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Fertility Preservation Discussions with Transgender People in Canada Prior to Beginning Medical Gender Affirmation

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Abstract

Background. Prevalence of fertility preservation discussions and procedures, participant characteristics associated with discussions, and prevalence of desire to parent are described.

Methods. Describes, for a clinical sample of < 16-year-olds: medical chart-recorded discussion and procedure prevalence, and desire to parent longitudinally. Describes self-reported discussion prevalence for a community sample of 14- to 39-year-olds. Bivariate and multivariable modified Poisson analyses were conducted for this sample.

Results. Discussion prevalence was confirmed for approximately 80% of the clinical sample, with approximately 20% unconfirmed. Self-reported discussion prevalence was 45% in the community sample. Non-binary gender with female sex at birth, greater family religiosity, and diagnosed mental health condition excluding depression or anxiety were crudely associated with less discussions. Multivariable analyses revealed no statistically significant predictors. Desire to parent was fairly consistent over time.

Conclusion. Discussions should be standard practice for all fertile patients pursuing medical gender affirmation.

Keywords

Transgender, non-binary, fertility, fertility preservation, desire to parent, gender-affirming medical care, Canada

Summary for Lay Audience

A transgender person may pursue a variety of social, physical, medical, and legal avenues for gender affirmation. Broadly, these create congruence between their experience of their gender, and how their gender is perceived by others.

Medical gender affirmation requires contact with the healthcare system. This includes obtaining prescriptions for hormone suppressant medication, hormones to promote development of secondary sex characteristics, and surgeries, which typically follow the initiation of hormone therapy. Some (typically surgical) medical gender affirmation can be permanently sterilizing. Research suggests that hormonal gender affirmation, the focus of this thesis, can also decrease fertility.

The World Professional Association for Transgender Health recommends fertility preservation counselling prior to beginning medical gender affirmation. The idea of fertility preservation generally receives strong support from the transgender community. However, actual utilization of fertility preservation procedures is much lower, and is less common among people whose sex at birth is female.

Delaying medical gender affirmation frequently produces emotional burden, one of many barriers that can prevent transgender people from pursuing fertility preservation. The barrier upon which this thesis focuses is that fertility preservation discussions with healthcare providers are not standard practice prior to beginning medical gender affirmation.

This thesis uses data from two different populations: a clinical sample of transgender youth < 16 years old accessing medical gender affirmation, and a community sample of transgender individuals 14- to 39-years-old.

In this study, approximately 80% of the clinical sample were confirmed to have discussed fertility preservation prior to beginning medical care, with the rest unconfirmed. 74% of youth in the clinical sample declined fertility preservation procedures. Self-reported discussion prevalence for the community sample was approximately 45%. In the community sample, non-binary gender with female sex at birth, greater family religiosity, and diagnosed mental health condition excluding depression or anxiety were crudely associated with less fertility preservation discussions.

Desire to parent was found to be fairly stable over time, with a greater proportion of youth age 10 to 13 being unsure of their future parenting desires.

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Chapter 1

Introduction

1.1 Overview of Study Rationale

Medical gender affirmation for transgender and non-binary people can include hormone therapy, and surgeries, that typically follow the initiation of hormone therapy. Research suggests that hormone therapy might impact fertility (e.g. Jindarak et al., 2018; Leavy et al., 2017; Schneider et al., 2015; Yaish et al., 2021). While some surgeries can be for aesthetic goals (for example, surgery to create the appearance of a masculine, rather than feminine chest) with no impact on fertility, others are permanently sterilizing (for example, removal of the ovaries and uterus, or removal of both testicles). Due to the potential impacts of medical gender affirmation on fertility, guidelines currently recommend that fertility preservation options be discussed at multiple points, including prior to beginning medical care (Ethics Committee for the American Society of Reproductive Medicine, 2015).

Within the transgender and non-binary community, not everyone desires to pursue medical gender affirmation. Additionally, some who do desire medical care that could impact fertility have already had children, and do not want more. As well, there are several ways to conceptualize families and parenting that do not relate to an individual's potential future reproductive ability. For personal reasons, an individual (transgender or cisgender), may decide that they are not going to pursue parenthood (e.g. Kyweluk et al., 2018; Voultsos et al., 2021).

Numerous jurisdictions previously enforced sterilization procedures before recognizing legal gender as different from sex at birth. In addition to this, unfounded rhetoric portrayed transgender individuals as unfit to parent, and contributed negatively to the perception of transgender parents. Therefore, within the transgender community, there is a historical precedent for the legal and political importance of fertility (Lowik, 2018). Additionally, within the community, the opportunity for fertility preservation and parenthood is widely recognized as important: in one Australian study, 95% responded "yes" to a question of whether "fertility preservation should be offered to all transgender and non-binary people" (Riggs & Bartholomaeus, 2018). Research suggests that transgender adults desire to parent at similar rates to cisgender (non-transgender) adults (De Sutter et al., 2002; Wierckx et al., 2012).

Many transgender and gender non-conforming youth in America have reported never discussing fertility (79.5%), or how hormone therapy for gender affirmation can impact fertility with a healthcare provider (82.7%) (Chen et al., 2018). Other research raises questions about potential inequities in fertility preservation discussions (e.g. almost 40% of those who had not received advice or counselling were non-binary), that could potentially reflect areas for further provider education (Riggs & Bartholomaeus, 2018).

Research suggests several potential barriers to accessing fertility preservation for transgender individuals, including additional emotional burden or perception of invasiveness of the procedures (Chen et al., 2017; Kyweluk et al., 2018; Nahata et al., 2017). Additionally, fertility preservation discussions are not routine practice, and the lack of standardized discussions could be a barrier to accessing fertility preservation for those who desire it. Though there are differences by sex at birth and across clinic settings, in general (and in the Canadian context) utilization of fertility preservation is uncommon among transgender individuals (e.g. Defreyne et al., 2020; Vyas et al., 2021).

With young patients, discussing fertility is challenging; oncology literature articulates many barriers clinicians face: some patients are unable to understand the magnitude of their decision to undergo (or avoid) fertility preservation, others feel embarrassed, and the clinicians themselves may also feel embarrassed or not sufficiently prepared to discuss fertility with young patients (Hudson et al., 2018). For transgender patients, providers may be less familiar with how different hormone regimens may impact fertility (Bartholomaeus & Riggs, 2020), and with the potential for successful outcomes from fertility preservation (Tishelman et al., 2019).

1.2 Research Questions

The objective of this research is to answer the following questions regarding transgender people's fertility preservation discussions with their healthcare providers prior to beginning medical gender affirmation in Canada:

(1) how prevalent are fertility preservation discussions with healthcare providers and fertility preservation procedures, and does prevalence differ by age?

(2) what patient characteristics are associated with discussing fertility preservation?

(3) how prevalent is desire to parent, does it differ by age, and to what extent does desire to parent change over time?

This project will use two different populations to answer these questions: (1) a clinical sample of pubertal transgender youth under the age of 16 years old, and (2) a community sample of transgender individuals.

The prevalence of fertility preservation discussions will be described using both populations. However, the prevalence of the uptake of fertility preservation procedures will be analyzed using only the clinical sample. The wording in the questionnaire completed by the community sample: "Did you ever freeze your sperm, eggs, or embryos?", precludes understanding of whether participants froze their genetic material prior to initiating medical gender affirmation (when it is recommended to be completed), or after medical gender affirmation had begun. Additionally, the community sample was not asked about their desire to parent on the questionnaire they completed. Therefore, desire to parent will only be described for the clinical sample. However, the prevalence of characteristics associated with discussing fertility preservation is more appropriately assessed using the community sample, for a few reasons. Most importantly, for the clinical sample, we cannot conclude whether participants did not discuss fertility preservation, for those for whom discussions were not reported in their medical records. Additionally, the community sample has a larger sample size compared to the clinical sample. Therefore, analyzing both populations allows all three research questions to be answered using the most relevant data possible.

Furthermore, the potential impact of age is explicitly included in the research questions above, as both samples are uniquely poised to offer insights about the impact of this variable. The community sample benefits from an expanded age range, including people of varying life stages from adolescent to middle-aged adult. The clinical sample benefits from a younger demographic, from child to adolescent. Age stratification is commonly used in the following analyses, to better understand the experiences of transgender people in Canada within each life stage.

Chapter 2

Literature Review

The literature review includes three main subsections: background, relevance, and barriers. In “background”, introductory information relevant to understanding gender affirmation, fertility preservation, the importance of fertility for the transgender community, and how medical gender affirmation may impact fertility is presented. In “relevance”, literature will cover topics including transgender adults’ desire to parent, and utilization of fertility preservation procedures in the transgender community. In “barriers”, literature will examine barriers transgender individuals may face to receiving fertility preservation. For reference, a glossary of terms used in the literature review is provided in the appendix.

2.1 Background

2.1.1 Gender Dysphoria. Gender dysphoria is defined in the DSM-V as a “marked incongruence between one’s experienced/expressed gender and their assigned gender, lasting at least six months”, which manifests in at least six of eight defined ways for children, and at least two of six defined ways for adolescents and adults (American Psychiatric Association, 2020). It must also be associated with clinically significant distress or impairment in functioning.

2.1.2 Social Gender Affirmation. Social gender affirmation is a series of steps taken that do not involve the medical system, to allow someone to present themselves to the world as a different gender. These steps may include cutting or growing out hair, or changing hairstyle, changing clothing style, and asking others to use a new name or pronouns. Social gender affirmation is completely reversible, and can take place at any age, regardless of whether physical/medical gender affirmation is ongoing or forthcoming (Bonifacio & Rosenthal, 2015).

2.1.3 Physical/Medical Gender Affirmation. Hormone therapy for gender affirmation, previously referred to as cross-sex hormones (for example: testosterone for transgender men, and estrogen for transgender women) is prescribed to reduce gender dysphoria. Hormone therapy can reduce secondary sex characteristics associated with sex at birth (often a strong source of gender dysphoria), and promote development of those associated with one’s gender. Medical gender affirmation can include behavioural interventions, hormone therapy, and surgical interventions to

acquire secondary sex characteristics and behaviours associated with an individual's gender identity, or shed those associated with their sex at birth (UCSF, 2019). Surgeries can include vaginoplasty, phalloplasty, scrotoplasty, metoidioplasty, chest "top" surgery, facial feminization procedures, reduction thyroid chondroplasty, voice surgery, augmentation mammoplasty, hysterectomy, oophorectomy, orchiectomy, and vaginectomy (UCSF, 2019), as well as electrolysis and laser hair removal, hair transplants, and liposuction. Notably, not all transgender people desire to pursue physical or medical gender affirmation.

For adolescents, often the first step of medical gender affirmation is to take gonadotropin-releasing hormone (GnRH) agonist therapy as a hormone suppressant medication. GnRH agonist therapy is used in the treatment of precocious puberty, and also for transgender youth beyond sexual maturity rating stage 2 (previously referred to as Tanner stages) to pause the development of secondary sex characteristics. A recent literature review examined outcomes of GnRH agonists for transgender youth from Tanner stage 2 through 4, finding changes in: body composition; improvements in: general functioning, social life, and affect; decreases in: emotional and behavioural problems, depressive symptoms, height velocity, and markers of bone turnover; and stagnation among: levels of gender dysphoria over time (Rew et al., 2021). When used for precocious puberty, the effects of GnRH agonists are thought to allow for a delay of puberty without resulting in long-term effects on fertility (Lai et al., 2020). However, this treatment pauses maturation of germ cells, so progressing directly from puberty suppressant medication to hormone therapy for gender affirmation (estrogen or testosterone) could affect fertility potential for transgender youth (Cheng et al., 2019; Finlayson et al., 2016; Johnson & Finlayson, 2016).

For example, in one study, among those who began treatment in early puberty (sexual maturity rating stage 2 or 3), all specimens contained immature germ cells only, with no spermatozoa observed, after treatment with estradiol and GnRH agonist triptorelin (de Nie et al., 2022). It is unlikely that these people will be able to produce mature eggs or sperm, though juvenile oncology research is ongoing (Olson-Kennedy et al., 2016). Long-term examinations of fertility are still needed for transgender people who progress from puberty suppressant medication to hormone therapy without cessation, and most transgender youth follow this trajectory (for example: Carmichael et al., 2021; de Vries et al., 2011).

Traditionally, Endocrine Society guidelines have recommended hormone therapy for gender affirmation be initiated for transgender youth treated with GnRH agonists beginning at age 16. However, some experts recommend initiation on an individual basis when they are ready based on their development, rather than strictly their age (Olson-Kennedy et al., 2016). Benefits of earlier initiation of hormone therapy for these youth include: (1) possible improvements in peak bone mineral density, as bone mineral density accumulates at a pre-pubertal rate while youth are taking GnRH agonists without hormone therapy, which could be potentially a 5-year to 7-year period for youth who begin puberty suppressant therapy at the earliest possible stage of development; (2) potentially safer period of emotional liability, as younger youth are less likely to have access to a car, alcohol, and drugs; and (3) potential positive impacts on self-esteem and relationships with peers, as "having the physical appearance of a sexually immature 11 year old in high school can present emotional and social challenges" (Olson-Kennedy et al., 2016).

Thresholds for amount and duration of hormone therapy for gender affirmation, above which there are permanent effects on fertility, have yet to be established (Chen et al., 2017). For this reason, the World Professional Association for Transgender Health (WPATH) recommends patients receive fertility preservation counselling before beginning hormone therapy.

2.1.4 Considerations Prior to Masculinizing Medical Gender Affirmation.

Masculinizing hormone therapy for gender affirmation (testosterone) can have the following effects: voice pitch reduction; increase in facial hair, body hair, and muscle mass; subcutaneous fat redistribution; change in sweat patterns, and body odour; hairline recession; the cessation of menstruation (Sherbourne Health, 2020); and vaginal atrophy and clitoral lengthening (American College of Obstetricians and Gynecologists, 2021). Menstruation typically ceases within three months (American College of Obstetricians and Gynecologists, 2021). A review article identified studies of prolonged exposure to androgens, with outcomes for endometrial tissue varying from proliferative, to active, to atrophic (Mattawanon et al., 2018). In one study, eight of 112 transgender men exposed to testosterone for at least three years had hyperplasia, and one had focal adenocarcinoma. Transgender men may experience ovarian stromal hyperplasia, and follicular atresia, typically seen in post-menopausal females. However, unplanned pregnancies have been reported while taking testosterone, therefore, it does not suppress ovulation sufficiently reliably to act as birth control (American College of Obstetricians and

Gynecologists, 2021; Mattawanon et al., 2018; Tishelman et al., 2019). If exposure to sperm occurs without effective contraception, it is recommended that an "emergency" copper IUD be implanted within five days (up to a maximum of seven days), to interrupt conception. If conception occurs, therapeutic abortion or cessation of testosterone is recommended to reduce the teratogenic risk to the fetus posed by testosterone therapy. There is no evidence to support the emergency birth control pill (also called "plan B", or "the morning after pill"), in patient populations who are presumably anovulatory, such as transgender men.

The Standards of Care published by WPATH list three absolute contraindications against prescribing masculinizing hormone therapy: (1) current pregnancy, (2) unstable coronary artery disease, and (3) untreated polycythemia (hematocrit greater than 55%) (Coleman et al., 2012).

2.1.4.1 Potential Impacts of Medical Gender Affirmation on Fertility. The literature is mixed regarding the effect of hormone therapy for gender affirmation on anti-Müllerian hormone levels. One study suggests that they decline in most patients after treatment with testosterone, an aromatase inhibitor, and a GnRH agonist (Caanen et al., 2015). Another recent study suggested that anti-Müllerian hormone levels showed a statistically significant decline, by 0.71 ng/mL, between baseline and 12-month follow-up in the prospective arm (Yaish et al., 2021). Sub-group analysis suggested that anti-Müllerian hormone levels only declined significantly in those with polycystic ovary syndrome (PCOS), with non-significant results for those without PCOS. In one study of transgender men prior to beginning testosterone, 58% of the almost 70 participants were diagnosed with PCOS based on the 2003 Rotterdam criteria (Baba et al., 2007). This suggests that transgender men may experience a disproportionate burden of fertility issues compared to cisgender women, as PCOS is associated with fertility issues. In the cross-sectional arm, the results suggested that anti-Müllerian hormone concentration was not associated with the duration of gender-affirming hormone treatment, but was inversely associated with age (Yaish et al., 2021).

2.1.4.2 Potential for Fertility Preservation. Fertility preservation includes two weeks of daily hormone injections to stimulate follicle development, with monitoring via transvaginal ultrasounds, and transvaginal oocyte collection. Ability to conceive using frozen oocytes was a

concern for the majority (60.9%) of transgender and non-binary people considering fertility preservation in one study (Defreyne et al., 2020). Healthcare providers have identified the need for more education and research regarding fertility preservation outcomes for those with a female sex at birth (Tishelman et al., 2019). In a case series including two transgender men who returned to use their cryopreserved oocytes, 90% and 95% of the thawed oocytes survived for these patients (Maxwell et al., 2017). Both pregnancies resulted in live twin births, both via Cesarean section, with all four babies weighing between 4 lb 9 oz and 4 lb 15 oz (Maxwell et al., 2017). All four babies were doing well at their most recent follow-up appointment included in the study.

