Australian Women's Knowledge of and Attitudes towards Non-Medical Oocyte Cryopreservation

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The University of Adelaide

28th September 2020

This thesis is submitted in partial fulfilment of the Honours Degree of Bachelor of Psychological Science

(Honours)

Word Count: 9,251

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ABSTRACT

Aims: Infertility is a global public health issue, with one in six couples worldwide facing fertility issues. One technique to potentially combat this issue and preserve fertility is oocyte cryopreservation (egg freezing), which has previously been heavily researched among cancer patients. The present study focused on egg freezing for non-medical indications and aimed to determine which factors are associated with the decision to freeze eggs.

Method: 514 participants aged between 18-44 years completed an online survey exploring knowledge of fertility, reproductive intentions and attitudes towards non-medical egg freezing. All factors were analysed descriptively. T-tests and Chi-Square analyses were also used to check for significant differences. Eighteen variables, identified as significant predictors of egg freezing in prior literature, were entered into a binary multiple logistic regression.

Results: Overall, participants had poor knowledge of fertility with a mean score of 2.35/7 (*SD*= 1.31) on the adapted Swedish Fertility Awareness Questionnaire. Attitudes towards non-medical egg freezing were generally positive, with 61.3% of participants (*N*= 315) positively endorsing the procedure. Five variables were identified as predictors for the choice to undergo non-medical egg freezing: age, health of offspring, the importance of having children, having had a prior fertility consultation, and Medicare subsidisation.

Conclusions: This study demonstrated an increasingly pressing need for targeted and effective fertility information. Future research, specifically examining the impacts of age and cost on the decision to undergo non-medical egg freezing in an Australian sample would be beneficial to determine if the results are replicable or the result of individual differences.

DECLARATION

This thesis contains no material which has been accepted for the award of any other degree or diploma in any University, and, to the best of my knowledge, this thesis contains no material previously published except where due reference is made. I give permission for the digital version of this thesis to be made available on the web, via the University of Adelaide's digital thesis repository, the Library Search and through web search engines, unless permission has been granted by the School to restrict access for a period of time.

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28th September 2020

CONTRIBUTION STATEMENT

In writing this thesis, my supervisor and I collaborated to generate research questions of interest and design the appropriate methodology. I conducted the literature search and completed the ethics application. We worked together to select the most appropriate questions for the survey, and I collected the data. I completed the data analysis with guidance from my supervisor and wrote up all aspects of the thesis.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank every one of my participants, without whom this research would not have been possible. I would also like to thank my wonderful supervisor, XXXX, for everything they have done for me this year. Their guidance, wisdom and support has aided me both in my thesis and beyond and they have helped me in more ways than I could describe; there are truly not enough words in my lexicon to describe how grateful I am to them.

To XXXX and XXXX, who were my two biggest supporters other than my supervisor. Thank you for believing in me on the days when I didn't believe in myself. Your support means the world to me, and I have no doubt that my thesis wouldn't be half of what it is if it wasn't for the two of you.

Thanks to XXXX and XXXX, for their endless positivity; to my dad, who has given up so much to see me go to university; and to XXXX and XXXX, who witnessed every one of my emotional bursts and still supported me anyway.

Finally, a lifelong thank you to the person that has always seen the best in me. XXXX, I wouldn't even be here writing this thesis if it wasn't for you; you truly have a part to play in all of achievements.

CHAPTER 1:

Introduction

1.1 Overview

One in six couples around the world experience infertility issues, with an approximation of 40.5 million people worldwide seeking infertility-related medical advice (Boivin, Bunting, Collins, & Nygren, 2007). Fertility issues can arise from genetics, bodily trauma, physiological conditions, and biological aging, wherein fertility significantly decreases as people move through the lifespan (Stoop, Nekkebroeck, & Devroey, 2011). Due to increasing social demands, many people are choosing to delay parenthood past the point of peak reproduction. In Australia, there has been a recent increase in the age of motherhood, with a median maternal age of 31.4 years for first-time mothers (Australian Bureau of Statistics, 2018).

Assisted Reproductive Technologies (ARTs) are one way to combat fertility issues and allow people the reproductive autonomy to delay parenthood. One such ART that is becoming increasingly popular is oocyte cryopreservation, known in lay terms as egg freezing, which is the term that will be used throughout the thesis in line with previous academic literary phrasing (Ikhena-Abel et al., 2017; Stoop et al., ; 2011Tan, Tan, Lau, Tan, & Nadarajah, 2014; Tozzo, Fassina, Nespeca, Spigarolo, & Caenazzo, 2019). Egg freezing was first primarily utilised as a medical intervention for women diagnosed with cancer and/or undergoing gonadotoxic treatments (treatments that may affect the health of the gonads, such as chemotherapy or radiation treatment); however, it is now gaining traction as an elective non-medical procedure (Baldwin, 2018). To date, the current literature on non-medical egg freezing has predominantly been descriptive, with limited research focusing on the motivations and factors involved with the choice to undergo the procedure; none of which, at the time of writing, has been conducted in

Australia. This study aims to add to the current literature by assessing the knowledge of and attitudes towards non-medical egg freezing in a representative sample of Australian women of legal reproductive age (aged between 18 and 44 years as per the guidelines of the Royal Australian College of General Practitioners (2018)).

1.2 Fertility Knowledge

Past literature has found that women tend to have poor knowledge regarding fertility (Lallemant, Vassard, Andersen, Schmidt, & Macklon, 2016; Lampic, Svanberg, Karlstrom, & Tyden, 2006; Lockwood, 2011). This finding has been replicated around the globe, with samples from Portugal, Canada, Spain, Japan, and Italy all reporting low levels of fertility knowledge (Almeida-Santos, Melo, Macedo, & Moura-Ramos, 2017; Bretherick, Fairbrother, Avila, Harbord, & Robinson, 2010; Garcia, Vassena, Trullenque, Rodriguez, & Vernaeve, 2015; Maeda et al., 2015; Tozzo et al., 2019). In samples of health professionals, fertility knowledge has been significantly higher, as would be expected (Ikhena-Abel et al., 2017; Tan et al., 2014).

The most prominent lack of fertility knowledge typically surrounds age-related fertility decline, with the majority of women overestimating their fertility and underestimating the age at which fertility begins to decline (Abiodun, Alausa, & Olasehinde, 2016; Daniluk & Koert, 2016; Stoop et al., 2011). This lack of knowledge about fertility decline is problematic as it can lead women to delay childbearing past the point of peak reproduction, which could unintentionally lead to fertility struggles and involuntary childlessness. It has been noted that fertility knowledge can be improved through frequent engagement with health professionals and information pamphlets, with empirical findings showing significant and sustained improvement on fertility questionnaires following exposure to appropriate healthcare materials (Maeda et al., 2015; Tan et al., 2014).

