentioned above⁷¹ show that the overall birth rate for men age 55 and older is 0.3 per 1000; and that the rate is higher for Black men (1.0 per 1000) than for Caucasian men (0.2 per 1000). Various factors may influence the birth rate for older men including the fact that fertility⁷³ and semen quality⁷⁴ decline with age. Furthermore, other factors such as the number of current children, wife's reproductive status, reduced sexual activity, and knowledge of the risk of genetic disease for the children may contribute to low birth rate at older ages.^{75,76}

For these reasons, older men in general (at least in Western industrial society) may not be distressed by medical treatments that cause infertility. The most common of these treatments would be for prostate cancer. Virtually, all treatments for prostate cancer (e.g., prostatectomy, androgen deprivation therapy [ADT]⁷⁷ and radiation therapy)⁷⁸ cause infertility. Currently, in the USA, the median age for a prostate cancer diagnosis is 66 (see.cancer.gov/statfacts/html/prost.html). By the time of diagnosis, most prostate cancer patients presumably are at a point in their life where they are disinterested in fathering children.

In contrast to prostate cancer patients, most testicular cancer patients are in their 20s and 30s, and may be distressed by infertility.^{79,80} Sperm banking is frequently offered to testicular cancer patients in the industrialized world⁸¹ although some testicular patients with unilateral treatment may recover fertility after radiation therapy or chemotherapy.^{82,83}

Although most prostate cancer patients may not be distressed by infertility, other side effects of prostate cancer treatments may be psychologically distressing. Some adverse effects of ADT – such as reduced lean muscle mass, increased adiposity, gynecomastia, ED, and loss of body hair – can make men feel emasculated.^{77,84} Admittedly, the bother from these side effects varies among people. Some of the more serious side effects are not conspicuous to patients, such as metabolic syndrome and osteoporosis, yet carry serious substantial risks. In contrast, the side effects that patients report as most bothersome are ones that may carry less risk but are easily felt or seen by the patients themselves and typically reflect emasculation and feminization (e.g., hot flashes, loss of body hair, genital shrinkage, ED, and gynecomastia).^{85,86}

Although physicians rarely discuss fertility issues with prostate cancer patients before starting ADT, at least in Canada,⁸⁷ this can be a concern for younger patients and sperm banking before they begin treatment can be an option.^{77,88} Interestingly, urologists in countries with low gross domestic product (GDP) were slightly more likely to discuss infertility as a side effect of ADT than urologists in Canada.⁸⁹

This may be because men in lower GDP countries, particularly those with more patriarchal societies, may see their ability to impregnate their partners as elevating their social status.

Indeed, the loss of fertility in old age can be psychologically distressing for many men in third world countries where manhood is often measured by the number of wives and offspring a man has. The birth rate is generally higher in African and Middle-Eastern countries than in Western countries.⁹⁰ In addition, large family size and men having multiple wives are common in some African and Middle-Eastern countries.^{91–93} In some Middle-Eastern countries, the loss of ability to have children can be a devastating condition.⁹⁴

Infertility prevalence rate appears to be higher in parts of developing world than in Western countries.^{94–96} Various factors have been suggested to impact male infertility in the Middle-East, such as the high prevalence of arranged marriage between closely related individuals, typically first cousins,^{97,98} cigarette smoking, and pollution.⁹⁴ One study on Iranian men⁹⁹ showed that infertility may cause depression, which is more likely to occur in those with lower education levels and those who smoke cigarettes. However, patriarchal Middle-Eastern societies, which grant elevated status to males that father many children, may account as well for some of the high demand for medical treatment to elevate a male's reproductive success.

Cross culturally, there appears to be variation in the contribution that the number of offspring makes to a male's status. Following a Darwinian model, the more assurance a male has that the females he has copulated with have produced offspring with his genes, the more likely it is that his status will be related to the number of offsprings he can claim with confidence as his own. Alternatively, when paternity cannot be assured, the best strategy for males to achieve high fecundity is to copulate with as many females as possible. In a society where females have greater freedom of movement and mating opportunities, one would expect the males to be driven to maximize their copulatory activities and not necessarily be as concerned about the number of offsprings that they are confident are theirs.

It is noteworthy that in strict traditional Islamic societies, where female access to sexual partners is restricted and husbands have control over their wives' movements,⁹³ the number of wives and the number of offsprings a man has been strong measures of his social status. Not surprisingly, for men from these societies, infertility is reported as particularly distressing. That distress, in turn, may drive men with few or no offspring to seek medical attention for infertility. Such a sociocultural factor may account for some of the comparatively high prevalence rate of infertility reported in the Middle-Eastern countries.⁹⁴ They also may account for the fact that infertility clinics are opening up much faster in the Middle-East than in Europe and North America. There are, for example, more than 70 fertility clinics in Iran and more than 25 in Tehran alone, with similarly high numbers in Turkey, Emirates, Egypt, Jordan, and Saudi Arabia.¹⁰⁰ However, despite the growing number of infertility clinics, most people in the developing world still cannot access assisted reproductive technologies, which mostly are limited to private clinics, due to financial constraints.¹⁰¹

CONCLUSIONS

Infertility can be psychologically distressing for many men and their partners, prompting them to seek fertility treatment. However, there are a variety of situations where males may not be concerned about being infertile and may even seek out treatments that cause them to become infertile. Some men, for example, choose to be vasectomized for birth control and want to avoid causing pregnancies. Many MtFs and voluntary eunuchs undergo orchiectomy knowing that they will

be infertile after castration. For them, the value of castration as part of their gender transitioning surpasses the loss of fertility.

In other male populations, fertility may not be distressing, but impotence and physical feminization can be bothersome. For instance, only a small percent of gay men may desire to father children, so infertility is less likely to be a psychological burden for most gay men. However, they may be distressed by ED, especially those who are “tops,” because their ability for anal penetration will be compromised. On the other hand, most prostate cancer patients are elderly and at an age where they may not want children, so infertility due to cancer treatment may not be a burden to them. Despite this, the emasculating side effects of the treatments – such as gynecomastia, loss of body hair, reduced muscle mass due to androgen deprivation – can be distressing for some.

Typically, men are more concerned about impotence than infertility. This appears to reflect our evolutionary history, where natural selection has favored males desiring to copulate with many females rather than to being motivated by any immediate and explicit desire to impregnate them all.

AUTHOR CONTRIBUTIONS

EW performed the initial literature search and drafted the manuscript. RW and TWJ provided additional references and contributed to various sections of the manuscript. All authors read and approved the final manuscript.

COMPETING INTEREST

None declared.

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