Transgender men have been known to successfully carry pregnancies themselves (e.g. Light et al., 2014), if they stop taking testosterone and hormone suppressant medication, though this might not be their preference. Of 41 transgender men who became pregnant in one survey, 61% (n = 25) had been receiving testosterone therapy prior to pregnancy (Light et al., 2014). Of these pregnancies, 84% (n = 21) used their own oocytes, suggesting that it is probable to regain fertility after testosterone cessation. Most, 80% (n = 20), resumed menstruation within six months of testosterone cessation, and 20% (n = 5) became pregnant before their menstrual cycle resumed. Duration of time using testosterone was categorized as less than one year prior to pregnancy (40%, n = 10), one to two years (24%, n = 6), three to ten years (16%, n = 4) and more than ten years (20%, n = 5). Many (60%, n = 9) who had stopped testosterone and were trying to conceive were able to do so in less than four months. Unplanned pregnancies comprised 24% of those reported from participants who had previously used testosterone (Light et al., 2014). Unplanned pregnancy is a “substantial concern” for transgender people capable of pregnancy, as contraception can be underutilized in this population due to difficulties accessing healthcare, and concerns about adverse effects of hormonal birth control on gender affirmation goals (American College of Obstetricians and Gynecologists, 2021).

Due to the likelihood of retaining fertility while pursuing masculinizing hormone therapy, in addition to the invasiveness of fertility preservation procedures for this population, and the frequently-reported concern for ability to use cryopreserved materials to successfully produce a pregnancy in the future, it is conceivable that fertility preservation may not be seen as an attractive option for masculinizing individuals to pursue prior to beginning medical gender affirmation.

2.1.5 Considerations Prior to Feminizing Medical Gender Affirmation. Feminizing hormone therapy for gender affirmation (estrogen) can reduce masculine features and accentuate/create feminine ones, including: reducing erectile function and testicular size, and increasing breast size and body fat percentage (American College of Obstetricians and Gynecologists, 2021). Voice pitch and linear bone growth (e.g. shoe size, height, glove size) do not change with feminizing hormone therapy. Transgender women can raise the pitch of their voice, if desired, with the help of a speech language pathologist, or surgery. The WPATH Standards of Care list no absolute contraindications against prescribing feminizing hormone therapy per se. However, there are absolute contraindications against some of the medications themselves, particularly estrogen. These include: (1) previous venous thrombotic event related to an underlying condition that causes hypercoagulation, (2) history of estrogen-sensitive neoplasm, and (3) end-stage chronic liver disease (Coleman et al., 2012). However, all hormone therapy for gender affirmation is specific to the individual's needs. "Many providers will initiate hormones with individuals with higher risk profiles when it increases their quality of life/chance of survival greatly" (Sherbourne Health, 2020).

Interestingly, in a large study assessing semen quality including 78 healthy transgender women participants with no known prior hormone therapy, and 141 healthy cisgender men participants, the transgender women had significantly worse count and concentration of sperm in their samples (Li et al., 2018).

2.1.5.1 Potential Impacts of Medical Gender Affirmation on Fertility. Possible side effects of feminizing hormone therapy include impairments in gonadal tissues, or the structure of these tissues, which may cause infertility or sterility. A review article examined different effects on fertility depending on hormone regimen (Mattawanon et al., 2018). Generally, transgender women may experience impaired spermatogenesis and the absence of testosterone-producing Leydig cells in their testes. Cyproterone acetate (CPA), commonly prescribed in Europe and Thailand, is a strong inhibitor of spermatogenesis that is prescribed as a compliment to estrogen therapy. Its effect on spermatogenesis appears to be reversible, though at the time of the review, it was unclear how long it would take normal sperm production to resume after receiving a standard dose (25-50 mg/day) for a prolonged period. Low dose (5-10 mg/day) CPA can impair

sperm quantity, motility, and morphology, after treatment for two to four months. At the time of the review, spironolactone had scarce published research on its effects on fertility in humans, however, in animal models, it impaired angiogenesis in the testicles.

Gonadotrophin-releasing hormone (GnRH) agonists lower serum testosterone to pre-pubertal levels, and decrease testosterone production. Their dose-dependent and duration-dependent effects on spermatogenesis are thought to be reversible unless testicular atrophy occurs. Estrogen can also supress spermatogenesis and androgen production. One study reported various levels of impaired spermatogenesis after prolonged use for more than six years, including total absence of sperm among some participants, and intact spermatogenesis among others. At the time of the review, it was unclear how long after estrogen therapy is stopped could normal spermatogenesis resume for those for whom it was impaired (Mattawanon et al., 2018).

One study found significant negative impacts after treatment with estradiol on the function and morphology of testicular cells, and on spermatogenesis (Leavy et al., 2017). Estradiol is the major female sex hormone responsible for the development of female secondary sex characteristics such as breasts, hip-widening, and a female fat distribution pattern. The primary class of estrogen used for medical gender affirmation is 17-beta estradiol (Deutch, 2016). Estradiol treatment resulted in a significantly smaller diameter of the seminiferous tubules, and adverse effects on the tissue surrounding the tubules (Leavy et al., 2017). The structure and number of Leydig cells were adversely affected, and the Sertoli cells showed vacuolation. Spermatogenesis was impaired to the extent that no sperm were present in the seminiferous tubules of seven of the nine patients (77.8%). The remaining two had single spermatids and few spermatozoa, with spermatogonia being present in most cases (56%). In every case where there were only spermatogonia present in the tubules the patients had been treated with estradiol and oral antiandrogens or gonadotropin-releasing hormone agonists (Leavy et al., 2017).

Androgen blockers (antiandrogens) allow for a lower dose of estradiol to be prescribed, including in populations who have already completed male puberty. The antiandrogen most commonly prescribed in the United States is spironolactone, a potassium-sparing diuretic which at higher doses suppresses testosterone synthesis and acts on anti-androgen receptors (Deutch, 2016). Other frequently prescribed antiandrogens include 5-alpha reductase inhibitors, including

finasteride and dutasteride, which may be better indicated for those seeking partial feminization, or those continuing to experience hair loss on full androgen blockade (Deutch, 2016).

Some transgender women are able to retain normal spermatogenesis after receiving hormone therapy for gender affirmation (Schneider et al., 2015). One study found that, after using hormone therapy for a mean duration of 8.51 years (SD = 4.67 years), 11% of transgender women had normal spermatogenesis, while 36.4% had maturation arrest, 26% had hypospermatogenesis, and 20.2% had Sertoli cell-only syndrome (Jindarak et al., 2018). In a study comparing semen parameters among transgender women, significant differences in sperm count, concentration, and motility were found. The best semen parameters were seen among participants who had not yet started hormone therapy (Adeleye et al., 2019). Those who had discontinued hormone therapy had semen parameters within the World Health Organization's guidelines for normal reference values. Among those who had continued their gender-affirming hormone therapy up to the date of their appointment, three (of seven) had samples displaying azoospermia (Adeleye et al., 2019).

Similarly, in another study of different treatment approaches prior to gender-affirming "sex reassignment" surgery (to discontinue hormone therapy (1) 6 weeks prior to surgery, (2) 2 weeks prior to surgery, or (3) not at all), almost half (45.45%) of the patients following approach (1) had normal spermatogenesis, whereas spermatogenic arrest was found in 43.14% and 40% of patients following approaches (2) and (3) respectively. Few patients following approach (3) demonstrated normal spermatogenesis (Schneider et al., 2015). More studies are needed to determine how these effects are influenced by dosage and treatment duration. Long-term studies of transgender women's fertility are necessary to determine whether these effects are reversible, and how long they might take to reverse if so.

2.1.5.2 Potential for Fertility Preservation. This process can be simpler and quicker—typically involving semen collection from masturbation—though this can present challenges for those with strong gender dysphoria about their genitalia, and for youth who might not be appropriately physically mature (Lai et al., 2020). Other potential methods of fertility preservation include "vibratory or electrostimulation, percutaneous epididymal sperm aspiration, or testicular tissue biopsies" (Lai et al., 2020).

In one study, nine of eleven transgender women participants cryopreserved their sperm, with one returning to use their sperm in an IVF-ICSI cycle (in vitro fertilization with intracytoplasmic sperm injection) that resulted in a viable pregnancy (Jones et al., 2016). Median parameters for semen concentration, normal motility, and normal morphology at the first visit were 30 million/mL, 46%, and 14%, respectively (Jones et al., 2016). The majority of participants were cryopreserving their samples prior to starting hormone therapy, with some participants having already started hormone therapy for a duration of up to two months prior to their first visit.

In another study, 10 transgender adolescents and young adults attempted and completed at least one semen collection, with eight cryopreserving sperm before beginning medical gender affirmation (Barnard et al., 2019). All samples had normal median semen analysis parameters, except morphology was abnormally low (median percent normal morphology: 6%, reference: > 13%). The first participant who had begun medical gender affirmation had received 15 mg intramuscular injection of leuprolide acetate every 28 days for six months, and then stopped for three months prior to her first attempt at semen cryopreservation, where her sample contained 12 sperm, two of which were motile. At her second attempt, two months later, her semen analysis parameters were all within normal limits, except the morphology of the sperm was low (9%). The second participant had received 100 mg of spironolactone daily and 75 μg per day of estradiol via a transdermal patch for 26 months. Semen analysis of her specimens—taken two, three, and four months after cessation of both medications—revealed persistent azoospermia. She proceeded with her scheduled orchiectomy without successfully completing fertility preservation (Barnard et al., 2019).

2.2 Relevance

2.2.1 Importance of Not Requiring Sterilization Before Recognizing Gender. Sweden was the first country to develop regulations concerning legal gender affirmation, with the *law on determination of sex in special cases* (Swedish: *Lagen om fastställande av könstillhörighet i vissa fall*) established in 1972 (Gunnarsson Payne & Erbenius, 2018). Being sterile was one of the requirements for the law, and it became precedent to sterilize transgender people through medical care before their gender could be recognized as different from their sex at birth in many places (Lowik, 2018). In 2019, to receive legal recognition of an individual's felt gender where it

differed from their sex at birth, 20 countries in Europe still mandated sterilization procedures (Cheng et al., 2019). In the past, it has been argued that transgender individuals are not mentally fit to parent, to justify denying them reproductive health services (Cheng et al., 2019). Studies have found no evidence that the well-being of children raised by transgender parents was compromised due to the gender identities of their parents (Cheng et al., 2019). Additionally, Article 16 of the United Nations' *Universal Declaration of Human Rights* includes the phrase: "The family is the natural and fundamental group unit of society, and is entitled to protection by society and the State" (United Nations, 1948). While Article 16 states that "Men and women of full age, without any limitation due to race, nationality, or religion, have the right to marry and found a family" (United Nations, 1948). In many countries, including Canada, fertility preservation procedures are increasingly allowed (and supported) for transgender people.

However, even where it is legal for transgender people to access fertility preservation, rising instances of discrimination can dissuade them from wanting to parent. For example, in Greece, due to socio-political changes in the country, participants expressed fears of violence and harassment, bullying, and discrimination from the general population if they became pregnant, as well as intrafamilial conflict, and the potential for forced removal of their child (Voultsos et al., 2021). Laws based on legal sex rather than reproductive function can discriminate against transgender parents, and decrease the legal security of their children (Gunnarsson Payne & Erbenius, 2018). Using a known sperm donor can also create a legal risk for their future children (Tornello & Bos, 2017).

2.2.2 Transgender Adults Frequently Desire to Parent. Being transgender does not preclude individuals from desiring to have their own biological children (Ethics Committee of the American Society for Reproductive Medicine, 2015). In a Belgian study, of 116 transgender men and 56 non-binary participants with female sex at birth (n = 172), 67 (39%) had a current or future desire to parent (Defreyne et al., 2020). In another study of 50 transgender men who had undergone or were considering gender confirmation surgery/surgeries 54% had a current desire to have children, with a further 8% having desired children in the past (Wierckx et al., 2012b). Additionally, 18 participants (37.5% of 48 respondents) would have considered freezing their germ cells prior to pursuing testosterone therapy if the technique were available at the time. In one study of 32 transgender people who hoped to become parents in the future, almost half

(n=15) reported a desire to be biologically related to their future child (Tornello & Bos, 2017). Most of these responses were from transgender men. In another study, which surveyed 121 transgender women, the majority would have proceeded with sperm cryopreservation, or at least seriously considered proceeding with it, had it been an option for them in the past (De Sutter et al., 2002). In another study of 397 transgender participants, reproductive life planning goals were reported by 48 participants, and 48 participants reported desiring fertility preservation (Vyas et al., 2021). Gender identity, racial/ethnic identification, and age were all not predictive of fertility preservation desire. However, a limitation of this study is the high prevalence of missing data for sexual orientation, racial/ethnic identification, reproductive life planning goals, having previously undergone fertility preservation, and desiring fertility preservation, ranging from 43.8% to 82.6% for these variables.

In a systematic review of 81 articles regarding fertility counseling for transgender adolescents, the results indicated that in in several studies, the majority of transgender people wanted to be parents, with approximately half of transgender adults specifically wanting to have children to which they were genetically related (Lai et al., 2020). In an Australian study of transgender adults, approximately one-third (33.6%) of the respondents to a question on the importance of being genetically related to their children, thought it was important (Riggs & Bartholomaeus, 2018). In the same study, 64 of the participants were already parents, while 345 were not. Of the parent participants, 28% gave birth to their child themselves (Riggs & Bartholomaeus, 2018). In another study of 156 transgender and gender non-conforming adolescents (14- to 17-years old) in the United States, almost half (48.7%) reported interest in having children someday, with an additional 23.7% being unsure (Chen et al., 2018). Regarding having biological children, 35.9% of respondents were interested, 26.3% were unsure, and 37.2% were uninterested (Chen et al., 2018).

2.2.3 Utilization of Fertility Preservation Among Transgender Individuals. Of the participants who had completed fertility preservation in one Australian study of transgender adults, most (67.9%) stored their gametes before starting gender-affirming hormone treatment, after beginning puberty. Fewer, 28.6% and 3.6% respectively, stored their gametes after beginning their gender-affirming hormone treatment, and stored fertilized embryos, respectively (Riggs & Bartholomaeus, 2018). Additionally, research suggests that fertility preservation is

pursued less frequently by transgender men or boys than by transgender women or girls. Some researchers have found that transgender women who identify as lesbians, or bisexuals, are more likely to complete sperm cryopreservation compared to transgender women who identify as heterosexual (Wierckx et al., 2012a). In a Belgian study, of 116 transgender men and 56 non-binary participants with female sex at birth (n = 172), 9.0% of the participants had had ovarian tissue or oocytes cryopreserved. A further 16.0% considered pursuing cryopreservation in the future, and of this group, 20.0% had already began gender-affirming hormone therapy (Defreyne et al., 2020). Most of those who had not undertaken fertility preservation in another study, 76% (n=204), had begun gender-affirming treatments which might impact their fertility.

A systematic review of the literature for transgender adolescents found enormous disparities across clinical settings and sex at birth, with American studies finding between 8.7% and 14.2% of transgender girls and 0% and 1.3% of transgender boys pursuing fertility preservation (Lai et al., 2020). In Canada, 0% of almost 80 transgender youth pursued fertility preservation, while in Holland 38% of transgender girls completed sperm cryopreservation after counseling (Lai et al., 2020). Similarly, a retrospective chart review of 106 children and adolescents with gender dysphoria referred to the Israeli Pediatric Gender Dysphoria Clinic, 14 (45%) pubertal transgender females and 3 (6.5%) pubertal transgender males completed fertility preservation (Segev-Becker et al., 2020). The authors suggested that the high fertility preservation rates seen in the Israeli adolescents could reflect different cultural perspectives. Meanwhile, from an American perspective, a retrospective chart review of 105 transgender adolescents aged 14 to 20 treated at a pediatric gender clinic between 2013 and 2016, found that a total of 13 participated in a formal consultation regarding fertility preservation before beginning gender-affirming hormone treatment (Chen et al., 2017). Of these adolescents, seven identified as transgender women, six identified as transgender men, and five completed fertility preservation (four sperm cryopreservation and one oocyte cryopreservation) (Chen et al., 2017). Another retrospective review of electronic medical records of 73 transgender adolescents referred to Pediatric Endocrinology between 2014 and 2016 found 72 had documented fertility counselling before beginning gender-affirming hormone therapy (Nahata et al., 2017). Of these adolescents, two attempted fertility preservation (Nahata et al., 2017). In another American study of eighteen transgender youth, twelve of whom were transgender men and six of whom were transgender women, half declined to receive a fertility consult (Kyweluk et al., 2018). Of the

nine who received a consultation, six completed fertility preservation: two transgender men and four transgender women.

A study conducted by researchers at the University of California Los Angeles (UCLA) Gender Health Program included 397 participants (male sex at birth reported for 38.3%), with a mean age of 29 years old (Vyas et al., 2021). Of those who had already completed fertility preservation 11 reported a male sex at birth, and one reported a female sex at birth.