1.3 Delayed Childbearing and Involuntary Childlessness

Delayed childbearing, sometimes referred to as delayed parenting, occurs when couples or individuals opt to have children later in their reproductive lifespan, sometimes past the optimum window of fertility (Lechner, Bolman & van Dalen, 2007). There are many factors involved with the choice to delay childbearing, including but not limited to, involvement in higher education, desire for career progression and advancement, seeking financial stability, and waiting for an appropriate partner with whom to conceive (Abiodun et al., 2016; Cooke, Mills, & Lavender, 2012). While individuals have their reasons for delayed childbearing, involuntary childlessness can be an unintended consequence.

Involuntary childlessness is the term given to individuals or couples who are unable to have their desired number of children due to social, economic, fertility or lifestyle factors (Bell, 2013; James & Singh, 2018). While lifestyle and fertility factors have a direct effect on the physical ability to conceive, social factors can indirectly lead to involuntary childlessness due to the choice to delay childbearing as outlined above in Section 1.2. The risk of involuntary childlessness increases with age, moving from 2-3% for women under the age of 30 years, to 36% for women over the age of 40 years (van Loendersloot et al., 2011)

1.3.1 The impacts of involuntary childlessness.

The impacts of involuntary childlessness are significant and psychologically distressing. Individuals of both genders are likely to suffer impacts from involuntary childlessness. However, the onus of the shame most often falls on women (Bell, 2013). Involuntary childlessness and infertility often lead to deep feelings of shame due to the social importance placed on parenthood (Lechner et al., 2007). This shame can further manifest in deep forms of depression, which have been likened to feelings of grief or bereavement experienced at the loss of a loved one (James &

Singh, 2018; Lechner et al., 2007). Grief caused by infertility and involuntary childlessness is felt by men and women and occurs when there is a failure to conceive naturally and spontaneously, or a failure to conceive despite repeated assistance of ARTs (James & Singh, 2018; Lechner et al., 2007).

1.4 Options for Fertility Preservation

There are several ARTs available for preserving fertility, though most procedures are costly and highly invasive, and not all procedures have high rates of success (von Wolff, Germeyer, Liebenthron, Korrell, & Nawroth, 2018). Commonly used techniques for fertility preservation include ovarian stimulation, in-vitro fertilisation (IVF), embryo cryopreservation, gamete (reproductive cells; can be egg cells or sperm cells) cryopreservation and egg freezing (Huang & Rosenwaks, 2014). Of these, ovarian stimulation and egg freezing are regarded as the best therapies to promote live births in women <35 years of age, with a success rate ranging between 30-40% (von Wolff et al., 2018). While there are many options for fertility preservation in men and women, the scope of this research will focus solely on non-medical egg freezing from a woman's perspective.

1.5 Egg Freezing

Following many years of clinical animal testing, human egg freezing gained attention in 1986 after the first live birth occurred via a slow freezing and rapid thawing of frozen human eggs (Gook, 2011); since then it has gradually risen in popularity worldwide. Egg freezing occurs in three stages: retrieval, frozen storage, and re-retrieval of eggs (von Wolff, Germeyer, & Nawroth, 2015). The most challenging aspects of this process are the freezing of the eggs, wherein the eggs are transferred from their optimal viability temperature of 37°C to their optimal cryopreservation temperature of -196°C, and the subsequent reheating when the eggs are ready to

be used (Chian, 2010; Paramanantham, Talmor, Osianlis, & Weston, 2015). The freezing stage typically utilises one of two methods: slow-freeze, where the eggs are coated in a low concentration low-toxicity cryoprotectant and metabolised at a slow freezing rate, or vitrification (rapid freezing), where the eggs are covered in a high concentration substantially toxic cryoprotectant and metabolised and frozen at a rapid rate by being exposed to liquid nitrogen (Paramanantham et al., 2015).

Pregnancy rates and successful live births with the use of previously frozen eggs is stable, with most studies reporting success rates similar to pregnancy rates via fresh eggs and IVF (Gook, 2011; Milman, Senapati, Sammel, Cameron, & Gracia, 2017). The success rate is predominantly consistent but varies depending upon the freezing technique used, with vitrification being regarded as more successful than slow cooling (Levi-Setti, Patrizio & Scavarelli, 2016; Paramanantham et al., 2015). While success rates are favourable, the high probability of pregnancy using thawed eggs is only applicable to women who thaw and use their eggs before the age of 35 years (von Wolff et al., 2015). After the age of 35 years, the successful live-birth rate decreases to approximately 30% between the ages of 35-39 years, further decreasing to only 15% between the ages of 40-44 years (von Wolff et al., 2015). These success rates can be problematic as global studies have shown that most women have limited knowledge of their fertility, and often desire to freeze their eggs after the age of 35 years (Daniluk & Koert, 2016; Stoop et al., 2011; Tozzo et al., 2019).

1.5.1 Medical egg freezing.

Medical egg freezing is when a woman undergoes the freezing procedure for medical reasons, typically relating to cancer or gonadotoxic treatments. Support for medical egg freezing is heavily researched, with most people holding positive and sympathetic attitudes towards

women who elect to freeze their eggs for medical indications (Daniluk & Koert, 2016; Jones et al., 2017; Lewis, Missmer, Farland, & Ginsburg, 2016; Lockwood, 2011; Schochow, Rubeis, Büchner-Mögling, Fries, & Steger, 2018; von Wolff et al., 2015). For this thesis, medical egg freezing will not be heavily discussed as the focus is on the lesser researched topic of non-medical egg freezing.

1.5.2 Non-medical egg freezing.

Non-medical egg freezing, also colloquially referred to as social egg freezing, refers to women that undergo egg freezing procedures for any reason outside of medical interventions, whether it be social, personal, or economic (Baldwin, 2018). The current literature has shown moderate to favourable support for non-medical egg freezing worldwide, with acceptance rates ranging between 40% (Tan et al., 2014) and 85% (Espirito-Santo et al., 2017). However, it is still far less accepted than medical egg freezing and is often stigmatised (Stoop et al., 2011). No comparable figures could be found for Australia due to the limited research completed in the area of egg freezing.

1.5.3 Costs of egg freezing.

While no published papers citing the cost of egg freezing in an Australian sample have been identified, studies in the United States of America (USA) report upfront costs ranging between $10,000USD and $13,000USD (Harwood, 2009). There are also associated medication costs ranging between $2000-$4000USD, and costs to store the eggs, which average $440USD per year (Harwood, 2009). Retrieval and fertilisation of the frozen eggs as well as transferring embryos also heeds another cost, averaging $5000USD minimum (Carroll & Kroløkke, 2017).