2.2.4 Youth are Accessing Medical Gender Affirmation at Younger Ages. Referrals for medical treatments for transgender youth appear to have increased in recent years. At one pediatric endocrinology clinic that saw 38 transgender patients over a 13-year period from 2002 to 2015, 74% (28 patients) were referred in the most recent three years (Chen et al., 2016). Their mean age at first presentation was 14.4 years old (SD = 3.2 years) (Chen et al., 2016). Additionally, opportunities for youth to begin medical gender affirmation at a younger age are coming, according to a report by CTV News, based on an advance copy of updated guidelines from WPATH (Tanner, 2022). Within the new guidelines, according to the article, hormone therapy for gender affirmation could be initiated at 14 years old, rather than 16 years old.

2.2.4.1 Relevance for Masculinizing Youth. For pre-pubertal transgender boys, there are two options for fertility preservation (Ainsworth et al., 2020). Ovarian tissue can be cryopreserved, or used as a source of immature oocytes for collection for in vitro maturation. In Europe, ovarian tissue cryopreservation is an established method of fertility preservation, however in the United States it is considered experimental (Ainsworth et al., 2020; Cheng et al., 2019). To use cryopreserved ovarian tissue in the future, it requires transplantation. This has been shown to be effective, with over 130 live births among cisgender women using this method (Ainsworth et al., 2020). Similarly, in vitro maturation is currently in practice for cisgender women, whereby immature eggs are collected from the ovaries, grown in vitro in a laboratory while they mature, and then fertilized and placed in the patient's uterus (TFP Oxford Fertility, 2021). IVM using this method is about half as successful as in vitro fertilization (IVF), with a woman under 35 having approximately a 20% chance of successful pregnancy after one cycle (TFP Oxford Fertility, 2021).

However, studies of humans suggest that there is a period, often between one to three years, post-menarche where the ability to reproduce is poor, and egg quality is diminished (Duncan, 2017). Therefore, cryopreserved gametes or tissue collected during this period may not be usable in the future.

2.2.5.2 Relevance for Feminizing Youth. The only option for fertility preservation prior to feminizing hormone therapy for gender affirmation for those who are pre-pubertal is testicular tissue cryopreservation (Ainsworth et al., 2020). In vitro maturation (IVM) of this testicular tissue is required to obtain spermatids, with the goal of producing mature gametes from this tissue in the future. Currently, research on mice, and in a laboratory setting, demonstrates promise that this might be a technique that could widen the options for prepubertal transgender youth in the future (Cheng et al., 2019). This tissue biopsy method is experimental in humans, if taken earlier in puberty or before the appearance of mature sperm (Lai et al., 2020).

2.3 Barriers

2.3.1 Financial Constraints. In 2017, the CBC reported that the cost of extracting and freezing eggs in Canada is typically around $10 000, with an additional annual cost of $300 for storage, and the cost of one IVF cycle being approximately $6 000 (Elliott, 2017). Currently, in Canada, one IVF cycle costs approximately $7 750 to $12 250 CAD, with medication costs contributing $2 500 to $7 000 CAD (Olympia Benefits, 2021). For people needing donor sperm, costs can be great. Four provinces currently provide financial assistance for fertility treatments (Ontario, Manitoba, New Brunswick, and Quebec) although the level of assistance varies (Olympia Benefits, 2021).

In several studies, fertility preservation has been identified as a cost-prohibitive procedure (e.g. Chen et al., 2017; Defreyne et al., 2020; Riggs & Bartholomaeus, 2018), for both transgender men and women (Kyweluk et al., 2018), and the cost can cause worry among those who are considering it (Defreyne et al., 2020). Financial considerations can also preclude people from certain methods of becoming parents (for example, via surrogacy) that may have been ideal if cost were not a factor (Tornello & Bos, 2017).

2.3.2 Lack of Standardization of Discussions with Healthcare Providers. The results of a literature review suggest that fertility preservation discussions are more commonly received by transgender adolescents and young adults who attend pediatric gender clinics for care, compared to other settings, with discussion rates ranging from 91% to 100% in three of the four studies that took place in this setting (Baram et al., 2019). Where fertility preservation discussions were highly prevalent, they were integrated into the normal clinic protocol (Baram et al., 2019). Similarly, other studies have found that the majority of people who completed fertility preservation received advice or counselling prior to doing so. For example, of the 9% (n = 26) that had completed fertility preservation in one study, 61.5% (n=16) responded that they were given advice or counselling prior (Bartholomaeus & Riggs, 2020). For another, 28 participants pursued fertility preservation in one study, over half of whom, 57.1%, received advice or counselling prior to undertaking it (Riggs & Bartholomaeus, 2018).

Where discussions were not integrated into the normal process of care, some transgender adolescents and young adults initiated their own discussions, and asked for referrals, others simply proceeded with their gender-affirming medical care without receiving fertility preservation advice or counselling (Baram et al., 2019). In one study of 156 transgender and gender non-conforming adolescents in America, the majority had never discussed fertility (79.5%), or how gender-affirming hormone treatments can impact fertility (82.7%) with a healthcare provider, with an additional 12.2% discussing fertility with a healthcare provider rarely (Chen et al., 2018).

A qualitative study of 12 Greek transgender individuals in different stages of medical gender affirmation (mean age = 40 years old; range 23 to 60 years old) identified lack of adequate information and fertility counselling as a key barrier to pursuing fertility preservation (Voultsos et al., 2021). Every participant reported not receiving adequate fertility preservation counselling prior to starting their medical transition. Some participants were not regretful or bothered by the inadequate discussions, but others felt deprived of the opportunity to make fertility decisions because of the lack of information they had received (Voultsos et al., 2021). Similarly, in an Australian study, 52.3% of 308 transgender adult respondents reported that they had not been given fertility preservation counselling, but they were fine with that, while 15.9% reported not receiving counselling, but wishing they had (Riggs & Bartholomaeus, 2018). Of

those who had not received counselling, 39% were non-binary, 30% were transgender men, 20% were transgender women, and 11% were agender (Riggs & Bartholomaeus, 2018). In another study, 50% of 269 respondents who had not undertaken fertility preservation reported not receiving any advice or counselling about their fertility preservation options, but they were fine with that, while 16% reported not receiving counselling, but wishing they had (Bartholomaeus & Riggs, 2020).

Similarly, in a Belgian study of 172 transgender men and non-binary (female at birth) participants, 36.5% reported not receiving any information on fertility preservation (Defreyne et al., 2020). Of this group, 17.1% responded that they did not need it, and 8.8% responded that they wanted to receive it. Of the 63.5% who did receive information on fertility preservation, only 35.9% reported their source was a healthcare worker. Those who identified as transgender men, as opposed to non-binary, were more likely to have received information, at 74.2% and 40.7% respectively. People who had previously sought a healthcare professional for transgender specific care, compared to those who had not, were also more likely to have received information on fertility preservation (Defreyne et al., 2020).

2.3.3 Short-Term Decision-Making. Short-term decision making could contribute to the underutilization of fertility preservation and to the frequent reports of never wanting children seen among youth transitioning at younger ages (e.g. 21% in Nahata et al., 2017). Many providers reported that their younger patients often denied wanting biological children when asked, with one writing: “With those under 18, almost always they are 100% sure that they do not want any children” (Tishelman et al., 2019). It is unclear to at least some of these providers whether these expressions represent true certainty about future family planning goals, immaturity, desire to transition quickly (and remove any perceived obstacles), or desire to reduce gender-related distress in the short-term (and deal with family planning later). Providers noted that affirming gender identity can be a greater priority than fertility preservation for their young patients (Tishelman et al., 2019). An expert commented: “A single meeting for fertility discussions may preclude sufficient reflection and […] reinforce an adolescent’s proclivity to engage in impulsive decision-making” (Nahata et al., 2018). Another provider noted: “… my biggest concern for the pediatric population is that they do not have the maturity to make such a

major life-altering decision such as medical/surgical treatments that would render them sterile and incapable of having genetically related children after transition" (Tishelman et al., 2019).

2.3.4 Invasiveness for Masculinizing Youth. The process of undergoing fertility preservation involves hormonally stimulating the ovaries to produce eggs, which some may find invasive, or uncomfortable (Finlayson et al., 2016). This may also exacerbate gender dysphoria and dysphoria related to the body. Transvaginal ultrasounds to monitor egg production can be especially uncomfortable for transgender youth (Finlayson et al., 2016), and can be a source of hesitation and anxiety (Cheng et al., 2019). Of the experience, one transgender man said: "those were horrible. It's so much easier talking about it than going through it" (Kyweluk et al., 2018). Literature suggests that invasiveness dissuades some youth from pursuing fertility preservation (Chen et al., 2017).

2.3.5 Invasiveness for Feminizing Youth. Depending on youths' age and sexual maturity, they may not have yet experimented with masturbation. This may make them uncomfortable discussing it with a healthcare provider, and further, with performing it to produce a semen sample (Finlayson et al., 2016). Some individuals may find it impossible to produce a specimen through masturbation (Cheng et al., 2019), as this can exacerbate gender dysphoria (Finlayson et al., 2016). However, freezing sperm from a semen sample produced by masturbation is the least invasive, easiest, and the safest option (Petropanagos & Campo-Engelstein, 2015). For those who have developed sufficiently, testicular sperm extraction can be used instead to produce a semen sample (Cheng et al., 2019).

2.3.6 Emotional Burden. Research suggests that an additional emotional burden can exist for transgender individuals associated with: misgendering (Chen et al., 2017) or other disrespectful treatment while seeking fertility preservation (Cheng et al., 2019), during pregnancy and post-partum (Lai et al., 2020; Voultsos et al., 2021); delaying medical gender affirmation to pursue fertility preservation (Chen et al., 2019; Chen et al., 2017; Defreyne et al., 2020); associations between their reproductive organs and their birth gender (Armuand et al., 2017; Cheng et al., 2019) that could exacerbate gender dysphoria; and preserving gametes that would be incongruent with their gender identity (Chen et al., 2018; De Sutter et al., 2002;

Voultsos et al., 2021). Youth in one study were concerned about how delaying medical gender affirmation to pursue fertility preservation would impact their mental health, with one youth saying: “I was thinking, ‘Yeah, this is smart. Why don’t I save my eggs?’ but at the same time […] I was just super depressed […] testosterone literally saved my life” (Chen et al., 2019). For people seeking masculinizing gender affirmation, a frequent rationale for not pursuing fertility preservation in one study was not wanting to take hormones to stimulate follicle development (Defreyne et al., 2020), the “feminizing” effects of the fertility preservation procedures themselves has been referred to by youth as “going backwards” (Chen et al., 2019). Additionally, the physical and mental challenges associated with testosterone cessation, such as fatigue, voice and odour changes, and resumption of menstruation, can increase gender dysphoria (Cheng et al., 2019).

2.3.7 Desiring to Adopt or Become a Non-Biological Parent. Literature suggests transgender youth are likely to desire children through adoption. Studies have reported 45% of participants mentioning a desire or plan to adopt children (Nahata et al., 2017); 70.5% of respondents indicating interest in adoption (Chen et al., 2018); and 96% indicating [strong] agreement to a question on whether they would consider adoption someday (Strang et al., 2018). Healthcare providers have noticed this trend, writing: “My patients generally aren’t concerned about biological parenting and most often speak to adoption […] Their understanding seems to be that adoption is easy.”, and “[…] they frequently say ‘I’ll just adopt’ without having the first clue what that entails” (Tishelman et al., 2019). Among adults, transgender women reported wanting to adopt more frequently (75%) than did transgender men, with 31.3% reporting wanting to adopt in total (Tornello & Bos, 2017). A qualitative study revealed that some participants felt their identities as transgender people were incongruent with biological parenthood, but they were open to becoming step-parents, for example (von Doussa et al., 2015). Research among cancer survivors has indicated that LGBTQ+ individuals were less likely to envision themselves as biological parents pre-diagnosis than were heterosexual, cisgender survivors, with adoption being the preferred parenthood method for some (Russel et al., 2016).

2.3.8 Ability to Predict Future Parenting Desires. Fertility counselling can occur early in life when it is not likely youth have good foresight to predict or plan future family

development (Lai et al., 2020). Ethical issues relating to youths' "ability to participate in medical decision-making" can arise (Cheng et al., 2019). Concern for whether they were appropriately mature to predict future desires and understand fertility and gender affirmation consequences of their decisions were raised by five articles in a recent review (Lai et al., 2020). Two articles suggested the low utilization of offered fertility preservation counselling is because youth are not developmentally ready to consider these issues (Lai et al., 2020). Youth have described feeling more "emotionally capable of considering future parenting desires" after beginning medical gender affirmation (Chen et al., 2017), and transgender adults have said that as adolescents they did not feel ready to make reproductive decisions for the rest of their lives (Voultsos et al., 2021). This suggests transgender youth specifically may be vulnerable to decision regret once they become ready to consider their future parenting desires.

2.3.9 Mental Health Considerations. Previous research suggests that transgender and non-binary people face a greater prevalence of mental health concerns, when compared with the general population, and when compared with the lesbian, gay, and bisexual population (Grant et al., 2011; Su et al., 2016). Specifically, the prevalence of anxiety, depression, and suicidal thoughts among transgender adolescents and adults alike is disproportionately high (Becerra-Culqui et al., 2018; Kattari et al., 2020), with depression being estimated to effect between half and two-thirds of transgender individuals (Clements-Nolle et al., 2006; Kim et al., 2006; Nuttbrock et al., 2010). In a clinical sample of transgender people, researchers found a similar burden of mental health challenges, estimating the prevalence of anxiety at almost two-thirds of the sample, and the prevalence of mood disorders at slightly over half (She et al., 2020). In a clinical sample of transgender youth in Canada, 24% had a diagnosed anxiety disorder, and 35% had a diagnosed mood disorder (Khatchadourian et al., 2014).

In community samples, a similarly disproportionate burden of mental health challenges, especially depression and anxiety, can be seen as in research from Australia and New Zealand (Pitts et al., 2009; Smith et al., 2014), the United Kingdom and Ireland (McNeil et al., 2012), and the United States (James et al., 2016). In Ontario, approximately 61.2% of transfeminine and 67% of transmasculine individuals experienced symptoms consistent with clinically significant depression (Rotondi, Bauer, Travers, et al., 2011; Rotondi, Bauer, Scanlon, et al., 2011). The Canadian Community Health Survey reported the prevalence of a past-year major depressive

episode as 71.1% for transgender Canadians and 7.8% for the general population (Veale, Watson, Peter, et al., 2017). The prevalence of lifetime suicide attempts were 37.8% for transgender Canadians, and 3.4% for the general population. In the Trans PULSE Project, 11.2% attempted suicide in the past year (Bauer et al., 2015). Youth were not exempt: 35% reported a past-year suicide attempt (Veale, Peter, Travers, et al., 2017). In terms of overall health, non-binary people had the worst level of mental health challenges, compared to binary transgender people (Veale, Watson, Peter, et al., 2017). Similarly, research suggests that anxiety disorders are more prevalent among the Canadian transgender population (57.0%) compared to the cisgender population (13.1%) (Jaffray, 2020).

Experts in the care of transgender youth note that "it is important to consider the possible impact of anxiety or depression on patients' abilities to form romantic relationships and/or envision future parenthood, and conversely, it is also important to consider the potential impact of pursuing or declining [fertility preservation] on their mental health" (Nahata et al., 2018). For many transgender adolescents, beginning medical gender affirmation to relieve dysphoria is more pressing than fertility preservation. Mental health issues are a recognized barrier to long-term decision-making abilities. Gender dysphoria and other mental health conditions might exacerbate difficulties being future-oriented when considering whether to pursue fertility preservation consultations. Mental health challenges can also dissuade people from wanting to parent (Voultsos et al., 2021).

Chapter 3

Methods

3.1 Study Sample

3.1.1 Clinical Sample. Trans Youth CAN! is a national study of transgender youth in Canada seeking gender-affirming clinical care at ten sites across the country, ranging from the West Coast to the Maritimes. The relevant Research Ethics Board (REB) for each institution involved approved the study's protocol.

Table 1

Description of study sites involved in the Trans Youth CAN! study.

Province	City	Clinic Name
British Columbia	Vancouver	BC Children's Hospital Gender Clinic
Alberta	Calgary	Alberta Children's Hospital METTA Clinic
	Edmonton	Stollery Children's Transgender Clinic
Manitoba	Winnipeg	GDAAY (Gender Dysphoria Assessment and Action for Youth) Clinic
Ontario	Toronto	SickKids Hospital Gender Clinic
	Hamilton	McMaster Children's Hospital Adolescent Medicine Clinic
	London	LHSC (London Health Sciences Centre) Children's Hospital Gender Pathways Service
	Ottawa	CHEO (Children's Hospital of Eastern Ontario) Diversity Clinic
Québec	Montréal	Montréal Children's Hospital Gender Variance Program and Centre Meraki
Nova Scotia	Halifax	IWK (Izaak Walton Killam) Health Centre Transgender Clinic

New patients referred to any of the study clinics for hormone suppressant medication or hormone therapy during the recruitment period (September 2017 to June 2019), who were less than 16 years old, and pubertal/post-pubertal were eligible to participate. Additional inclusion criteria included: being enrolled after referral for hormonal suppression of puberty or cross-sex gender-affirming hormone therapy, and not previously using gonadotropin-releasing hormone agonists, estrogen, or testosterone therapy (except contraceptives). Informed consent (or assent, as required) was obtained from youth, and from parents/guardians on behalf of youth, depending on local regulations.