In line with the USA, costs of egg freezing in Australia appear relatively high, with limited government subsidies available. Australian medical clinics report costs between $5000-

$6000AUD, with Monash IVF clinic reporting a cost of $4927AUD (Monash IVF, 2019), and Pivet Medical Centre listing a cost of $5950AUD (Pivet Medical Centre, 2020). There are additional costs for medication, hospital stays, and anaesthesia; these costs fluctuate and are not covered in the upfront cost (Monash IVF, 2019; Pivet Medical Centre, 2020). While the initial cost typically covers 12 months of egg storage, further storage fees need to be paid after this period and costs vary. Previous literature has looked at potential alleviations for the high costs of egg freezing, such as the use of government subsidisations and employer coverage (Datta, 2020; Tan et al., 2014; Tozzo et al., 2019), with findings indicating women would be more inclined to undergo egg freezing procedures if the cost was reduced or subsidised (Tan et al., 2014; Tozzo et al., 2019).

1.5.4 Motivations: who is likely to freeze?

While there have been limited studies worldwide concerning motivations to undergo non-medical egg freezing, what research has been undertaken has demonstrated similar motivating factors. Being single or lack of a suitable partner has been cited throughout the literature as the most common motivator for undergoing non-medical egg freezing (Baldwin, Culley, Hudson, Mitchell, & Lavery 2015; Baldwin, Culley, Hudson, & Mitchell, 2018; Hodes-Wertz, Druckenmiller, Smith, & Noyes, 2013; Ikhena-Abel et al., 2017; Stoop et al., 2011). However, this could be due to younger women (< 30 years) being more likely to positively endorse the procedure (O'Brien, Martyn, Glover, & Wingfield, 2017; Stoop et al., 2011). Despite support from younger women, most women who undergo non-medical egg freezing do not freeze their eggs until their mid-thirties (Baldwin et al., 2018; Pritchard et al., 2017; Stoop et al., 2011).

Higher education and a desire for career progression have been reported as being strong motivators in some samples (Baldwin et al., 2015; Tozzo et al., 2019), but in other samples have

also been shown to have little effect on decision-making (Ikhena-Abel et al., 2017; Stoop et al., 2011; Tan et al., 2014). Income has been a mostly insignificant predictor (Ikhena-Abel et al., 2017; Tozzo et al., 2019), though government subsidisation of the procedure has been reported as a factor that would potentially alter decision making in both women who identify as potential freezers and doubtful/never freezers (Tan et al., 2014; Tozzo et al., 2019). Already having children has been shown to be both a strong non-motivator (Stoop et al., 2011) and a strong motivator (Espirito-Santo et al., 2017) in electing to freeze eggs, indicating individual differences may influence motivation. People that already have children have been regarded as less likely to positively endorse non-medical egg freezing (Stoop et al., 2011), while placing strong importance on having children has been regarded as a potential motivator (Ikhena-Abel et al., 2017; Stoop et al., 2011; Tozzo et al., 2019), as has already planning to have children (Hodes-Wertz et al., 2013). Women that have higher fertility knowledge, specifically from health-related pamphlets or health professionals directly, have been noted as less likely to undergo non-medical egg freezing (Milman et al., 2017; Tan et al., 2014).

1.5.5 Societal attitudes towards non-medical egg freezing.

The past literature indicates that societal attitudes are generally more favourable towards egg freezing for medical reasons compared to non-medical reasons (Baldwin, 2018; Daniluk & Koert, 2016; Wennberg, Rodriguez-Wallberg, Milson, & Brännström, 2016). The lower level of support for non-medical egg freezing appears to stem from beliefs and stereotypes surrounding traditional motherhood. The general attitude is that women who undergo the procedure for non-medical reasons are acting in a ‘selfish’ or ‘greedy’ manner (Baldwin, 2016), as opposed to women who, due to medical reasons, have no other option than to freeze.

Societal attitudes towards non-medical egg freezing also appear to be influenced by age, with younger women generally more accepting of the treatment than older women (Daniluk & Koert, 2016; Stoop et al., 2011). This lack of acceptance from the older age bracket could be due to generational differences, as older women tend to be more inclined to endorse strong beliefs towards traditional motherhood and biological conception (Baldwin, 2016). Further research is required to assess the attitudinal differences towards egg freezing between younger and older women; however, this remains the current consensus in the literature.

Attitudes towards non-medical egg freezing remain largely unknown in the Australian population, where the literature has more narrowly focused on the attitudes of women that have already undergone the procedure (Pritchard et al., 2017). From a global lens, support for non-medical egg freezing remains relatively low on the whole, though there is divided opinion in some areas. In a Singaporean sample, only 26.4% of women indicated a favourable opinion towards non-medical egg freezing (Tan et al., 2014). This level of support was also echoed in an Italian sample (Tozzo et al., 2019) and a sample comprised of participants across both the United Kingdom (UK) and Denmark (Milman et al., 2017), wherein support for the procedure stood at 19.5% and 21.6%, respectively. Contrastingly, support towards non-medical egg freezing is positive in Brazil, where 85.4% of participants in a population sample expressed willingness to undergo the procedure and support for women that chose to use it as a means to preserve fertility (Espirito Santo et al., 2017).

1.6 The Current Study

Despite being a growing field of study, further research needs to focus on identifying the factors associated with decisions to undergo egg freezing. While various studies have focused on egg freezing, most have examined egg freezing for medical reasons with limited exploration of

freezing for non-medical reasons. The research on non-medical egg freezing has largely been descriptive and has more broadly focused on attitudes of women that have already undergone fertility treatments (Pritchard et al., 2017). The body of research that has focused on the motivations behind non-medical egg freezing (Ikhena-Abel et al., 2017; Lallemant et al., 2016; Schochow et al., 2018; Stoop et al., 2011; Tan et al., 2014; Tozzo et al., 2019) has, at the time of writing, not been replicated in a representative sample of Australian women.

The current study provides an opportunity to expand the literature by attempting to determine the factors associated with women's decisions about freezing their eggs in a sample of Australian women of legal reproductive age. This research also intends to build upon existing understandings by examining knowledge of and attitudes towards non-medical egg freezing in a sample of Australian women of reproductive age and determining whether their knowledge and attitudes are consistent or differ from those reported in the current literature. The results of the current study may be useful to health professionals and may improve information and services available to women in Australia.

1.6.1 Aims of the current study.

There are two main aims of this research:

1. To examine knowledge of fertility and attitudes towards non-medical oocyte cryopreservation (egg freezing) among Australian women of legal reproductive age (18-44 years), and
2. To determine the factors associated with the decision to freeze eggs for non-medical reasons among Australian women of reproductive age (18-44 years).