Trans Youth CAN! is a prospective cohort study, for which adolescent participants were asked to complete three questionnaires with a trained interviewer during their regularly scheduled clinic visits (or virtually, during the COVID-19 pandemic) at the following times: (1) baseline, (2) 12-month follow-up, and (3) 24-month follow-up, with the clinic where they were receiving medical gender affirmation. Survey data were also collected for youth who switched care to another clinic (e.g. their primary care provider), or who stopped receiving medical gender affirmation. Each questionnaire took 45 to 60 minutes to complete, for which youth received a $20 gift card, compensation for parking, and refreshments and snacks. Some information about youth's health and the medical gender affirmation they were receiving at the clinics was extracted from medical records. Ultimately, 174 youth participated in the baseline Trans Youth CAN! questionnaire, 163 in English and 11 in French.

3.1.2 Community Sample. Trans PULSE Canada was a national community-based survey of transgender and gender-diverse people conducted over the course of ten weeks in 2019, focusing on the health and well-being of transgender and non-binary people in the country. It was designed as a cross-sectional study, with a self-administered questionnaire that could be completed in English or French, online, on paper, via telephone with a language interpreter, or in person with peer research associates in major cities. The inclusion criteria for the study were: being 14 years of age or older, living in Canada, and identifying as a gender other than that which was assigned at birth. Therefore, the questionnaire could be completed by individuals in any stage of social and/or medical gender affirmation, including by those with no plans to pursue medical gender affirmation. Parental/guardian consent was waived to allow youth who hadn't yet disclosed their gender identity to their parents/guardians to complete the questionnaire without needing to do so.

Participants could choose to complete the full questionnaire, covering demographics, health, health care experiences, and social experiences, as well as questions designed to inform policy and practice, or they could complete the short form questionnaire. The short form questionnaire included demographic information, and one key question from each major content area covered by the full questionnaire. The full questionnaire took approximately 70 minutes to complete, which could vary depending on how many sections were not applicable to individual respondents, and the short form took approximately 10 minutes. Participants could pause and

return to the questionnaire, or schedule multiple sessions to complete it. There was no honourarium for questionnaire completion. Ultimately, the sample size for this study was 2 873.

The short-form questionnaire did not cover key data, including whether fertility preservation was discussed at participants' consultation visits for medical gender affirmation. Therefore, only participants who completed the full version of the questionnaire were eligible for analysis for the purposes of this thesis. A subgroup of Trans PULSE Canada participants comprised the analytic sample, for which the inclusion criteria included answering: (1) "Have you met with a healthcare provider about receiving puberty blockers, hormones, or surgeries?" affirmatively, and (2) both age-related questions (the age they were at the time of their consultation, and their age as of questionnaire completion). Additionally, participants in the analytic sample must have (1) been 39 years old or younger at the time of questionnaire completion, and (2) had their consultation when they were the same age as, or one year younger than, their age when completing the questionnaire. In the questionnaire itself, participants could respond to the questions on their medical gender affirmation consult and fertility preservation discussion therein if they were 50 years of age or younger, with their consultation occurring in the five years prior to questionnaire completion.

The decision to limit the analytic sample to those 39 years old or younger at questionnaire completion was based upon research suggesting that cisgender men's fertility begins to decline at the age of 35, and that after they reach the age of 40, most will experience significant age-related fertility decline (Dunson et al., 2004). At the age of 45, the average duration of time required for cisgender men to successfully impregnate their female partners was five times longer than that required for those aged 25 (Hassan & Killick, 2003). Fertility potential among cisgender women begins to decline in the 30s, declining particularly after age 35, and declining even more steeply after they reach the age of 40 (Dunson et al., 2004). Limiting the amount of time that had passed between the consultation and the completion of the questionnaire was done to (1) increase the likelihood that responses reflected the participants' situations when they received their consultation, and (2) reduce the potential for participants to forget with increasing time whether they discussed fertility preservation with their healthcare provider.

There were 417 participants 39 years old and younger at the time of responding to the questionnaire, for whom their reported age matched or was one year different from their age at

consultation. Participants who were born outside of Canada, who had lived in Canada for 2 years or less, were removed from the analytic sample. This was to ensure, as much as possible, that results reflected characteristics of the Canadian healthcare system, and not those of other countries. After this was done, the final analytic sample included 404 participants.

3.2 Study Measures

3.2.1 Outcome Variables.

Desire to parent. Clinical sample participants were asked "Would you like to have or adopt a child in the future?", with response options "Yes", "No", and "Undecided/unsure", at three different time points: baseline, 12-month follow-up, and 24-month follow-up. This was not an outcome for the community sample.

Discussion of fertility preservation. For the clinical sample, this outcome was extracted from medical records. If there was no indication confirming that a fertility preservation discussion took place, the outcome was reported as "Unsure". For the community sample, this outcome was reported from participants' response of "Yes" or "No" to the question "Did your health care provider discuss options to freeze your eggs, sperm, or embryos, to have children later?".

3.2.2 Demographics – Equity Analyses.

Sex and gender. Participants in both samples could indicate only one option of "Male" or "Female", to describe their sex at birth. Then, they could select only one of the following options "Man or boy", "Woman or girl", "Indigenous or other cultural gender identity", and "Non-binary, genderqueer, agender, or a similar identity" to report their gender identity. Clinical sample participants did not have the option to select an Indigenous or cultural gender identity on their baseline questionnaire, from which information about their gender identity was extracted. For this thesis, gender categories were classified as "binary", including man or woman gender identities, or "non-binary", including non-binary and similar gender identities, as well as cultural gender identities, where applicable. Therefore, two gender categories were created for each sex at birth for the community sample. For male sex, these were: transgender women, and non-binary; for female sex, these were: transgender men, and non-binary. For the clinical sample, one

participant was retained in the study sample whose gender identity and sex at birth were congruent. Therefore, for the clinical sample, there were three gender categories for each sex at birth: man/boy, woman/girl, and non-binary/other.

Ethnoracial identity. For the purposes of this thesis, community and clinical sample participants' ethnoracial background was analyzed as a three-category variable: (1) Indigenous, (2) non-Indigenous racialized, or (3) non-Indigenous white. For the clinical sample, these data were collected as part of the youth's baseline questionnaire.

Perceived as a person of colour. Participants in the community sample could respond with either "Yes", or "No", to whether they were "perceived or treated as a person of colour in Canada".

Low income. Participants from the community sample were classified as low-income by their total household income before taxes divided by the number of people supported on this income, in accordance with Statistics Canada's low income measure (Statistics Canada, 2017). Response options were presented as $10 000 ranges, covering incomes from "less than $10 000" to "$150 000 or more", the midpoint of which was used (or else $1 less or more for the lowest and highest brackets respectively) for the determination of low income. Participants over the age of 16 were eligible to respond.

Newcomer to Canada status. Participants from the community sample were able to write in their own responses for how long they had been living in Canada in numbers of years and months if they were born outside of Canada. For the purposes of this thesis, this question was used to define newcomers to Canada, using a cut-off of seven years. Traditionally, the cut-off for newcomer status is five years (for example, Statistics Canada, 2010). This was extended to seven years here, because participants' medical gender affirmation consultation visits could have occurred almost two years before their response to the questionnaire.

Immigrant family status. Participants from the clinical sample could indicate on their baseline questionnaire whether they were "someone who immigrated to Canada from another country", or

"someone whose parent or parents immigrated to Canada from another country". For the purposes of this thesis, if participants responded "yes" to either question, they were considered to come from an immigrant family.

Age. Participants in both studies could report their age in years.

Family religiosity. Participants in the community sample were asked "How religious or faith-based was your upbringing?", with response options "Not at all religious", "Slightly religious", "Somewhat religious", "Pretty religious", or "Very religious". For the purposes of this thesis, responses were dichotomized into: "More than somewhat religious" or "Somewhat religious or less".

3.2.3 Demographics – Other Analyses.

Community size. For the purposes of this study, rural was defined as an area with a community size less than 10 000 people. This information was derived from participants' postal code information, for those in the community sample, based on postal code community size designations. This cut-point was chosen because these areas are outside of census agglomerations and census metropolitan areas.

Potential for pregnancy with future partner. This variable was created for this thesis to represent whether participants could potentially produce a pregnancy (for themselves, a partner, or a surrogate) with a future romantic/sexual partner using their gametes and those of their partner, categorized as "Yes", "No", or "Unsure". Participants from the community sample could check multiple response options to indicate to whom they are sexually and/or romantically attracted. Potential for future pregnancy was based on participants' sex at birth: for male, responses of any of "Trans men", "Cis (non-trans) women", "Non-binary people (assigned female at birth)", and "All of the above" were coded as "Yes"; for female, responses of any of "Trans women", "Cis (non-trans) men", "Non-binary people (assigned male at birth)", and "All of the above" were coded as "Yes". If none of those responses was checked, potential for future pregnancy was coded as "No". For participants who only selected "Unsure", their potential for future pregnancy was "Unsure".

Education level. Participants from the community sample could select one option for the highest level of formal education they had completed. For the purposes of this thesis, the responses were recoded into 4 categories: (1) some high school work or graduate, (2) some CÉGEP/college work or graduate, (3) some undergraduate university work or degree, or (4) more education.

Experience with parenthood status. Participants from the community sample were asked "Are you a parent of children, including adult children? This also includes fostering, adopting, or co-parenting children", with response options "Yes", and "No".

3.2.4 Health Information. For disability and mental health diagnoses, participants from the community sample could select as many as were applicable for the conditions with which they had been diagnosed. Each of the four disability diagnosis categories and two mental health diagnosis categories to follow were dichotomous "Yes"/"No" variables created for the purposes of this thesis.

(1) **Neurodevelopmental condition.** Participants were classified as being diagnosed with a neurodevelopmental condition if they selected any of "Autism or Asperger's", "Intellectual or developmental disability", or "Learning disability".

(2) **Chronic pain condition.** Participants were classified as being diagnosed with a chronic pain condition if they selected "Chronic pain condition".

(3) **Mobility/physical disability or vision impairment.** Participants were classified as being diagnosed with a mobility/physical disability or vision impairment if they selected "Mobility or physical disability", or "Vision impairment".

(4) **Mental health condition.** Participants were classified as being diagnosed with a mental health condition if they selected "Mental health condition".

(1) **Depression and/or anxiety.** Participants were classified as being diagnosed with depression and/or anxiety if they selected at least one of "Major depression" or "Anxiety disorders".

(2) **Other mental health condition.** Participants were classified as being diagnosed with another mental health condition if they selected at least one of "Dementia", "Post-traumatic stress disorder", "Schizophrenia", "Bipolar disorder", "Dissociative identity disorders (multiple personality disorder)", "Borderline personality disorder", "Anorexia nervosa", "Bulimia nervosa", "Exercise bulimia", or "Binge eating disorder".

Intersex. For the purposes of this thesis, one dichotomous ("Yes"/"Not yes") variable was created to reflect community sample participants' lived perception of intersex experience ("Were you born with, or developed naturally in puberty, sex characteristics that do not fit standard definitions of male or female?"), or diagnosis with a recognized intersex condition ("Have you been diagnosed with a medically-recognized intersex condition?"). The "Not yes" group included responses of both "No", and "Unsure".

Baseline prescription type received. Type of medical gender affirmation received by participants in the clinical sample was extracted from medical records after completion of the baseline questionnaire. For the purposes of this thesis, type of medical gender affirmation was classified as continuous contraception only, hormone suppression only, any testosterone (alone or in combination therapy), or any estrogen (alone or in combination therapy). Any testosterone or estrogen were together referred to as "cross-sex hormones". Multiple medications could be selected, based on the youth's sex at birth. For male, options were: "Lupron", "Spironolactone", "Estrogen", and "Other". For female, options were: "Lupron", "Depo-Provera", "Continuous birth control pills", "Levonorgestrel-releasing intrauterine system", "Testosterone", and "Other". For the purposes of this thesis, "Lupron", and "Spironolactone" were classified as hormone suppressant medication, while "Depo-Provera", "Continuous birth control pills", and "Levonorgestrel-releasing intrauterine system" were classified as continuous contraception. None of the participants' medical records indicated receipt of "Other" prescriptions.

Baseline cross-sex hormone prescription. For the purposes of this thesis, receipt of cross-sex hormone prescription was also analysed as a binary variable (yes/no) for participants in the clinical sample who received a baseline prescription, as described above.

Outcome of fertility preservation discussion with a provider. Clinical sample participants' decision regarding fertility preservation was extracted from medical records after completion of the baseline questionnaire. This could be indicated with options: "Accepted", "Declined", "Undecided", "Not available in region and unwilling/unable to travel for it", and "Not in medical record".

3.3 Data Considerations

3.3.1 Missing Data for Research Questions 1 and 2. The first and second research questions were: (1) how prevalent are fertility preservation discussions with healthcare providers and fertility preservation procedures, and does prevalence differ by age?, and (2) what characteristics are associated with discussing fertility preservation? The former was answered using both the clinical, and the community sample, while the latter was answered using the community sample only.

First, missing data for (1) the prevalence of fertility preservation discussions, and (2) demographic and health characteristics that were examined for potential associations with fertility preservation discussions were assessed for the community sample. Missingness for single variables (Table 2), and missingness across patterns (Table 3) were examined. In Table 2, the count of participants missing for each variable is reported, as well as the proportion out of 404, the count of participants in the analytic sample for this thesis. In Table 3, an "x" indicates that data are not missing, and "mis" indicates that data are missing for the variable indicated in the column header. The "outcome" column refers to missingness for participants' fertility preservation discussions with their healthcare providers. The frequency, in numbers of participants, is reported for each missing data pattern.

Missing data for (3) the prevalence of fertility preservation discussions for the clinical sample was not assessed. In the participants' medical records, no indication of a fertility preservation discussion does not necessarily mean that a discussion did not occur, but rather that it cannot be confirmed to have occurred. Therefore, there is no missing data per se for the

prevalence of fertility preservation discussions for the clinical sample. Where there were no indications confirming that fertility preservation discussions took place, discussion prevalence was reported as “unsure”.

Table 2

Summary of Data Missingness for Single Variables, Community Sample

Variable	Missing observations (n)	Percent missingness (%)
Demographics – Equity Analyses		
Sex and gender	3	0.7
Ethnoracial group	2	0.5
Low household annual income	67	16.6
Newcomer to Canada	0	0.0
Age	0	0.0
Family religiosity	51	12.6
Demographics – Other Analyses		
Community size	10	2.5
Potential for pregnancy with future partner	51	12.6
Education level	2	0.5
Parenthood experience status	8	2.0
Health Information		
Diagnosed disability	0	0.0
Diagnosed mental health condition	49	12.1
Intersex experience	51	12.6
Diagnosed intersex condition	51	12.6
Outcome		
Fertility preservation discussion	51	12.6

Table 3

Summary of Data Missingness Across Patterns, Community Sample

Sex & Gender	Ethnoracial group	Low income	Family religiosity	Rural	Potential for pregnancy	Education level	Parenting status	Mental Health	Intersex	**Outcome**	Frequency
x	x	x	x	x	x	x	x	x	x	**x**	277
x	x	x	x	x	x	x	mis	x	x	**x**	8
x	x	x	x	x	x	mis	x	x	x	**x**	2
x	x	x	x	x	mis	x	x	x	x	**x**	1
x	x	x	x	mis	x	x	x	x	x	**x**	3
x	x	x	mis	x	x	x	x	x	mis	**mis**	1
x	x	x	mis	x	mis	x	x	mis	mis	**mis**	39
x	x	x	mis	mis	mis	x	x	mis	mis	**mis**	2
x	x	mis	x	x	x	x	x	x	x	**x**	54
x	x	mis	x	mis	x	x	x	x	x	**x**	4
x	x	mis	mis	x	x	x	x	x	mis	**mis**	1
x	x	mis	mis	x	mis	x	x	mis	mis	**mis**	7
x	mis	x	x	x	x	x	x	x	x	**x**	2
mis	x	x	x	mis	mis	x	x	x	x	**x**	1
mis	x	x	mis	x	mis	x	x	mis	mis	**mis**	1
mis	x	mis	x	x	x	x	x	x	x	**x**	1

These results show that 12.6% of the analytic sample had missing data for their fertility preservation discussions. Further, results revealed that only 277 participants had complete data for every variable of interest, of the analytic sample of 404. The pattern of missing data was examined, to assess the type of missing data. Results of this suggest an arbitrary (non-monotone) pattern. Where frequencies of missing data patterns were relatively high (e.g. 39 or 54), the displayed means of predictor variables were different from those of the pattern with no missing data. This suggests that the missing data follow a MAR (missing at random) mechanism. Therefore, performing listwise deletion would bias the results. For this reason, multiple imputation of the missing predictor variables and outcome was used, using the fully conditional specification method, prior to running the regression analyses. This method was chosen because fully conditional specification is appropriate for missing data that follow a non-monotone pattern, including data with different types (Berglund & Heeringa, 2014).

3.3.2 Missing Data for Research Question 3. The third research question was: how prevalent is desire to parent, does it differ by age, and to what extent does desire to parent change over time? This question was answered using the clinical sample.

The following Tables 4 to 6 examine the missingness patterns present over the three survey time points. Data missingness is examined by age group in Table 4 (for 10- to 13-year-olds) and Table 5 (for 14- to 15-year-olds), and then for the full sample in Table 6. For Tables 4 to 7, the column headers “Baseline”, “12 months”, and “24 months” are used, reflecting the three time points for which participants could complete a questionnaire. Only participants in the analytic sample were included in these analyses, referring to participants who received baseline prescriptions for medical gender affirmation, excluding continuous oral contraception only. For Tables 4 to 6, column totals are displayed in the last row of each of columns “baseline”, “12 months”, and “24 months”. Column totals include the count of participants who completed the questionnaire at each respective time point. Row totals are presented in the last column, showing the count of participants who follow each missing data pattern. The word “Present” reflects completion of the questionnaire for a given time point, while the word “Missing” reflects that the questionnaire was not completed. Desire to parent for one of these patterns, wherein participants responded to the baseline and 24-month questionnaires, but were missing for the 12-month questionnaire, is examined in more detail in Table 7.

In Table 8, potential correlates of questionnaire missingness were examined. “Fisher’s” refers to the Fisher’s exact statistical test, and “χ^2” refers to the chi-square test of independence. Fisher’s exact tests were used when one or more expected cell count for the chi-square test of independence was less than five. The “missing pattern” refers to the four possible patterns of missing data for desire to parent: (1) no missing data, (2) missing data at 12 months only, (3) missing data at 24 months only, and (4) missing data at 12 months and 24 months. “Missingness” refers to a binary indicator of whether data for desire to parent was missing at either follow-up time point.

Table 4

Data Missingness Over Time, Baseline Age 10 to 13, Clinical Sample

Baseline	12 months	24 months	Row Total
Present	Present	Present	n = 24
Present	Present	Missing	n = 3
Present	Missing	Present	n = 1
n = 34 (100%)	n = 27 (79%)	n = 25 (74%)	

Table 5

Data Missingness Over Time, Baseline Age 14 to 15, Clinical Sample

Baseline	12 months	24 months	Row Total
Present	Present	Present	n = 50
Present	Present	Missing	n = 14
Present	Missing	Present	n = 10
n = 92 (100%)	n = 64 (70%)	n = 60 (65%)	

Table 6

Data Missingness Over Time, Full Clinical Sample

Baseline	12 months	24 months	Row Total
Present	Present	Present	n = 73
Present	Present	Missing	n = 17
Present	Missing	Present	n = 11
n = 126 (100%)	n = 91 (72%)	n = 85 (67%)	

Table 7

Desire to Parent Among Missing Respondents Returning at 24 Months, Full Clinical Sample

Baseline	12 months	24 months	Total (n = 11)
Yes	------	Yes	n = 4
	------	No	n = 0
	------	Unsure	n = 1
No	------	Yes	n = 0
	------	No	n = 0
	------	Unsure	n = 1
Unsure	------	Yes	n = 1
	------	No	n = 1
	------	Unsure	n = 3

Table 8

Potential Correlates of Missingness, Clinical Sample

Test	Statistical test	p-value
Missing pattern by ethnoracial group *(Indigenous/non-Indigenous racialized/non-Indigenous white)*	Fisher's	0.1054
Missingness by ethnoracial group *(Indigenous/non-Indigenous racialized/non-Indigenous white)*	Fisher's	0.3437
Missing pattern by sex at birth *(female/male)*	Fisher's	0.5202
Missingness by sex at birth *(female/male)*	χ^2	0.4399
Missing pattern by gender identity category *(binary/non-binary)*	Fisher's	0.8648
Missingness by gender identity category *(binary/non-binary)*	Fisher's	1.0000
Missing pattern by age category *(10 to 13/14 to 15)*	Fisher's	0.3283
Missingness by age category *(10 to 13/14 to 15)*	χ^2	0.0803
Missing pattern by immigrant family status *(yes/no)*	Fisher's	0.9184
Missingness by immigrant family status *(yes/no)*	χ^2	0.9293
Missing pattern by baseline prescription type received *(continuous contraception only/hormone suppression only/cross-sex hormones)*	Fisher's	0.4682
Missingness by baseline prescription type received *(continuous contraception only/hormone suppression only/cross-sex hormones)*	Fisher's	0.3231
Missing pattern by baseline cross-sex hormone prescription *(yes/no)*	Fisher's	0.9802
Missingness by baseline cross-sex hormone prescription *(yes/no)*	χ^2	0.9357

The goal of these tests was to determine whether the missing pattern of data for desire to parent, or the missingness of the data for desire to parent were significantly associated with any of the above variables (representing sociodemographic variables, and gender-affirming medical care received). These variables were chosen based on the literature and a priori knowledge. If

there were a statistically significant relationship observed (p-value less than 0.05), it would suggest data were following the missing at random mechanism.

Missingness, and the patterns of missing data, were not found to be significantly associated with any of the assessed variables at the $\alpha = 0.05$ level, which suggests that data were not following the missing at random mechanism. While we did not have the ability to analyse the values of the missing data in this study, the pattern of responses, shown in the preceding Table 7, is similar to the pattern of responses seen with a complete case analysis, wherein only participants with no missing data for any of the three time points are included in the analysis. This suggests that missingness is probably not dependent on the values of the missing data itself, which would be the case if data were following the missing not at random (MNAR) mechanism. This suggests that the missing data is following an ignorable mechanism for this dataset. Therefore, the results from the complete case analysis are presented in the following chapter.

3.4 Statistical Analyses

3.4.1 Statistical Analyses for Research Question 1. The first research question was: how prevalent are fertility preservation discussions and procedures, and does prevalence differ by age?

To answer this question, a flow chart was created for the clinical sample, which included whether prescriptions were obtained, the type of prescription obtained, whether a discussion of fertility preservation with a healthcare provider could be confirmed, and the recorded outcome of the fertility preservation discussion. The flow chart was stratified by sex at birth and gender identity, with counts of participants presented in each segment of the flow chart. Totals were also presented along the side, to allow the reader to easily see prevalences in total, and by each sex and gender category. Proportions were not provided alongside these counts, to avoid over-interpretation of the data, as the numbers in some of these groups were small.

For the community sample, two descriptive tables were created. The first included the full, available sample of participants who were eligible to respond to the questions on their consultations for medical gender affirmation. This group included an expanded age range, compared to the analytic sample, and participants whose consultations occurred within the five years prior to their questionnaire completion. The purpose of including this larger group of participants in the analysis was to present a more complete picture of fertility preservation

discussions in Canada, with the data available. The count and proportion of participants, by their reported discussion of fertility preservation (yes/no/not reported), were reported in total, and stratified into six age groups. Chi-squared tests for specific proportions were conducted for each of the three possible reported fertility preservation discussion experiences, testing the null hypothesis that the proportion observed in the youngest age group was not significantly different from the proportions observed in other age groups.

The second descriptive analysis used the analytic sample. This group included a narrower age range, and participants whose consultations occurred within almost two years prior to their questionnaire completion. The purpose of separately analysing this sample is to present a more focused picture of fertility preservation discussions among those whose data would be less vulnerable to the temporality issue, and who would be in the typically fertile age range. The count and proportion of participants in total, and in each age group, for each discussion group (yes/no/not reported) were calculated, with chi-squared tests of specific proportion testing the null hypothesis that the proportion observed in the younger age group was not significantly different from the proportion observed in the older age group.

3.4.2 Statistical Analyses for Research Question 2. The second research question was: what characteristics are associated with discussing fertility preservation? This research question was examined using the community sample.

The characteristics of participants in the analytic sample, with respect to the count and proportion observed for each of the variables of interest, were described in a table. Chi-square tests of specific proportions were conducted to assess whether the proportion observed in the younger age group was significantly different from the proportion observed in the older age group.

Another table described the participants in the analytic sample by their discussion of fertility preservation, with respect to their characteristics. Whether there were significant associations between the fertility discussion groups and the variables of interest was assessed using chi-square tests of independence. Where expected counts for one or more cells of the chi-square test were fewer than five, Fisher's exact tests were performed, as these are too low for chi-square tests to function reliably.

Prevalence risk ratios were calculated to predict the likelihood of a person receiving a fertility preservation discussion with their healthcare provider in a multivariable modified Poisson regression model with robust variance estimators (Zou, 2004). The variables were entered into the model in three sequential chunks: (1) demographics for equity analyses: sex and gender identity categories, ethnoracial group, newcomer status, age, family religiosity, and whether a person lives in a low-income household), (2) other demographic analyses: community size, potential for pregnancy with a future partner, education level, and parenthood status, and (3) health information: diagnosed disabilities, diagnosed mental health conditions, and interex experience. The first chunk of this model also included interaction terms between sex and gender categories and: (1) age, (2) family religiosity, and (3) ethnoracial group, as well as interactions between sex at birth and identifying with a binary or non-binary gender identity. Age was assessed as a continuous variable, and a quadratic term was added to assess whether age had a non-linear relationship with the outcome. From these three models, predictor variables were removed from the final model if they met or exceeded the threshold of the p-value to remove, which in this case was $p = 0.2$. However, if interaction terms were retained, their lower-order terms would also remain in the model, and if the quadratic age term were retained, the original age term would also be retained.

Poisson regression is commonly used when the dependent variable is a count variable. In this thesis, discussing fertility preservation with a healthcare provider was the dependent variable, which is binomial. However, Poisson regression was chosen in place of logistic regression so that prevalence risk ratios could be estimated, rather than prevalence odds ratios. The benefit of risk ratios is that they are more readily interpretable than are odds ratios. Because the link function for a Poisson regression is log, the results presented for this analysis were exponentiated (using the base e), to present the prevalence risk ratios, instead of the log prevalence risk ratios. The command PROC GENMOD was used to run the regression analyses, after 20 imputations had been performed, using fully conditional specification. Multiple imputation was used because complete case analysis would shrink the available analytic sample from 404 to 277, which would result in a loss of power. Multiple imputation creates several plausible imputed data sets, based on the observed values for the model, and can be used to impute missing outcome data. A seed value (47744774) was specified during the imputation step

so results would be reproducible. The FCS DISCRIM and LOGISTIC statements were used to impute missing data for nominal and ordinal variables, respectively.

Reference categories for the multivariable modified Poisson regression were chosen as follows. For the demographics for equity analyses variables, the reference category was the option that was least likely to be subject to equity issues specific to fertility preservation, based on the literature and *a priori* knowledge. For example, the reference category for the ethnoracial group variable was non-Indigenous white. Other reference categories for this set of variables included transgender women for sex and gender categories, not low income for dichotomized annual household income, not newcomer for newcomer status, and somewhat religious or less for family religiosity.

For the other demographic variables, the reference category was the option that was most likely to facilitate parenthood, based on the literature and *a priori* knowledge. For example, the reference categories for potential for pregnancy with a future partner and parenthood status were both yes. The reference category for community size was not rural due to the potential for easier access to services (such as fertility preservation-, parenting-, and health services) associated with living in a non-rural area. However, the referent category for highest level of education was high school, as the sample included youth as young as 14 years old.

For the health variables, the reference category was the option that indicated not having the listed health condition. For example, the reference category was not having a disability for each of the four diagnosed disability variables: neurodevelopmental condition, chronic pain condition, mobility/physical or vision impairment, and mental health condition. Other reference categories for this set of variables included not having a diagnosed depression or anxiety disorder, not having a diagnosed other mental condition, and not reporting intersex experience or diagnosis of an intersex condition.

3.4.3 Statistical Analyses for Research Question 3. The third research question was: how prevalent is desire to parent, does it differ by age, and to what extent does desire to parent change over time?

To answer this question, the following variables were examined: desire to parent, and age at baseline. Desire to parent was analysed for the subgroup of clinical sample participants who received a gender-affirming medical prescription at baseline, excluding those who received

continuous oral contraception only. At each time point, there were three possible responses regarding desire to parent: (1) yes, (2) no, and (3) unsure. Groups were created to reflect each possible situation, based on the possible responses at each time point. Therefore, there were three groups at baseline, nine at 12-month follow-up, and twenty-seven at 24-month follow-up.

The count of participants was reported for each group. At baseline, the proportion of participants in each group was reported as a proportion of the subgroup of participants who received medical gender affirmation at baseline. At the 12- and 24-month follow-ups, the portion of participants in each group was reported with respect to the number of participants in the group from which they came. For example, the proportion of participants who "remained yes" at 12-month follow-up was calculated as the count of participants who "remained yes" at 12-month follow-up, divided by the count of participants who responded "yes" at baseline. Another proportion was calculated, reflecting the proportion of participants who followed each pathway from baseline to 24-months.

This procedure was repeated twice more, with the participants eligible for this analysis stratified into two age groups: 10 to 13 years old at baseline, and 14 or 15 years old at baseline.

Chapter 4

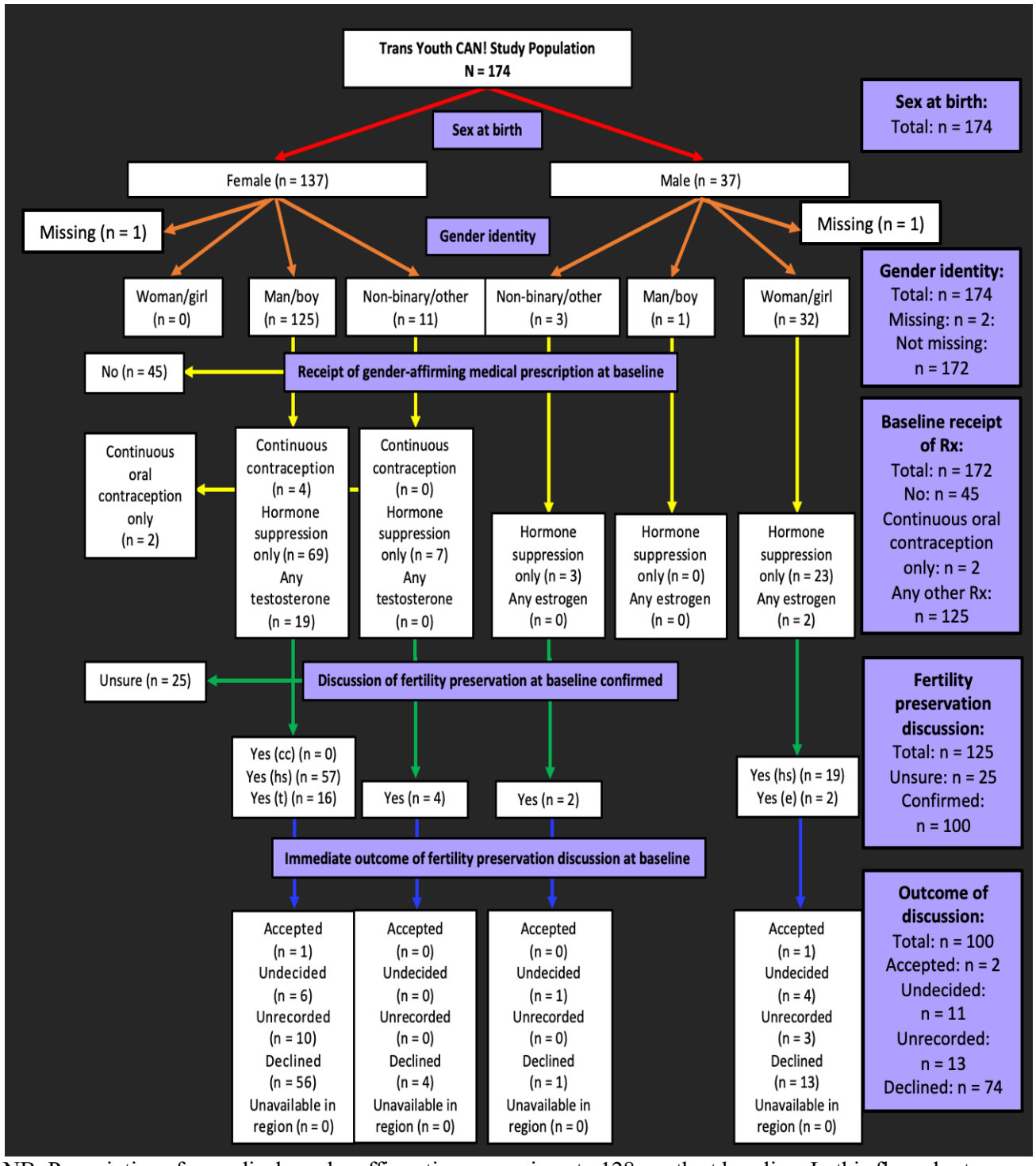
Results

4.1 Research Question 1

The first research question was: how prevalent are fertility preservation discussions with healthcare providers and fertility preservation procedures, and does prevalence differ by age?. For the clinical sample, Figure 1, below, presents the prevalence of fertility preservation discussions and procedures, stratified by youths' sex at birth, and gender identity. Along the right-hand side of the figure, purple boxes display summarized information for the reader. Discussion of fertility preservation is presented by the type of baseline prescription for medical gender affirmation that youth received, with options including continuous contraception only (Depo-Provera (medroxyprogesterone acetate) or levonorgestrel-releasing intrauterine system), hormone suppression only (Lupron (leuprolide acetate) or spironolactone), and any estrogen or testosterone (alone, or in combination therapy with hormone suppressants). Discussion prevalence was not assessed for youth who were prescribed continuous oral contraception only. For the community sample, Tables 9 and 10, below, present the total and age-stratified prevalence of fertility preservation discussions for the full available sample and the analytic sample respectively.