CHAPTER 2:

Method

2.1 Participants

Participants comprised a sample of Australian women of legal reproductive age, defined as between 18 years and 44 years as per guidelines of the Royal Australian College of General Practitioners (2018), who were fluent in the English language. 514 females aged between 18-44 years (*M*= 27.32 years, *SD*= 6.43) participated. Most participants were in a relationship (69.8%), employed (86.2%) and identified as heterosexual (84.4%) and Australian (82.7%). Demographic characteristics and information about reproductive intentions can be found in Tables 1 and 2, respectively.

Table 1

Demographic characteristics of study population

Characteristics[a]	Sample (*N* = 514)
Age, M (*SD*)	27.32 (*6.43*)
Sexual Orientation	
Heterosexual	434 (84.4)
Lesbian	9 (1.8)
Bisexual	56 (10.9)
Pansexual	11 (2.1)
Asexual	2 (0.4)
Other	2 (0.4)
Residential Location	
Major City	363 (70.6)
Regional	145 (28.2)
Remote	6 (1.2)

Ethnic Heritage	
Australian	425 (82.7)
Asian	14 (2.7)
African	2 (0.4)
European	42 (8.2)
Indigenous Australian	2 (0.4)
Maori or Pacific Islander	2 (0.4)
Middle Eastern	4 (0.8)
Other	23 (4.5)
Relationship Status	
Single	149 (29.0)
In a relationship	164 (31.9)
Married/Defacto/Engaged	195 (37.9)
Separated/Divorced	6 (1.2)
Highest Level of Education	
High school	240 (46.7)
Apprenticeship/Certificate	106 (20.6)
Bachelor Degree	135 (26.3)
Honours Degree	22 (4.3)
Masters	8 (1.6)
PhD	3 (0.6)
Employment Status	
Unemployed	71 (13.8)
Full Time	191 (37.2)
Part Time	124 (24.1)
Casual/Temporary	128 (24.9)

Notes. [a] Data presented as *n* (%), unless otherwise indicated; percentage values may add to greater than 100% due to rounding protocol.

Table 2

Reproductive characteristics of study population

Characteristics[a]	Sample (N = 514)
Have children	
Yes	115 (22.4)
No	399 (77.6)
Plan to have children	
Yes	305 (59.3)
No	105 (20.4)
Number of children desired, *M (SD)*	2.41 (0.83)
Desired age at first child, *M (SD)*	28.13 (3.9)
Desired age at last child, *M* (*SD)*	32.55 (4.32)
Importance of having children	
Very important	165 (32.1)
Important	128 (24.9)
Moderately Important	78 (15.2)
Slightly Important	55 (10.7)
Not at all Important	88 (17.1)
Confidence in having children	
Very confident	121 (23.5)
Confident	114 (22.2)
Moderately confident	144 (28.0)
Slightly confident	71 (13.8)
Not confident	64 (12.5)
Action if unable to conceive naturally	
Fertility treatment	282 (54.9)
Adopt a child	102 (19.8)
Foster a child	34 (6.6)
Choose not to have a child	96 (18.7)

Previous fertility consultation	
Yes	79 (15.4)
No	435 (84.6)

Notes. [a] Data presented as *n* (%), unless otherwise indicated; percentage values may add to greater than 100% due to rounding protocol.

2.2 Materials

The 40-item survey (Appendix A) was hosted online via Qualtrics and comprised four sections: demographic items, reproductive intentions, fertility knowledge and attitudes towards non-medical egg freezing.

2.2.1 Demographic items.

Participants were asked several demographic items, including age, sexuality, residential location, ethnicity, relationship status, highest completed education level, and employment status.

2.2.2 Reproductive intentions.

Reproductive intentions were measured using four items from the intention to have children subscale, one item from the importance of having children subscale, and two items from the behavioural intention in case of infertility subscale of the Swedish Fertility Awareness Questionnaire (SFAQ) (Lampic et al., 2006). The SFAQ has acceptable face validity and reliability (Peterson, Pirritano, Tucker, & Lampic, 2012); however, the internal consistency of this subscale has not been tested. Permission was obtained from the creator to use the SFAQ (Appendix B).

2.2.3 Fertility knowledge.

Fertility knowledge was measured using eight items from the awareness of fertility issues subscale of the SFAQ (Lampic et al., 2006), adapted to be suitable for an Australian sample. Each correct answer is assigned one point, while each incorrect answer is assigned zero points; a higher score reflects higher levels of fertility knowledge. No details about the internal consistency of this subscale are available. Test-retest reliability has been assessed, but the findings are unpublished (Lampic et al., 2006). This subscale has previously been used in female populations of reproductive age. In the current study, the internal consistency was acceptable ($\alpha = .67$).

Participants also provided a self-rating of their fertility knowledge on a 5-point Likert scale, ranging from 'Not at all educated' to 'Extremely educated', where a higher score indicated a perception of higher knowledge. Additionally, they provided information about their sources of fertility information, and whether they had undergone any consultations about their fertility.

2.2.4 Attitudes towards non-medical egg freezing.

Participants answered 12 items concerning their attitudes towards non-medical egg freezing. No psychometrically validated scales about egg freezing were identified. Therefore, a series of items were selected from previously published literature (Ikhena-Abel et al., 2017; Skoog, Lampic, Bergh, & Lundkvist, 2003; Stoop et al., 2011; Tozzo et al., 2019) which had been informed and developed through explorative interviews with health professionals and extensive focus group data (Skoog et al., 2003; Stoop et al., 2011). Items included whether, and at what age, participants would consider freezing their eggs for non-medical reasons. Participants were also provided with eight circumstances and asked whether any of these would alter their decision to freeze their eggs for non-medical reasons. Finally, participants were asked who

should bear the costs of non-medical egg freezing and whether they would be more inclined to use this medical procedure if the Australian Medicare system subsidised the costs.

2.3 Procedure

The University of Adelaide Human Research Ethics Subcommittee approved the current study (Approval number: 20/09). Participation was voluntary, and all participants were provided with an information sheet (Appendix C) and consent form (Appendix D) before commencement. Data were collected between March 30th 2020 and April 20th 2020 via an online cross-sectional survey which took approximately 15 minutes to complete. Ballot-box stuffing was prevented to ensure participants could only complete the survey once.

Participants were recruited through the University of Adelaide School of Psychology Research Participation System, via Facebook advertisements (Appendix E) and passive snowballing. Due to the outbreak of COVID-19, on-campus advertising could not be used. First-year psychology students received course credit for completing the survey; no other participants were incentivised to participate.

Definitions of oocyte cryopreservation and non-medical reasons were provided to participants before commencing the survey. At the end of the survey, participants indicated whether they would like to receive a copy of the study results after completion of the research; those that indicated yes provided an email address. All data were de-identified with email addresses stored separately to survey responses.

2.4 Power Analysis

While many rules of thumb have been proposed to determine appropriate sample size in logistic regression, there is currently no consistent rule (Ranganathan, Pramesh & Aggarwal,

2020). Proposed rules of thumb typically posit a minimum number of participants depending on the number of independent variables within a study.

Long (1997) posits that 500 participants is typically ‘adequate’, but further proposes a sample size equal to 10 events per variable. Research has critiqued this approach (Peng, Lee, & Ingersoll, 2002; van Smeden et al., 2019), with alternatives proposing that relaxing the sample to 5-9 events per variable is the most beneficial (Vittinghoff & McCulloch, 2006). Whilst there is notable criticism towards the events per variable rule, it remains the commonly used rule of thumb; though results must be interpreted with caution. In the current study, 18 independent variables were identified as potential predictors to be entered into the binary multiple logistic regression. Using the suggestion of Long (1997) a minimum of 180 events would be required. The current study included 514 participants and 315 events, therefore satisfying both of Long’s (1997) recommendations, demonstrating sufficient statistical power.

2.5 Data Analysis

Data were analysed using SPSS Statistics Version 26, where statistical significance was defined as a probability value of $p < 0.05$. Before data analysis, the data were screened to determine suitability for analysis, and any data that violated inclusion criteria were excluded.

2.5.1 Attitudes towards non-medical egg freezing.

To determine whether participants would undergo non-medical egg freezing, answers to this question were dichotomised into potential freezers or doubtful/never freezers (where potential freezers = the combination of ‘yes’ and ‘maybe’ and doubtful/never freezers = ‘no’ and ‘I don’t know’). Variables were dichotomised in this way in line with the previous literature, which states that anyone who does not answer ‘yes’ or ‘maybe’ cannot be considered a potential freezer at the time of responding (Ikhena-Abel et al., 2017; Stoop et al., 2011; Tan et al., 2014;

Tozzo et al., 2019). Following this rationale, those that answered ‘I don’t know’ were categorised as doubtful/never freezers.

Frequencies were then calculated to determine the number and percentage of participants who were agreeable to non-medical egg freezing, the age at which they would be most likely to freeze their eggs, and the circumstances that would influence their decision to freeze their eggs. Frequencies were also calculated to ascertain whom participants thought should bear the cost of egg freezing for non-medical reasons and whether their decision to freeze their eggs for non-medical reasons was influenced by the procedure being subsidised by the Australian Medicare system. T-test analyses were used to determine if there was significant differences between demographics and freezer status and Medicare subsidisation. Differences in responses to circumstances that would influence women’s decision to freeze their eggs between ‘potential freezers’ and ‘doubtful/never freezers’ were analysed using Chi-Square analyses.

2.5.2 Factors associated with the decision to freeze eggs for non-medical reasons.

2.5.2.1 Variable selection.

Past literature informed the independent variables selected for the binary logistic regression. From past research, 18 variables were identified as being significant predictors or important motivators in multiple papers. Following assumption testing, where assumptions were satisfied, these variables were entered into the final regression model.

2.5.2.2 Testing assumptions for binary logistic regression.

Many assumptions need to be met in order to run a binary multiple logistic regression; such assumptions include multicollinearity and linearity. Multicollinearity was assessed using Pearson correlations. This assumption was satisfied as no variables had correlations greater than or equal to 0.7.

Linearity between continuous independent variables was assessed using the Box-Tidwell procedure. A Bonferroni correction was applied to the model, with statistical significance being accepted when $p < .00278$. All continuous independent variables were significant under this correction and found to have a linear relationship to the logit of the dependent variable, and thus, the assumption was satisfied.

2.5.2.3 Variables for analysis.

18 variables, based on prior literature, were chosen for analysis to identify factors associated with the decision to freeze eggs for non-medical reasons. These variables were grouped into four categories: demographic, reproductive intention, fertility factors and attitudes towards egg freezing.

2.5.2.3.1 Demographic characteristics.

Two demographic characteristics, age and relationship status, were examined. Relationship status was dichotomised into ‘single’ and ‘in a relationship’, while age in years was a continuous variable.

2.5.2.3.2 Reproductive intentions.

Five factors relating to reproductive intentions were examined, including already having children, plans to have children, importance of having children, confidence in having children, and previous fertility consultation. All five variables were categorical.

2.5.2.3.3 Fertility Knowledge.

Three items about fertility knowledge were examined, including the adapted awareness of fertility issues subscale of the SFAQ, fertility knowledge source and self-rated fertility knowledge. Awareness of fertility issues was a continuous variable, while fertility knowledge source was dichotomised into ‘information from health professionals/public health centres’, and ‘information from non-health related sources.’ Self-rated fertility knowledge was categorical.

2.5.2.3.4 Attitudes towards egg freezing.

Eight factors assessing attitudes towards egg freezing were examined, including health of offspring, does not affect future fertility, complexity of treatments, absence of a suitable partner, likelihood of success, financial reimbursement, desire for a child, and Medicare subsidisation. The first seven of these variables were dichotomised into ‘unlikely’ and ‘likely’. Medicare subsidisation was dichotomised into ‘yes’ and ‘no’.

The dependent variable examined was the decision to freeze eggs for non-medical reasons. Initial predictor variables were analysed descriptively and checked for assumptions. All variables satisfied the assumptions and were examined using binary multiple logistic regression to determine the relative importance of each variable. Potential factors were entered using the enter method.

CHAPTER 3:

Results

3.1 Knowledge about fertility and egg freezing

When asked to rate their knowledge of fertility, 58.4% of participants (N = 300) regarded themselves as being somewhat educated on the topic of fertility. Of the remaining sample, 24.7% (N = 127) considered themselves to have moderate to advanced knowledge of fertility, and 16.9% of participants (N = 87) regarded themselves as having no knowledge of fertility. Participants reported gaining their knowledge from a range of sources. The internet was the most common source of information for participants (74.9%, N = 385), followed by health professionals and public health centres (62.8%, N = 323). A relatively high number of participants also sought information from friends (47.1%, N = 242), and family (42.2%, N = 217).

Participants' knowledge about fertility was assessed using seven-items from the SFAQ, which was adapted to be relevant to an Australian sample. Participant scores ranged from zero to six, with a mean score of 2.35 (SD = 1.31); none of the participants answered all seven questions correctly. While the creators of the SFAQ have not stipulated which scores reflect low, modest and high levels of knowledge, the typical convention in other fertility research posits that <40% indicates low knowledge, 40-75% indicates modest knowledge, and 76-100% indicates high knowledge (Abiodun et al., 2016; Daniluk, Koert & Cheung 2012; Tan et al., 2014; Tozzo et al., 2019). Using this framework, scores of 0-2 are low, scores of 3-5 are modest, and scores of 6-7 are high, which would imply a low-modest level of fertility knowledge in the study sample. Despite prior studies reporting that participants tend to overestimate their fertility knowledge (Abiodun et al., 2016, Daniluk et al., 2012), in this study participants scores on the SFAQ and

their self-rated fertility knowledge were consistent, with relatively low levels reported for both measures.