Figure 1

Flow Chart of Youths' Baseline Visit, Clinical Sample



NB: Prescriptions for medical gender affirmation were given to 128 youth at baseline. In this flow chart, 127 participants are shown receiving a prescription. The missing participant did not report their gender identity.
cc: continuous contraception only
hs: hormone suppression only
e: estrogen
t: testosterone
Rx: prescription

The clinical sample included 174 participants, of whom 137 reported female sex at birth (gender identity: woman/girl n = 0; non-binary/other n = 11; man/boy n = 125; missing n = 1), and 37 reported male sex at birth (gender identity: woman/girl n = 32; non-binary/other n = 3; man/boy n = 1; missing n = 1).

This paragraph focuses on the 136 youth with female sex at birth, for whom gender identity is known. At baseline, 99 were prescribed medical gender affirmation, 92 of whom reported man/boy gender. Of these 92 youth, prescriptions included continuous contraception for 4 (continuous oral contraceptives: n = 2; medroxyprogesterone acetate: n = 2), hormone suppression only for 69 (all leuprolide acetate) and any testosterone for 19 (alone: n = 16; combination with leuprolide acetate: n = 3). Of the 99 youth, all 7 reporting non-binary/other gender were prescribed hormone suppression only (all leuprolide acetate). Fertility preservation discussion prevalence was assessed for 97 youth, with the two youth prescribed continuous oral contraception excluded. Discussions were confirmed to have occurred in the medical records of 77 youth, with unknown discussion prevalence for the remaining 20. Of the 77 youth with confirmed discussions, 60 declined to pursue preservation procedures, and one accepted.

This paragraph focuses on the 36 youth with male sex at birth, for whom gender identity is known. At baseline, 28 were prescribed medical gender affirmation, 25 of whom reported woman/girl gender. Of these 25 youth, 23 were prescribed hormone suppression only (leuprolide acetate: n = 22; spironolactone: n = 1) and 2 received any estrogen (both in combination with leuprolide acetate). Of the 28 youth, all 3 reporting non-binary/other gender received hormone suppression only (leuprolide acetate: n = 2; spironolactone: n = 1). Fertility preservation discussion prevalence was assessed for 28 youth, with medical records confirming discussions occurred for 23 youth, and unknown discussion prevalence for the remaining 5. Of the 23 youth with confirmed discussions, 14 declined to pursue preservation procedures, and one accepted.

For the community sample, slightly less than half of the total available sample (Table 9) reported discussing fertility preservation (n = 522, 44.9%). A similar proportion reported not discussing fertility preservation (n = 494, 42.5%). Among the analytic sample (Table 10), similar proportions to those seen in Table 9 discussed fertility preservation (n = 184, 45.5%), and reported not discussing fertility preservation (n = 169, 41.8%). In both tables, chi-square tests revealed no statistically significant differences by age group.

Table 9

Fertility Preservation Discussion by Age Group, Full Community Sample

	Total (N = 1162)		Age 14-19 (N = 157)		Age 20-25 (N = 377)		Age 26-31 (N = 306)		Age 32-37 (N = 174)		Age 38-43 (N = 82)		Age 44-50 (N = 66)		χ^2 test:
Variable	n	%	n	%	n	%	n	%	n	%	n	%	n	%	p-value
Fertility preservation discussion															
Yes	522	44.9	79	50.3	179	47.5	129	42.2	78	44.8	30	36.6	27	40.9	0.6286
No	494	42.5	53	33.8	151	40.1	142	46.4	76	43.7	40	48.8	32	48.5	0.3226
NR[a]	146	12.6	25	15.9	47	12.5	35	11.4	20	11.5	12	14.6	7	10.6	0.7180

[a]NR = not reported

NB: characteristics of full community sample: consultation visit for medical gender affirmation within 5 years of questionnaire completion, age ≤ 50 years old.

Table 10

Fertility Preservation Discussion by Age Group, Analytic Community Sample

	Total (N = 404)		Age 14-24 (N = 202)		Age 25-39 (N = 202)		χ^2 test:
Variable	n	%	n	%	n	%	p-value
Fertility preservation discussion							
Yes	184	45.5	99	49.0	85	42.1	0.3020
No	169	41.8	76	37.6	93	46.0	0.1910
Not reported	51	12.6	27	13.4	24	11.9	0.6744

NB: characteristics of analytic community sample: consultation visit for medical gender affirmation within 2 years of questionnaire completion, age < 40 years old, living in Canada for > 2 years if born outside of Canada.

4.2 Research Question 2

The second research question was: what patient characteristics are associated with discussing fertility preservation?. For the community sample, Tables 11 through 13 present a summary of participants' demographic information, a crude analysis of associations between fertility preservation discussions and participants' demographic information, and multivariable regression models for fertility preservation discussions, respectively.

Table 11, below, summarizes participants' demographic information. The largest proportion of participants identified as non-binary, with female sex at birth (36.9%). Transgender men made up a significantly smaller-than-expected proportion of the older age group in this sample (p-value of 0.0001). Ethnoracial group was classified as non-Indigenous white for most participants (83.1%). Approximately half of respondents (49.0%) were living in a low income household. Participants' potential for pregnancy with a future partner was most commonly classified as "yes" (90.93%). The older age group contained fewer than expected high-school-educated participants and more than expected college- or CÉGEP-educated participants, and participants with more than an undergraduate education, based on proportions observed in the younger age group. Most participants were not parents (90.91%), with significantly more parents in the older age group. Mental health condition was the most prevalent of the four disability diagnosis categories. Depression and/or anxiety disorder diagnoses were common in the sample (69.6%).

Table 11

Participants' Demographic Information, Community Sample

Proportions presented in the "total sample" column are of the observed totals, which may not be 404 for all variables. Proportions in the columns for each age group sum to the proportion presented in the "total sample" column.

	Total sample (N=404)		Age 14-24 (N=202)		Age 25-39 (N=202)		χ^2 test for spec. prop.
Variable	n or $\bar{x}$	% or SD	n or $\bar{x}$	% or SD	n or $\bar{x}$	% or SD	p-value
Sex and gender							
Transgender women	121	30.2	51	12.7	70	17.5	0.0841
Transgender men	114	28.4	78	19.5	36	9.0	0.0001
Non-binary/other AFAB	148	36.9	63	15.7	85	21.2	0.0705
Non-binary/other AMAB	18	4.5	9	2.2	9	2.2	1.0000
Ethnoracial group							
Indigenous	32	8.0	20	5.0	12	3.0	0.1573
Non-Indigenous racialized	36	9.0	22	5.5	14	3.5	0.1824
Non-Indigenous white	334	83.1	160	39.8	174	43.3	0.3792
Perceived as a person of colour in Canada							
Yes	37	9.2	17	4.2	20	5.0	0.6219
No	367	90.8	185	45.8	182	45.1	0.8756
Low household annual income							
Yes	165	49.0	76	22.6	89	26.4	0.3179
No	172	51.0	66	19.6	106	31.5	0.3298
Newcomer to Canada							
Yes	8	2.0	4	1.0	4	1.0	-----
No	396	98.0	198	49.0	198	49.0	1.0000
Age	25.06	6.3117	19.84	2.9772	30.28	4.0229	-----
Family religiosity							
> somewhat religious	73	20.7	37	10.5	36	10.2	0.8169
≤ somewhat religious	280	79.3	138	39.1	142	40.2	0.9056
Community size							
< 10 000 people	21	5.3	14	3.6	7	1.8	0.1266
≥ 10 000 people	373	94.7	180	45.7	193	49.0	0.7215
Potential for pregnancy with future partner							

Yes	321	90.9	161	45.6	160	45.3	0.9128
No	21	6.0	7	2.0	14	4.0	0.1266
Unsure	11	3.1	8	2.3	3	0.9	0.1317
Education level							
High school work/graduate	117	29.1	98	24.4	19	4.7	<0.0001
CÉGEP/college work/graduate	91	22.6	32	8.0	59	14.7	0.0046
Undergraduate work/degree	145	36.1	66	16.4	79	19.7	0.2803
More education	49	12.2	5	1.2	44	11.0	<0.0001
Parenthood status							
Yes	36	9.1	4	1.0	32	8.1	<0.0001
No	360	90.9	193	48.7	167	42.2	0.1418
Diagnosed disability							
Neurodevelopmental condition							
Yes	78	19.3	41	10.2	37	9.2	0.6506
No	326	80.7	161	39.9	165	40.8	0.8247
Chronic pain condition							
Yes	53	13.1	20	5.0	33	8.2	0.0741
No	351	86.9	182	45.1	169	41.8	0.4878
Mobility/physical/vision impairment							
Yes	50	12.4	29	7.2	21	5.2	0.2579
No	354	87.6	173	42.8	181	44.8	0.6707
Mental health condition							
Yes	260	64.4	136	33.7	124	30.7	0.4568
No	144	35.6	66	16.3	78	19.3	0.3173
Diagnosed mental health condition							
Depression and/or anxiety							
Yes	247	69.6	128	36.1	119	33.5	0.5271
No	108	30.4	49	13.8	59	16.6	0.3359
Other mental health condition							
Yes	110	31.0	45	12.7	65	18.3	0.0565
No	245	69.0	132	37.2	113	31.8	0.2029
Intersex							
Yes	33	9.4	16	4.5	17	4.8	0.8618
Not yes	320	90.7	159	45.0	161	45.6	0.9551

Table 12, below, shows statistically significant associations between sex and gender categories and discussing fertility preservation (p-value < 0.0001). Non-binary participants with a female sex at birth were less likely to discuss fertility preservation with their healthcare provider, while transgender women were more likely to discuss fertility preservation compared to participants in other sex and gender categories. Participants with family religiosity levels greater than somewhat religious were significantly less likely to discuss fertility preservation with their healthcare provider compared to participants with lower levels of family religiosity (p-value of 0.0036). Participants with a diagnosed mental health condition other than depression or anxiety were significantly less likely to discuss fertility preservation with their healthcare provider compared to participants without this type of diagnosed mental health condition (p-value of 0.0317).

Table 12

Fertility Preservation Discussions by Participants' Demographic Information, Community Sample

	Total (N = 404)					Age 14-24 (N = 202)					Age 25-39 (N = 202)				
	Yes		No		χ^2	Yes		No		χ^2	Yes		No		χ^2
Variable	n	%	n	%	p	n	%	n	%	p	n	%	n	%	p
Sex and gender					< 0.0001					0.0015					< 0.0001[a]
Transgender women	83	76.1	26	23.9		35	74.5	12	25.5		48	77.4	14	22.6	
Transgender men	53	53.5	46	46.5		37	56.9	28	43.1		16	47.1	18	52.9	
Non-binary AFAB	35	27.8	91	72.2		20	37.7	33	62.3		15	20.5	58	79.5	
Non-binary AMAB	12	70.6	5	29.4		7	77.8	2	22.2		5	62.5	3	37.5	
Ethnoracial group					0.0535					0.1289					0.2877
Indigenous	10	38.5	16	61.5		6	42.9	8	57.1		4	33.3	8	66.7	
Non-Indigenous racialized	12	37.5	20	62.5		8	40.0	12	60.0		4	33.3	8	66.7	
Non-Indigenous white	162	55.3	131	44.7		85	60.3	56	39.4		77	50.7	75	49.3	
Perceived as a person of colour					0.1721					0.9641					0.0735
Yes	13	40.6	19	59.4		8	57.1	6	42.9		5	27.8	13	72.2	
No	171	53.3	150	46.7		91	56.5	70	43.5		80	50.0	80	50.0	
Low household income					0.7635					0.4834					0.9529
Yes	73	52.1	67	47.9		37	56.9	28	43.1		36	48.0	39	52.0	
No	83	53.9	71	46.1		36	63.2	21	36.8		47	48.5	50	51.5	
Newcomer to Canada					0.2664[a]					1.0000[a]					0.1223[a]
Yes	2	28.6	5	71.4		2	66.7	1	33.3		0	0.0	4	100.0	
No	182	52.6	164	47.4		97	56.4	75	43.6		85	48.9	89	51.1	
Family religiosity					0.0036					0.2736					0.0022
> somewhat	27	37.0	46	63.0		18	48.6	19	51.4		9	25.0	27	75.0	
≤ somewhat	157	56.1	123	43.9		81	58.7	57	41.3		76	53.5	66	46.5	
Community size					0.0608					0.2529					0.1202[a]
< 10 000	6	31.6	13	68.4		5	41.7	7	58.3		1	14.3	6	85.7	
≥ 10 000	175	53.7	151	46.3		92	58.6	65	41.4		83	49.1	86	50.9	
Potential for pregnancy					0.7252					0.3210[a]					0.9150[a]
Yes	165	51.4	156	48.6		88	54.7	73	45.3		77	48.1	83	51.9	
No	10	52.6	9	47.4		4	80.0	1	20.0		6	42.9	8	57.1	
Unsure	7	63.6	4	36.4		6	75.0	2	25.0		1	33.3	2	66.7	
Education level					0.9802					0.7780[a]					0.9980
High school	52	53.6	45	46.4		45	54.9	37	45.1		7	46.7	8	53.3	

CÉGEP/college	41	50.6	40	49.4	15	53.6	13	46.4	26	49.1	27	50.9
Undergraduate	66	52.4	60	47.6	34	57.6	25	42.4	32	47.8	35	52.2
More education	24	51.1	23	48.9	4	80.0	1	20.0	20	47.6	22	52.4
Parenthood status				0.3336				1.0000[a]				0.6435
Yes	14	43.8	18	56.2	2	50.0	2	50.0	12	42.9	16	57.1
No	165	52.7	148	47.3	95	57.2	71	42.8	70	47.6	77	52.4
Diagnosed disability												
Neurodevelopmental				0.8910				0.6969				0.6359
Yes	37	52.9	33	47.1	21	53.8	18	46.2	16	51.6	15	48.4
No	147	51.9	136	48.1	78	57.4	58	42.6	69	46.9	78	53.1
Chronic pain condition				0.2115				0.2731				0.5951
Yes	21	43.8	27	56.2	8	44.4	10	55.6	13	43.3	17	56.7
No	163	53.4	142	46.6	91	58.0	66	42.0	72	48.6	76	51.4
Mobility/physical/vision				0.8842				0.4638				0.6524
Yes	23	51.2	22	48.9	13	50.0	13	50.0	10	52.6	9	47.4
No	161	52.3	147	47.7	86	57.7	63	42.3	75	47.2	84	52.8
Mental health condition				0.3987				0.7002				0.3474
Yes	114	50.4	112	49.6	65	55.6	52	44.4	49	45.0	60	55.0
No	70	55.1	57	44.9	34	58.6	24	41.4	36	52.2	33	47.8
Diagnosed mental health condition												
Depression and/or anxiety				0.9533				0.8874				0.9557
Yes	129	52.2	118	47.8	72	56.2	56	43.8	57	47.9	62	52.1
No	55	51.9	51	48.1	27	57.4	20	42.6	28	47.5	31	52.5
Other mental health condition				0.0317				0.0242				0.5251
Yes	48	43.6	62	56.4	19	42.2	26	57.8	29	44.6	36	55.4
No	136	56.0	107	44.0	80	61.5	50	38.5	56	49.6	57	50.4
Intersex				0.5103				0.5780				0.1412
Yes	19	57.6	14	42.4	8	50.0	8	50.0	11	64.7	6	35.3
Not yes	165	51.6	155	48.4	91	57.2	68	42.8	74	46.0	87	54.0

[a]Results were reported for Fisher's exact test, rather than chi square test.

Table 13, below, shows the results from the multivariable regression models that were conducted, displaying prevalence risk ratios for discussing fertility preservation with a healthcare provider. Predictor variables were examined in three chunks: (1) demographics for equity analyses, (2) other demographic information, and (3) health information. In this table, "r" refers to the word "referent", and "gender identity type" refers to a binary indicator of whether a participant indicated (1) a binary gender identity (such as man or woman), or (2) a non-binary, agender, or similar gender identity or cultural gender identity.

The first chunk also examined interaction effects, shown in bolded text in the table. The intercept was 0.63 (95% CI: 0.04 to 9.68). No predictors were statistically significant; the only retained predictors were the interaction effect between sex and gender, and age (PRR: 0.99, 95% CI: 0.96 to 1.01), and the lower order terms of this interaction. Therefore, after adjustment for other demographic variables for equity analyses, there were no statistically significant differences in discussion of fertility preservation by sex and gender or family religiosity individually, as seen previously in crude analyses.

The intercept for the second chunk was 0.49 (95% CI: 0.27 to 0.88). No predictors were significant in this model. This suggests that after adjustment for other demographic variables for other analyses, there were no statistically significant differences in discussion of fertility preservation by any of the predictor variables in this chunk individually, consistent with crude analyses. The only retained predictor was community size (PRR: 0.50, 95% CI: 0.20 to 1.23).

The intercept for the third chunk was 0.53 (95% CI: 0.49 to 0.55). No predictors were statistically significant; the only retained predictor was diagnosis of a mental health condition other than depression or anxiety (PRR: 0.78, 95% CI: 0.55 to 1.09). Similarly to results seen in crude analyses, this suggests that participants diagnosed with another mental health condition were less likely to discuss fertility preservation, though this was not statistically significant.

The final model contained retained predictors from the three chunks. For this model the intercept was 0.72 (95% CI: 0.30 to 1.70), and there were no significant predictors.