3.2 Intentions towards Egg Freezing

When asked about whether they would freeze their eggs for non-medical indications, 31.7% of participants (*N*= 163) answered 'Yes'. Of the remaining participants, 29.8% of participants (*N*= 153) answered 'Maybe', 22.2% of participants (*N*= 114) answered 'No', and 16.3% of participants (*N* = 84) answered 'I don't know'. Consistent with previous research, the responses were re-categorised into 'Potential Freezers', consisting of the participants that answered 'Yes' or 'Maybe', and 'Doubtful/Never-Freezers' consisting of those that answered 'No' or 'I don't know'. There was no difference between potential freezers and doubtful/never freezers based on age, ethnicity, relationship status, sexual orientation, education or employment status. The age at which participants indicated they would consider freezing their eggs also did not differ between potential freezers and doubtful/never freezers. Overall, 32.5% of participants (*N*=167) indicated they would consider freezing their eggs between the ages of 31-36 years; this comprised 131 potential freezers and 36 doubtful/never-freezers. A moderate percentage of women (25.3%, *N*= 130) also indicated a preference to freeze their eggs between the ages of 26-30 years old, with 107 potential freezers and 23 doubtful/never freezers selecting this option. Of the remaining sample, 9.3% of women (*N*= 48) would freeze their eggs between 21-25 years, which is the optimal age for freezing; 38 potential freezers and 10 doubtful/never freezers selected this option. Freezing between 36-40 years was equally as desirable, with another 9.3% of women (*N*= 48) indicating they would prefer to freeze during this age. Only 1.4% of the sample (*N*= 7) would choose to freeze their eggs over the age of 40 years.

3.3 Factors influencing Decision-Making regarding Egg Freezing

Participants were asked whether eight items from previously published literature would influence their decision to freeze their eggs. The health of offspring was the most influential factor affecting decision-making, with 71.6% of the total sample (N = 368) indicating that this would impact their decision to freeze. The health of offspring was the most influential factor among potential freezers and doubtful/never-freezers, with 81.9% of potential freezers (N= 258) and 55.3% of doubtful/never-freezers (N= 110) indicating this would affect their decision to freeze their eggs. The desire for a child was also a factor that would influence the decision-making of a large proportion of participants, with 61.8% of participants (N= 318) indicating it would affect their decision to freeze their eggs. Absence of a suitable partner and being unsure of the desire to have children were the least likely factors to influence the decision-making process with 43.9% (N= 226) and 37.5% (N= 193) of participants endorsing these factors, respectively. Alongside health of offspring, potential freezers were most likely to be influenced by desire for a child (68.3%) and likelihood of success (66.7%). Doubtful/never freezers also cited desire for a child (51.2%) as a strong motivator in decision making, but were slightly more likely to report the complexity of treatments (46.2%) as a factor in decision making compared to the likelihood of success (45.2%).

There were significant differences between the potential freezers and the doubtful/never freezers for six of the eight variables. Potential freezers were more likely to report likelihood of success (t(347.12) = -5.37), complexity of treatments (t(327.99) = -4.18), absence of a suitable partner(t(381.31) = -3.92), desire for a child(t(354.18) = -4.74), health of offspring(t(307.26) = -7.08), and unsure of desire to have children (t(379.90) = -3.14) as factors influencing their decision to freeze compared to doubtful/never freezers (See Table 3).

Table 3

Factors influencing Australian women's decision-making regarding egg freezing presented for the total sample and according to egg freezing status

Variable[a]	Total Sample (*N* = 514, %)	Potential Freezers (*n* = 315)	Doubtful/Never-Freezers (*n* = 199)	p Value
Does not affect my future fertility	170 (33.0)	120 (38.1)	50 (25.1)	0.41
Financial reimbursement	258 (50.2)	173 (54.9)	85 (42.7)	.092
Likelihood of success	300 (58.4)	210 (66.7)	90 (45.2)	.000
Complexity of treatments	270 (52.6)	178 (56.5)	92 (46.2)	.000
Absence of suitable partner	226 (43.9)	154 (48.9)	72 (36.2)	.001
Desire for child	318 (61.8)	215 (68.3)	103 (51.2)	.000
Health of offspring	368 (71.6)	258 (81.9)	110 (55.3)	.000
Unsure of desire to have children	193 (37.5)	125 (39.7)	68 (34.2)	.005

Notes. [a] Data presented as n (%), unless otherwise indicated; percentage values may add to greater than 100% due to rounding protocol.

3.4 Attitudes towards Funding of Egg Freezing

When asked who should fund non-medical egg freezing, 44.6% of participants (*N*= 229) indicated that it should be the responsibility of the woman looking to have the procedure. There was also considerable support for funding to come from private health insurance (*N*= 167, 32.5%), and moderate support for Medicare subsidisation (*N* = 117, 22.8%). Only one respondent (0.2% of the total sample) indicated that employers should fund the procedure.

Participants were also asked whether they would be more inclined to freeze their eggs if the Australian Medicare system subsidised the procedure. Of the sample, 242 participants (47.1%) indicated that they would be more inclined to freeze their eggs if there was Medicare subsidisation; this comprised 212 potential freezers (87.6%) and 30 doubtful/never-freezers (12.4%). An independent samples t-test indicated that there was a significant difference between potential freezers and doubtful/never-freezers with regards to Medicare subsidisation *(t*(339) = 19.20, *p* = <*.001).* Significant differences were also found relating to age and Medicare subsidisation (*t*(505)= -4.80, p = < *.001),* with younger women being more likely to freeze their eggs if the procedure was subsidised by Medicare. Additionally, significant differences were also found between women who already had children and those who did not (*t*(339) = 2.78, p = *.006*), with childless women being more likely to freeze their eggs if a Medicare subsidy was available (49%), compared to their counterparts with children (41%). No significant differences with regards to funding were identified based on education, employment status, sexuality, or relationship status.

3.5 Factors associated with the decision to freeze eggs for non-medical reasons

Multiple logistic regression was performed with egg freezer status as a binary outcome variable (i.e., potential freezer or doubtful/never-freezer) and the main effects of a range of demographic, reproductive intention, fertility knowledge and attitudinal factors as predictor variables. The logistic regression model (Table 4) was statistically significant, $\chi^2(18) = 155.95$, $p < .001$, and explained 44% of the variance of being a potential egg freezer (Nagelkerke's $R^2 = .44$). The model correctly classified 79.3% of cases, with sensitivity classifications of 92.4% and specificity classifications of 57.6%. Of the 18 predictor variables, five were statistically

significant; age, the importance of having children, prior fertility consultations, the health of offspring and Medicare subsidisation.

A women's age was predictive of being a potential freezer (B = .06, Wald χ^2 (1) = 4.44, p = .035). Every one-unit increase in age increased the odds of potentially freezing eggs by 106%, making it the weakest of the five predictors. Medicare subsidisation of egg freezing was considerably stronger than the other four predictors in the model, (B = 2.98, Wald χ^2 (1) = 65.54, p <.001), with women favouring a Medicare subsidy having 19.7-times greater odds of being a potential freezer. Placing high importance on having children was predictive of the choice to freeze (B = 0.80, Wald χ^2 (1) = 4.33, p = .037) and increased the odds of belonging to the potential freezer group by 222%. Health of offspring as a factor influencing decision-making resulted in 2.63 times greater odds of being a potential freezer (B= 0.97, Wald χ^2 (1) = 6.40, p = .011). Having had a fertility consultation with a health professional was predictive of being a potential freezer (B = 1.15, Wald χ^2 (1) = 5.20, p = .023), and increased the odds of belonging to the potential freezer group by 314%.

Table 4: *Binary multiple logistic regression of demographics, reproductive intention, fertility knowledge and attitudinal factors predicting likelihood to freeze eggs*

Variable	B	SE	Wald	Df	Sig.	Odds Ratio	95% CI Lower	95% CI Upper
Constant	-5.100	1.07	22.76	1	.000	.006		
Age	.060	.03	4.44	1	.035	1.06	1.00	1.12
Relationship status	.26	.29	.84	1	.359	1.30	.74	2.29
Does not affect future fertility	.08	.30	.08	1	.782	1.09	.61	1.95
Health of offspring	.97	.38	6.40	1	.011	2.63	1.24	5.55
Complexity of treatments	.24	.30	.62	1	.431	1.27	.70	2.30
Absence of a suitable partner	-.24	.29	.65	1	.420	.79	.44	1.41
Likelihood of success	.09	.35	.06	1	.808	1.09	.55	2.17
Financial reimbursement	.04	.30	.02	1	.895	1.04	.58	1.86
Desire for a child	-.23	.34	.46	1	.496	.79	.41	1.55
Currently have children	1.42	1.15	1.53	1	.217	4.13	.44	39.23
Plan on having children	-.32	.42	.59	1	.443	.73	.32	1.65

Importance of having children	.80	.38	4.33	1	.037	2.22	1.05	4.70
Confidence in achieving desired number of children	.17	.29	.32	1	.571	1.18	.66	2.10
Self-rated fertility knowledge	.22	.35	.38	1	.537	1.24	.63	2.46
Previous fertility consultation	1.15	.50	5.20	1	.023	3.14	1.17	8.40
Fertility knowledge	.10	.10	.996	1	.318	1.11	.91	1.34
Medicare Subsidisation	2.98	.37	65.54	1	.000	19.70	9.57	40.55
Source of fertility knowledge	.31	.29	1.13	1	.287	1.36	.77	2.38

Chapter 4

Discussion

4.1. Overview

This study sought to explore fertility knowledge and attitudes towards egg freezing for non-medical indications among a sample of Australian women of legal reproductive age (18-44 years). The study also attempted to determine whether women would choose to undergo non-medical egg freezing and what factors were the most predictive of this choice. While international studies have focused on these issues, research in Australia regarding egg freezing has mostly been descriptive and qualitative; with no identifiable studies quantitatively assessing the factors predictive of egg freezing in an Australian sample. The current results provided differentiated findings with regards to cost and subsidisation, while also contributing consistent findings to the existing body of literature with regards to fertility knowledge and factors associated with the decision to freeze eggs for non-medical reasons. Summaries of the findings, along with methodological considerations, implications, and potential avenues for future research, are discussed in turn.

4.2. Summary of the Findings

The findings will be discussed with regards to the two broad aims of the research: to examine knowledge of fertility and attitudes towards non-medical egg freezing among Australian women of legal reproductive age, and to determine factors associated with the decision to freeze eggs for non-medical reasons among Australian women of reproductive age.

4.2.1 Knowledge of fertility.

Participants in this study had a mean score of 2.35/7, or 33%, for the adapted SFAQ. Such a score is noted in the literature as a low level of fertility knowledge, with previous studies

categorising knowledge levels below 40% on fertility questionnaires to be low (Daniluk et al., 2012). These findings were consistent with previous international research which indicates that women tend to have poor fertility knowledge (Abiodun et al., 2016; Tan et al., 2014; Tozzo et al., 2019). In studies where women were also asked to self-rate their fertility knowledge, women tended to overestimate their knowledge levels when compared to their scores on fertility questionnaires (Abiodun et al., 2016, Daniluk et al., 2012). This study yielded a contrasting result, where only 24.7% of women (*N*= 127), regarded themselves as being moderately to extremely educated about fertility, while the remaining 75.3% of women (*N*= 387) indicated an awareness that they were not educated about fertility.

Some studies have reported women as having a more moderate to high level of fertility knowledge (Ikhena-Abel et al., 2017; Schochow et al., 2018; Tan et al., 2014), though the target populations in these studies tended to be healthcare professionals, who could be anticipated to have greater knowledge due to their professional training. While the current study targeted any woman fluent in English of legal reproductive age, more than half of the sample were highly-educated women working in the healthcare industry, similar to the studies listed above; however, the former studies were comprised solely of healthcare professionals, whilst the current study was a blended mix of the general population. While there is a slight conflation between the low-level knowledge results in this study and the moderate-high results in other studies with a large number of healthcare professionals, the low estimate can likely be attributed to the remainder of the current sample being non-health professionals bringing down the average knowledge score.

4.2.2 Attitudes towards non-medical egg freezing.

Of the 514 participants, 61.3% of women (*N*= 315) indicated that they would consider freezing their eggs, compared to 38.7% of women (*N*= 199) who would not freeze their eggs,

indicating a generally favourable attitude towards non-medical egg freezing. This finding is consistent with results from Brazil, USA and Denmark which predominantly reported favourable attitudes towards egg freezing, with 85.4%, 71%, and 89% of participants positively supporting the procedure, respectively (Espirito-Santo et al., 2017; Ikhena-Abel et al., 2017; Lallemant et al., 2016). Conversely, in Belgium and Italy participants typically had more negative views towards egg freezing for non-medical indications, with support for the procedure as low as 31.5% and 19.5%, respectively (Stoop et al., 2011; Tozzo et al., 2019).

4.2.3 Factors associated with the decision to freeze eggs for non-medical reasons.

Five factors were identified as being predictive of the intention to undergo non-medical egg freezing: age, the health of offspring, having had a prior fertility consultation, the importance of having children, and availability of a Medicare subsidy.