Table 13

Multivariable Regression Models for Fertility Preservation Discussions, Community Sample

	Demographics – equity			Demographics – other			Health information			Final model		
Variable	PRR	95% CI	p	PRR	95% CI	p	PRR	95% CI	p	PRR	95% CI	p
Sex & gender, referent: transgender women												
Transgender men	2.10	0.31, 14.01	0.4465							1.30	0.47, 3.56	0.6157
Non-binary, sex: female	2.12	0.13, 35.16	0.5999							1.10	0.24, 5.10	0.8983
Non-binary, sex: male	1.65	0.53, 5.16	0.3860							1.32	0.60,2.92	0.4889
Ethnoracial group, referent: non-Indigenous white												
Non-Indigenous, racialized	0.72	0.27, 1.88	0.4926									
Indigenous	0.45	0.09, 2.29	0.3401									
Low income, referent: no	1.03	0.76, 1.39	0.8342									
Newcomer, referent: no	0.83	0.22, 3.19	0.7875									
Age	1.05	0.85, 1.28	0.6618							1.02	0.97, 1.06	0.4454
Religiosity, r: ≤ somewhat	0.68	0.27, 1.73	0.4246									
Sex and gender*age	0.99	0.96, 1.01	0.1975							0.99	0.97, 1.01	0.1573
Sex*gender identity type	0											
Sex & gender*religiosity	1.05	0.76, 1.45	0.7729									
Sex &gender*ethnoracial	0.92	0.70, 1.22	0.5883									
Community size, referent: ≥ 10 000 people				0.50	0.20, 1.23	0.1317				0.53	0.24, 1.19	0.1241
Potential for pregnancy with future partner, r: yes												
No				1.01	0.54, 1.90	0.9690						
Unsure				1.16	0.51, 2.64	0.7163						
Highest education level, referent: high school												
CÉGEP/college				0.92	0.61, 1.40	0.7130						
Undergraduate				0.97	0.67, 1.39	0.8553						
More education				0.95	0.58, 1.54	0.8306						
Parenthood status, referent: yes, a parent				1.14	0.66, 1.97	0.6469						
Diagnosed disability, referent: no												
Neurodevelopmental							1.04	0.73, 1.49	0.8059			
Chronic pain condition							0.81	0.51, 1.31	0.3931			
Mobility/physical/vision							1.07	0.68, 1.68	0.7491			
Mental health condition							0.96	0.67, 1.39	0.8405			
Diagnosed mental health condition, referent: no												
Depression and/or anxiety							1.11	0.76, 1.60	0.6029			
Other mental health condition							0.78	0.55, 1.09	0.1535	0.92	0.67, 1.28	0.6524
Intersex, referent: not yes							1.15	0.72, 1.84	0.5651			

4.3 Research Question 3

The third research question was: how prevalent is desire to parent, does it differ by age, and to what extent does desire to parent change over time?. For the clinical sample, Tables 14 through 16, below, present a summary of participants' reported desire to parent over time, and two age-stratified analyses of participants' reported desire to parent over time, respectively.

Table 14 shows that 57 youth reported an initial desire to parent, 45% of the 126 youth who received a prescription for medical gender affirmation at baseline. Several of these youth (n = 28, 49%), reported the same desire at 12 months, the majority of whom reported the same desire at 24 months (n = 21, 75%). Similarly, 53 youth (42%) were unsure of their future parenting desires at baseline. Several of these youth remained unsure at 12 months (n = 21, 40%), almost half of whom remained unsure at 24 months (n = 10, 48%).

These results suggest that desiring to parent, and being unsure of future parenting desires are common among transgender youth in clinical care. The largest proportion of each baseline desire to parent group reported the same response at 12- and 24-month follow-ups, though changes in desire to parent over time were common in the sample.

Table 14

Summary of Desire to Parent Over Time, Clinical Sample

Total sample receiving gender-affirming prescription at baseline								Proportion of n = 126
Baseline desire to parent (N = 126)			12-month desire to parent (N = 89)			24-month desire to parent (N = 73)		Proportion
response	n	%	response	n	%	response	n	%	%
						Remain "Yes"	21	75	17
			Remain "Yes"	28	49	Δ *to* "No"	1	4	<1
						Δ *to* "Unsure"	3	11	2
						Δ *to* "Yes"	1	50	<1
"Yes"	57	45	Δ *to* "No"	2	4	*Remain* "No"	0	0	0
						Δ *to* "Unsure"	1	50	<1
						Δ *to* "Yes"	3	30	2
			Δ *to* "Unsure"	10	18	Δ *to* "No"	1	10	<1
						Remain "Unsure"	4	40	3
						Remain "Yes"	0	0	0
			Δ *to* "Yes"	1	6	Δ *to* "No"	0	0	0
						Δ *to* "Unsure"	0	0	0
						Δ *to* "Yes"	0	0	0
"No"	16	13	*Remain* "No"	7	44	*Remain* "No"	5	71	4
						Δ *to* "Unsure"	1	14	<1
						Δ *to* "Yes"	0	0	0
			Δ *to* "Unsure"	4	25	Δ *to* "No"	1	25	<1
						Remain "Unsure"	3	75	2

						Remain "Yes"	5	56	4
			Δ *to* "Yes"	9	17	Δ *to* "No"	0	0	0
						Δ *to* "Unsure"	3	33	2
						Δ *to* "Yes"	0	0	0
"Unsure"	53	42	Δ *to* "No"	7	13	*Remain* "No"	1	14	<1
						Δ *to* "Unsure"	2	29	2
						Δ *to* "Yes"	2	10	2
			Remain "Unsure"	21	40	Δ *to* "No"	5	24	4
						Remain "Unsure"	10	48	8

Table 15, below, shows desire to parent over time for youth aged 10 to 13 at baseline. An initial desire to parent was reported by 12 youth, 35% of the 34 youth who received a prescription for medical gender affirmation at baseline. Over half, 19 youth (56%) were unsure of their future parenting desires at baseline.

Table 16 shows desire to parent over time for youth aged 14 or 15 years old at baseline. Forty-five youth reported an initial desire to parent, 49% of the 92 youth who received a prescription for medical gender affirmation at baseline. Additionally, 34 youth (37%) were unsure of their future parenting desires at baseline.

These results suggest that being unsure of future parenting desires is more common among younger transgender youth in clinical care, though the sample of youth in the younger age range was small. Similar trends in changes in desire to parent over time were seen in both age groups, compared to those previously seen in the full sample.

Table 15

Desire to Parent Over Time, Baseline Age 10 to 13, Clinical Sample

Total sample receiving gender-affirming prescription at baseline, age 10 to 13 years old at baseline									Proportion of n = 34
Baseline desire to parent (N = 34)			12-month desire to parent (N = 27)			24-month desire to parent (N = 24)			Proportion
response	n	%	response	n	%	response	n	%	%
						Remain "Yes"	6	75	18
			Remain "Yes"	8	67	Δ *to* "No"	0	0	0
						Δ *to* "Unsure"	0	0	0
						Δ *to* "Yes"	1	100	3
"Yes"	12	35	Δ *to* "No"	1	8	*Remain* "No"	0	0	0
						Δ *to* "Unsure"	0	0	0
						Δ *to* "Yes"	0	0	0
			Δ *to* "Unsure"	2	17	Δ *to* "No"	1	50	3
						Remain "Unsure"	1	50	3
						Remain "Yes"	0	0	0
			Δ *to* "Yes"	0	0	Δ *to* "No"	0	0	0
						Δ *to* "Unsure"	0	0	0
						Δ *to* "Yes"	0	0	0
"No"	3	9	*Remain* "No"	2	67	*Remain* "No"	2	100	6
						Δ *to* "Unsure"	0	0	0
						Δ *to* "Yes"	0	0	0
			Δ *to* "Unsure"	1	33	Δ *to* "No"	1	100	3
						Remain "Unsure"	0	0	0

						Remain "Yes"	2	67	6
			Δ *to* "Yes"	3	16	Δ *to* "No"	0	0	0
						Δ *to* "Unsure"	1	33	3
						Δ *to* "Yes"	0	0	0
"Unsure"	19	56	Δ *to* "No"	1	5	*Remain* "No"	0	0	0
						Δ *to* "Unsure"	1	100	3
						Δ *to* "Yes"	0	0	0
			Remain "Unsure"	9	47	Δ *to* "No"	2	22	6
						Remain "Unsure"	6	67	18

Table 16

Desire to Parent Over Time, Baseline Age 14 to 15, Clinical Sample

Total sample receiving gender-affirming prescription at baseline, age 14 to 15 years old at baseline									Proportion of n = 92
Baseline desire to parent (N = 92)			12-month desire to parent (N = 62)			24-month desire to parent (N = 49)			Proportion
response	n	%	response	n	%	response	n	%	%
						Remain "Yes"	15	75	16
			Remain "Yes"	20	44	Δ *to* "No"	1	5	1
						Δ *to* "Unsure"	3	15	3
						Δ *to* "Yes"	0	0	0
"Yes"	45	49	Δ *to* "No"	1	2	*Remain* "No"	0	0	0
						Δ *to* "Unsure"	1	100	1
						Δ *to* "Yes"	3	38	3
			Δ *to* "Unsure"	8	18	Δ *to* "No"	0	0	0
						Remain "Unsure"	3	38	3

"No"	13	14	Δ *to* "Yes"	1	8	*Remain* "Yes"	0	0	0
						Δ *to* "No"	0	0	0
						Δ *to* "Unsure"	0	0	0
			Remain "No"	5	38	Δ *to* "Yes"	0	0	0
						Remain "No"	3	60	3
						Δ *to* "Unsure"	1	20	1
			Δ *to* "Unsure"	3	23	Δ *to* "Yes"	0	0	0
						Δ *to* "No"	0	0	0
						Remain "Unsure"	3	100	3
"Unsure"	34	37	Δ *to* "Yes"	6	18	*Remain* "Yes"	3	50	3
						Δ *to* "No"	0	0	0
						Δ *to* "Unsure"	2	33	2
			Δ *to* "No"	6	18	Δ *to* "Yes"	0	0	0
						Remain "No"	1	17	1
						Δ *to* "Unsure"	1	17	1
			Remain "Unsure"	12	35	Δ *to* "Yes"	2	17	2
						Δ *to* "No"	3	25	3
						Remain "Unsure"	4	33	4

Chapter 5

Discussion

This chapter will discuss how the findings relate to previous research included in the literature review. Strengths, and limitations of this work, as well as implications for practice will be examined. Suggestions for future research will also be presented.

5.1 Summary of Results

5.1.1 Research Question 1. The first research question was: how prevalent are fertility preservation discussions with healthcare providers and fertility preservation procedures, and does prevalence differ by age?.

Among transgender adolescents and young adults, fertility preservation discussions typically occur very frequently in pediatric gender clinics where they are integrated into the normal care protocol, with discussion rates surpassing 90% in three studies in this setting (Baram et al., 2019). In this study, fertility preservation discussions were confirmed by the medical records of 79% of youth who received prescriptions for medical gender affirmation at baseline, with unsure discussion prevalence for the remaining youth. These results suggest that providers at Canadian clinics frequently discuss fertility preservation with their transgender youth patients.

Literature on fertility preservation discussions for transgender individuals, where they are not integrated into the normal process of care, suggest a range from approximately 80% not discussing fertility with a healthcare provider (Chen et al., 2018) to approximately 68% (Riggs & Bartholomaeus, 2018), or 66% (Bartholomaeus & Riggs, 2020). In this study, the prevalence of reporting not discussing fertility preservation among the analytic community sample was lower compared to this literature, at approximately 49% of respondents. This suggests that fertility preservation discussions with healthcare providers may be more common among the transgender community in Canada, compared to other countries. However, further research should be conducted to analyse global trends in prevalence of fertility preservation discussions for this population to better understand these results.

When analyzing the full available community sample by age, younger participants discussed fertility preservation more frequently than did older participants. While statistically insignificant, these results support themes in the literature including concerns for the future

fertility of younger transgender people, fertility declines in men and women after age 40, and increasing likelihood of having already accomplished one's family planning goals with age.

Research suggests that utilization of fertility preservation procedures is low, with more feminizing transgender individuals pursuing fertility preservation than masculinizing (Chen et al., 2017; Lai et al., 2020; Segev-Becker et al., 2020). This could be partly explained by fertility preservation procedures being more invasive for masculinizing individuals. This can cause additional distress, and hesitation towards pursuing fertility preservation (Cheng et al., 2019; Finlayson et al., 2016; Kyweluk et al., 2018), to the point of discouraging people from pursuing it (Chen et al., 2017). Consistent with published research (e.g. Chen et al., 2017; Lai et al., 2020; Vyas et al., 2021), this study found very low acceptance of fertility preservation procedures among the youth in the clinical sample (2%). Notably, almost 80% of the clinical sample were masculinizing individuals. Therefore, the low acceptance level seen in this research could be related to the unattractiveness of fertility preservation procedures for this population. Both youth who accepted preservation procedures had binary gender identities.

5.1.2 Research Question 2. Research question 2 was: what patient characteristics are associated with discussing fertility preservation?.

In this study, the results from the community sample support findings in the literature that non-binary people tend to discuss fertility preservation less frequently with their healthcare providers than do binary transgender people (Defreyne et al., 2020; Riggs & Bartholomaeus, 2018). Specifically, non-binary participants with a female sex at birth were significantly less likely to discuss fertility preservation in crude analyses. Research suggests that some healthcare providers are more knowledgeable about fertility preservation for patients with a male sex at birth (Tishelman et al., 2019). However, after adjustment for other demographic factors, sex and gender were no longer significant predictors of fertility preservation discussions.

Mental health conditions were the most frequently observed disability diagnosis category in the sample. Diagnoses of anxiety and/or depression were reported by almost 70% of the analytic community sample. Other studies have also reported that transgender communities experience a disproportionately high burden of mental health challenges, particularly depression and anxiety (Jaffray, 2020; Rotondi, Bauer, Scanlon, et al., 2011; Rotondi, Bauer, Travers, et al., 2011). Diagnosis of a mental health condition other than depression or anxiety was less common

(26%), however, this was significantly associated with reduced likelihood of fertility preservation discussions in crude analyses. Though this was no longer significant after adjustment for other health factors, future research should investigate whether this association is seen in other studies of transgender individuals.

5.1.3 Research Question 3. The third research question was: how prevalent is desire to parent, does it differ by age, and to what extent does desire to parent change over time?.

Considering the available analytic sample, at baseline (n = 126), almost half of the participants (45%) reported having a desire to parent. A similar proportion (42%) reported being unsure about their future desire to parent. There is tension in the literature regarding transgender youths' future parenting desires, with some studies suggesting that approximately half desire children in the future, with approximately one-quarter being unsure (Chen et al., 2018), and others suggesting that the vast majority report no future desire to parent when asked by a healthcare provider (Tishelman et al., 2019). The results of this study more closely resemble the former. Still, other studies report that transgender youth frequently express a desire to pursue non-biological methods of parenthood, such as adoption (for example, Chen et al., 2018; Nahata et al., 2017; Strang et al., 2018; Tishelman et al., 2019; Tornello & Bos, 2017). In this study, desire to parent as measured included desire for both biological and non-biological parenthood.

Analysing trends in desire to parent by age, a greater proportion of younger youth (baseline age: 10 to 13 years old) in this study were more frequently unsure of their future desire to parent at baseline (56% compared to 37% for youth aged 14 to 15 at baseline). After twenty-four months, 18% of the original sample of 34 younger youth remained unsure. Future research should follow younger transgender youth in clinical care over a longer period to better understand how and when their desire to parent evolves. Additionally, future research should longitudinally evaluate decision regret for not pursuing fertility preservation among these youth. However, the sample size of the younger youth was very small (n = 34 at baseline). Therefore, count differences of a few youth could have large impacts on the observed proportions. Future studies should investigate whether the high prevalence of being unsure of future parenting desires at baseline, compared to the older youth seen in this study, are consistent with a larger sample of younger youth.

Rarely did participants completely reverse their reported desire to parent from one time point to the next (yes to no, or no to yes). It was less rare to see participants report becoming unsure over time when they had previously reported having or lacking a desire to parent. The converse was also true. In general, there were a fair number of participants whose desire to parent changed over the two-year study period, though the largest proportion of each baseline desire to parent group reported the same response at 12- and 24-month follow-ups. Therefore, future research should continue to assess desire to parent longitudinally among youth in clinical care over a longer period to better understand how it changes over a longer duration.

5.2 Strengths

The analysis of the data from the clinical sample, Trans Youth CAN!, has several strengths. Principally, this study contributes to the existing literature, as this is a salient topic for the transgender community. There is a lot of concern, from parents, clinicians, and researchers alike, about fertility preservation for transgender youth pursuing medical gender affirmation. Notably, the sample of youth included in the analysis were all accessing medical gender affirmation, and receiving a prescription at their baseline visit. Compared to existing studies where desire to parent was commonly assessed among a community sample of transgender people, who may or may not desire medical gender affirmation, and who may or may not have already accessed medical care, it is a strength of this study that the youth were all accessing their consultation visit at the time they completed their baseline questionnaire.

Another strength of the study is that the longitudinal design allows for collection of data from the same participants at different time points, which allows for the possibility of examining changes over time. This is particularly a strength when studying desire to parent among transgender youth accessing medical gender affirmation. Research has identified concerns from providers and parents alike that youths' age and stage of development could obscure whether they are truly certain about their future family planning goals. Youth may be influenced by immaturity (which can cause short-term decision-making, and may lead to underestimating the difficulties associated with non-biological parenthood, such as adoption). Desire to transition quickly, or to reduce gender-related distress in the short term (from dysphoria youth feel in their pre-medical care state, and to avoid any that may come from delaying medical care to pursue fertility preservation, or from the fertility preservation procedures themselves) have also been

linked to unease associated with one-time assessments of desire to parent. Additionally, there are questions in the literature regarding whether medical gender affirmation is itself associated with changes in desire to parent over time. Therefore, this is an area where more research would be beneficial.

Another strength of this study is that the data are collected from participants accessing care from multiple clinics across the country, which allows for a more complete, representative, picture of the state of fertility preservation discussions in Canada for transgender youth in clinical care than would a single-site study. To our knowledge, no other study has published research from a clinical sample seeking medical gender affirmation from across Canada for youth in this age range regarding their fertility preservation discussions and uptake of fertility preservation. Another strength is that confirmation of a fertility preservation discussion in this study was extracted from participants' medical records, not self-reported data.

Additionally, it is a strength that this study takes place in a Canadian context, because (1) Canada is among the top five countries for social acceptance and rights of LGBTQ+ individuals, compared to the international community (Flores, 2021), (2) laws in Canada do not preclude transgender people from accessing fertility preservation services, (3) laws in Canada protect transgender people from discrimination, and have federally recognized non-binary genders on passports since 2017, and (4) gender-affirming medical care for youth is recognized and established in Canada. These social contexts are a strength for this study, because transgender individuals have historically been a difficult population to study due to being hidden, not recognized, and discriminated against.

While the Trans Youth CAN! data came from a clinical sample of younger transgender individuals, that population is not reflective of the transgender community in Canada as a whole. The principal strength of the analysis of the community sample data, from Trans PULSE Canada, is the large, diverse sample, comprising many priority populations for which there is a salient need for more research. For example, this study contains a relatively large proportion of non-binary people, which has been identified as a priority population for research both within the transgender and non-binary community, and within literature on the health and experiences of this community. The diverse community sample allows for the results to be more generalizable, and to be more reflective of the experiences of subgroups of the transgender and non-binary

community who may additionally be members of other minority populations in Canada (such as Indigenous participants, for one example).

The analyses of the community sample data includes several descriptive analyses of participants, with respect to whether they reported discussing fertility preservation, which will contribute to the literature on this important topic. Another strength of the analysis of the Trans PULSE Canada data is the multivariable model to better understand how different factors may be associated with a participant's likelihood of discussing fertility preservation. This research builds on previous qualitative and descriptive literature in the field through the creation of mutivariable models for regression analyses.

5.3 Limitations

The principal limitation of the clinical sample data was that we were unable to confirm that fertility preservation discussions did not take place for youth for whom discussions were not reported in their medical record. Youth and parent participants were not asked for this information in their questionnaires.

In the literature, there are typically three groups identified by researchers in this field: (1) individuals who discuss fertility preservation, (2) individuals who do not discuss fertility preservation, but do not feel badly about that, and (3) individuals who do not discuss fertility preservation, but wish they had. In this study, as we were unable to confirm that discussions did not take place, there was also no ability to assess, within the limitations of the data collected, how individuals might have felt about the fertility preservation discussions, or lack thereof, that they received.

One element that is frequently mentioned in the literature, is participants feeling unhappy with the quality of their fertility preservation discussions. This could be due to numerous factors, such as over-emphasis on biological parenthood, or perception of provider discomfort or lack of expertise in the area. Based on the data available, it was not possible to assess participants' perception of their fertility preservation discussions in this study. Future research should assess discussion quality along with discussion prevalence.

Additionally, while it is a strength that the questionnaire asked about parenthood, broadly defined, it was not possible to distinguish in which type of parenthood (biological or non-biological or both) participants were interested. Therefore, it is unclear how many participants

were specifically conceptualizing their future parenting goals in a way that would require their fertility to be preserved.

Finally, while it is a strength of the study that a longitudinal design was used, longitudinal studies are vulnerable to attrition as time progresses. The previous description of missing data outlines the extent of missingness, and information that is known about participants who were lost to follow-up. To mitigate potential biases resulting from differential loss to follow-up, research assistants in this study extended effort to recruiting participants who did not respond to their twelve-month questionnaire to offer them the opportunity to complete the twenty-four-month questionnaire. The main analyses for desire to parent excluded those participants who were missing at twelve month follow-up, but returned at twenty-four month follow-up. However, examination of desire to parent among these participants suggests that data follow a similar pattern to that of the main analyses. Additionally, missingness, and the patterns of missing data, were not found to be significantly associated with any of the predictor variables assessed at the $\alpha = 0.05$ level. While it would certainly be preferable to have complete data for all eligible baseline participants at each time point, this suggests that the missing data for this analysis probably follow an ignorable mechanism.

The most salient limitation for the community sample data analysis is the temporality issue in the data (participants reported their characteristics at the time of questionnaire completion, however their consultation visits, and therefore their fertility preservation discussions (if applicable) occurred in the past). Several steps were taken during the design of the analyses to mitigate the limitation of the temporality issue. The analytic sample was limited to those participants who received their consultation visits in the two years prior to when they completed the questionnaire, and variables were chosen for analysis that were determined to be less likely to have changed over that time period than other variables available in the questionnaire. For example, mental health challenges were assessed with participants' reports of any diagnosed mental health conditions they may have, rather than using assessments of their self-reported mental health, or their scores on scales measuring psychological distress, such as the CES-D-10 depression scale, or the OASIS anxiety scale, which were also available in the data. However, despite these efforts, it is still possible that participants' predictor variables may have differed from when they received their consultation visits to when they were measured, and

it is not possible to determine the extent to which this may have been the case, which is a limitation.

An extension of the temporality issue relates to the way in which the outcome of interest was measured. Participants were asked about whether a fertility preservation discussion took place in the past, during their consultation visit, while completing their questionnaire. While this method of retrospectively assessing via self-report whether participants received fertility preservation discussions is seen frequently in the literature for this population, it is still vulnerable to participants' experiencing recall bias. Limiting the analytic sample to those whose consultation visits occurred in the just under two years before their questionnaire completion, had the additional benefit of narrowing the window of time between consultation and questionnaire completion. However, there is still the potential for recall issues to bias the results.

Another limitation of the data is that there is no information available about any existing (in)fertility issues participants may have been facing at the time of their consultation visits, about which their physicians may have been aware, and which could conceivably be associated with whether participants received a fertility preservation discussion. Limiting the analytic sample to those under the age of 40 reduces the likelihood that participants in the analytic sample were experiencing age-related fertility issues.

5.4 Implications for Practice

Discussing fertility preservation with a healthcare provider can be important on a personal level for transgender individuals, and the prevalence of fertility preservation discussions in the transgender community can also reflect society's laws about, and attitudes towards, transgender people. Fertility preservation discussions with youth are known to present a challenge for healthcare providers, and the level of challenge can be perceived as greater when the youth are transgender (Hudson et al., 2018; Nahata et al., 2018; Tishelman et al., 2019). Fertility preservation discussions can be opportunities for providers to foster connections with their patients, and positively impact their well-being. Conversely, they can be negative experiences, wherein patients feel disempowered, uncomfortable, and un- or ill-informed (Bartholomaeus & Riggs, 2020). One of the most important factors in how the discussion is perceived is whether it contains meaningful, correct information about how different options for medical gender affirmation impact fertility, and the options individuals have for fertility

preservation (Bartholomaeus & Riggs, 2020). Research suggests that, among transgender youth specifically, interest in learning more about fertility preservation, and how gender-affirming hormone therapy may affect fertility, is moderate (60.9%; Chen et al., 2018), and is viewed with high importance (84%; Strang et al., 2018). Fertility preservation discussions are perceived as highly important within the transgender community. The importance of these discussions should be considered when endeavouring to provide quality care for medical gender affirmation, with discussions themselves providing evidence-based information in a non-judgemental way.

Some literature suggests that short-term decision-making could be a contributing factor to the underutilization of fertility preservation among transgender youth, and to the frequent reports of not wanting children seen among youth transitioning at younger ages (for example, Tishelman et al., 2019). Teenagers are more likely to engage in short-term decision-making, compared to adults, due to their stage of development. Additionally, mental health challenges are common among transgender individuals, including transgender youth (for example, Clements-Nolle et al., 2006; Grant et al., 2011; Kim et al., 2006; Nuttbrock et al., 2010; Su et al., 2016). "Psychiatric disorders are defined by abnormalities of thought, affect, and impulse control" (Cáceda, Nemeroff & Harvey, 2014). These characteristic symptoms can affect a person's ability to make good decisions. The likely presence of mental health challenges, the additional distress of gender dysphoria, and the age and developmental stage of transgender youth set the stage for provider worry that these youth may have challenges accurately predicting their future parenting desires, especially prior to beginning medical gender affirmation. Therefore, additional care should be taken during fertility preservation discussions with transgender youth. In this research, results suggest that youth were considering their future parenting desires at baseline. Further, they suggest that youth continued to reflect upon their future parenting desires throughout the two-year follow-up period, with some youths' reported desire changing over time as their opinions shifted, and others' remaining solid.

Despite almost half of youth reporting a desire to parent at baseline, results were consistent with published research, that almost all youth who discussed fertility preservation at that time were not interested in pursuing it (Nahata et al., 2017). Providers should consider potential barriers to accessing fertility preservation for transgender individuals, including financial constraints (Chen et al., 2017; Defreyne et al., 2020; Kyweluk et al., 2018; Riggs & Bartholomaeus, 2018; Tornello & Bos, 2017), short-term decision-making (Nahata et al., 2017;

Tishelman et al., 2019), invasiveness (Chen et al., 2017; Cheng et al., 2019; Finlayson et al., 2016; Kyweluk et al., 2018), emotional burden (Armuand et al., 2017; Chen et al., 2017; Chen et al., 2019; Cheng et al., 2019; Defreyne et al., 2020; Kyweluk et al., 2018; Lai et al., 2020; Voultsos et al., 2021), desiring to adopt or become a non-biological parent (Chen et al., 2018; Nahata et al., 2017; Strang et al., 2018; Tishelman et al., 2019; Tornello & Bos, 2017; von Doussa et al., 2015), ability (or lack thereof) to predict future parenting desires (Chen et al., 2017; Cheng et al., 2019; Lai et al., 2020), and mental health considerations (Nahata et al., 2018; Lai et al., 2020; Voultsos et al., 2021) and how these could affect individual patients during their consultations. Providers should endeavour to reduce the barriers within their control. For example, fertility preservation can be associated with an additional emotional burden due to the potential for: misgendering (Chen et al., 2017; Voultsos et al., 2021); feeling like preserving fertility preserves an association with sex at birth, or that it prevents "complete" transitioning (Armuand et al., 2017; Voultsos et al., 2021); delay of transition (Chen et al., 2019; Defreyne et al., 2020); and worsening gender dysphoria (Chen et al., 2018; Voultsos et al., 2021). Therefore, providers should endeavour to avoid misgendering patients, and to explain how undergoing fertility preservation procedures may affect their timeline for beginning medical gender affirmation.

5.5 Conclusion

Despite the low prevalence of utilization of fertility preservation procedures seen in the clinical sample and in existing literature on this population, it is important to discuss fertility preservation with transgender individuals prior to their initiation of medical gender affirmation. These discussions are important because (1) many transgender individuals will desire to have children to whom they are genetically related, (2) a proportion who are not currently discussing fertility preservation will have wanted to do so, (3) these discussions are opportunities to better understand the medical care they will be receiving, and (4) discussing fertility preservation with a knowledgeable healthcare provider allows individuals the opportunity to make their own decision regarding preserving their future fertility.

While there are many barriers to accessing fertility preservation for the transgender community, such as (frequently) financial constraints, and the invasiveness of the procedures

themselves, the lack of standardization of fertility preservation discussions is a barrier which could be easily amenable to interventions.

In this research, fertility preservation discussions were confirmed for 79% of the clinical sample, with unknown discussion prevalence for the remainder of the sample. In the community sample, discussion prevalence was self-reported, and was unable to be confirmed by participants' medical records. Almost half of the participants in the community sample reported discussing fertility preservation. Research suggests that discussion prevalence is greatest in pediatric gender clinics where these discussions are integrated into the normal process of care. Therefore, there is an opportunity to potentially improve discussion prevalence in Canada by making fertility preservation discussions standard practice, not just for pediatric populations, but for all transgender individuals pursuing medical gender affirmation.

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Appendix

Glossary of Terms

Angiogenesis: formation of new blood vessels from pre-existing blood vessels

Anti-Müllerian hormone level: serum hormone concentration, used to predict the number of eggs in the ovarian reserve

Aromatase inhibitor: class of drugs used to treat cancer in some cases, and off-label to reduce estrogen conversion while supplementing testosterone exogenously,

Asthenozoospermia: reduced sperm motility

Augmentation mammoplasty: surgery to increase breast size

Azoospermia: no sperm in the semen sample

Chest "top" surgery: surgery including removing breast tissue, and contouring the chest to have a typically masculine appearance

Facial feminization procedures: a broad category which may include forehead contouring, blepharoplasty (removing tissue from the upper eyelids), cheek augmentation (with implants, fat, or fracturing and moving the cheekbones), rhinoplasty (typically to reduce the overall size and angularness of the nose), lip lift and augmentation, mandibular angle reduction (to create a narrowed look to the jaw), genioplasty (to shorten and narrow the chin by removing some of the bone), tracheal shave (to minimize the Adam's apple), lowering the hairline, and hair transplants (to create a more feminine hairline)

Follicular atresia: the breakdown of the ovarian follicles

Gender: the socially constructed roles, behaviours, expressions and identities of girls, women, boys, men, and gender diverse people. It influences how people perceive themselves and each other, how they act and interact, and the distribution of power and resources in society

Germ cells: cells that are precursors to the gametes (egg and sperm cells)

Hematocrit: the proportion of red blood cells in the blood

Hyperplasia: the enlargement of an organ or tissue caused by an increase in the amount of organic tissue that results from cell proliferation

Hypospermatogenesis: all stages of spermatogenesis are present, but sperm count is low

Hysterectomy: surgery to remove the uterus and, typically, the cervix

Leydig cells: cells that produce testosterone in the presence of luteinizing hormone (LH)

Maturation arrest: interruption of the process of development before the final stage is reached

Meiotic arrest: cessation at the spermatocyte stage of germ-cell formation

Metoidioplasty/Metaoidioplasty: creation of a penis using clitoral tissue

Misgendering: the act of referring to a transgender person by terms that do not correspond to their affirmed gender

Oligozoospermia: low sperm count

Oophorectomy: surgery to remove ovaries

Orchiectomy: surgery to remove testicles

Ovarian stromal hyperplasia: a rare, non-cancerous condition, normally seen in post-menopausal females, relating to changes in the ovaries

Phalloplasty: surgical construction of a phallus (penis)

Polycystic ovary syndrome: a hormone disorder, causing irregularities of the menstrual cycle, and excess androgen levels

Polycythemia: an increase in the number of red blood cells that can cause thickening the blood and increase the risk of related health issues

Reduction thyroid chondroplasty: surgery to reduce the Adam's apple

Scrotoplasty: surgery to create a scrotum

Seminiferous tubules: the site of spermatogenesis in the testes, where spermatozoa develop

Sertoli cells: cells that facilitate the development of spermatozoa; the regulation of spermatogenesis occurs by acting on the Sertoli cells

Sertoli-cell only syndrome: the most severe form of azoospermia; complete absence of germ cells

Sex: a set of biological attributes in humans and animals. It is primarily associated with physical and physiological features including chromosomes, gene expression, hormone levels and function, and reproductive/sexual anatomy

Spermatids: haploid cells formed during meiosis II, that develop into sperm cells

Spermatogenesis: the development of sperm cells within the testes

Spermatogenic arrest: interruption in the differentiation of germinal cells of specific cellular type, which elicits an altered spermatozoa formation

Spermatogonia: undifferentiated male germ cells; cells that undergo spermatogenesis to form spermatozoa

Spermatozoa: sperm cells

Teratozoospermia: abnormal sperm morphology

Testicular atrophy: loss of volume of the testicles

Transfeminine: transgender people with a male sex at birth who identify primarily with a gender identity on the female side of the spectrum

Transmasculine: transgender people with a female sex at birth who identify primarily with a gender identity on the male side of the spectrum

Tubular shadows: atrophy resulting in complete hyalinization of the seminiferous tubules

Vacuolation: the most common early sign of injury to the Sertoli cells

Vaginal atrophy: changes to the vaginal tissues that may include reduced secretions, reduced elasticity, and symptoms of dryness and/or discomfort

Vaginectomy: surgery to remove the vagina

Vaginoplasty: surgery to construct a vagina

Venous thrombotic event: a blood clot, typically in a deep vein in the legs or in the lungs (also known as a pulmonary embolism)

Voice surgery: surgery to shorten the length, increase the tightness, or decrease the mass of the vocal chords, in order to raise the pitch of the voice

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