Among the sample, older women were more likely to freeze their eggs. While this is problematic given the procedures' declining efficacy with increased age, it is consistent with previous findings (Baldwin et al., 2015; Stoop et al., 2011). Delaying fertility treatments until advanced age often stems from pursual of higher education, and absence of a suitable partner, as posited from previous studies (Baldwin et al., 2015; Ikhena-Abel et al., 2017; Pritchard et al., 2017; Stoop et al., 2011). Despite this, neither absence of a suitable partner, single relationship status or higher levels of education were predictive factors in this study, perhaps indicating there are other confounding reasons as to why older age is a strong predictor for undergoing fertility treatments.

Participants were also more likely to report an intention to freeze if assured that their offspring would be healthy. This factor has been found to be a moderate-high predictor in previous research (Daniluk & Koert, 2016; Ikhena-Abel et al., 2017; Stoop et al., 2011), and

there is a sizeable literature that discusses the importance of infant health in the choice to reproduce (Bower & Hansen, 2005; Declercq et al., 2015). Women that identified as doubtful/never-freezers were also more likely to consider freezing their eggs if they could be assured there would be a healthy live birth following egg thawing and subsequent use. In the current sample, women were more likely to be a potential freezer if they had experienced a prior fertility consultation. While this has not been explored as a factor in international studies, there is significant literature that indicates women are more knowledgeable about fertility and ARTs if they have received information from a health professional (Tan et al., 2014), hence why it was selected as a potential predictor. Further studies utilising this predictor could provide more insight as to whether it is a strong factor in the decision to undergo non-medical egg freezing, or if it is more indicative of individual differences.

Placing high importance on having children was also identified as a factor in deciding to undergo egg freezing. While there has been support for this factor in prior studies, placing high importance on having children has also been associated with high desires for a child, labelled as ‘desire for a child’ or ‘desire for children’ in previous studies (Ikhena-Abel et al., 2017; Skoog et al., 2003; Stoop et al., 2011). In the current study, a variable from a different scale, labelled ‘desire for a child’, was also entered into the regression. However, it was not identified as a significant predictor. This finding could be due to linguistic differences, in that the former is easier to comprehend in Australia, whereas the latter ‘desire for a child’ was translated from Swedish. Contrastingly, it could also indicate that women may well place high importance on having children but may not necessarily have strong desires for a child, which may be indicative of social pressures surrounding the societal expectations of motherhood and nuclear family dynamics.

The strongest predictor identified in the regression model was Medicare subsidisation, with participants being 19.7 times more likely to be a potential freezer if government subsidies were available. While this predictor was substantially higher than the other four, this inflation is not unreasonable given the expensive nature of egg freezing procedures, which requires compounded costs during harvesting, storing, thawing and retrieval (Ben-Rafael, 2018; Carroll & Kroløkke, 2017; Datta, 2020; Hirshfield-Cytron, Grobman, & Milad, 2012; van Loendersloot et al., 2011). In previous studies, the high cost of egg freezing procedures has been found to deter women from egg freezing (Milman et al., 2017; Tan et al., 2014), though particular samples place less importance on cost, rationalising that they will spend far more money on a child after it is born (Kilic & Gocmen, 2018). With regards to government subsidies specifically, this result is consistent with previous research. In prior studies examining Singaporean medical students and Italian undergraduate students, 71% of participants and 50% of participants respectively, indicated that they would be more inclined to freeze their eggs if a government subsidy was available to them (Tan et al., 2014; Tozzo et al., 2019). Regarding the high cost, previous research has also examined the impacts of employer coverage to reduce the cost of egg freezing (Datta, 2020; Ikhena-Abel et al., 2017; Mertes, 2015), though this area would benefit from a more thorough analysis comparing the efficacy of both options in improving the cost-effectiveness of egg freezing procedures.

4.3 Methodological Considerations

The present study offers a valuable contribution to the field of fertility, with it being the first study of its kind conducted with an Australian sample. While previous Australian research has used qualitative approaches to examine women's lived experiences of infertility and usage of reproductive technologies (Pritchard et al., 2017), this study, to the best of the researcher's

knowledge, is the first to quantitatively examine the factors associated with Australian women's decision to freeze their eggs. While this study predominantly sought to examine fertility knowledge and reproductive attitudes toward egg freezing in an Australian sample, preliminary analyses also explored attitudes towards the cost of the procedure. From this analysis it was determined that most women would be more likely to consider the procedure if government subsidies were available, providing potential future avenues for research into the economics of fertility preservation techniques and healthcare more broadly. The current study also benefitted from a large sample size, which allowed for more diverse opinions and increased statistical power.

While the study benefitted from a large sample size, the participants shared notable similarities. The women surveyed were predominantly ethnically Australian-identifying, highly-educated, heterosexual women from urban areas. While a lack of cultural diversity can be considered a weakness and may limit the overall generalisability of the results, this is consistent with previous international studies that typically survey participants of their country's largest ethnic pool. It would be beneficial for future research to focus on lesser represented ethnicities, especially in highly multicultural countries such as Australia, to examine cultural differences. The lack of LGBTQIA+ identifying women in the sample also limits the generalisability of the results, and future studies would benefit from explicitly examining the opinions of LGBTQIA+ women, as well as non-binary and transgender individuals. The majority of women in the sample were also from urban areas, where healthcare services are typically more diverse and easily accessible. For many women from rural and remote regions, healthcare is more limited (Wakerman et al., 2008), with specialised information and fertility services being challenging to access, likely leading to a reduction in fertility knowledge and less education on

assisted reproductive technologies, such as egg freezing; therefore these results may not be as generalizable to women living in rural and remote settings.

4.4 Implications of the study

4.4.1 Increased demand for targeted fertility information.

The participants in this study demonstrated a poor knowledge about fertility and reproductive technologies, with a mean score of 33% on the adapted SFAQ. This lack of knowledge, while concerning, is consistent with previous literature indicating women have low levels of fertility knowledge (Almeida-Santos et al., 2017; Bunting, Tsibulsky, & Boivin, 2012; Lundsberg et al., 2014). Of the total sample, only 11.7% of women (*N*= 60) were aware that fertility gradually begins to decline between the ages of 25-29 years, with the majority of the sample overestimating the age of peak reproductive health. Lack of knowledge towards age-related fertility decline has been demonstrated around the world even among samples of predominantly highly-educated women (Bretherick et al., 2010; Maeda et al., 2015), such as this one. These findings are problematic, as they indicate that fertility knowledge is lacking nationally and internationally.

These findings demonstrate the importance of more targeted health information focusing on fertility and the need for this to be distributed at a national level. While most women choose to have children after completing their education, better sexual and reproductive health education programs in secondary schools would be beneficial. Educating young people about fertility and reproductive health, including fertility decline and contraception, is imperative. In the public sphere, more accessible family planning and fertility services could also increase fertility knowledge, as many people are unable to visit fertility specialists due to financial limitations or insufficient medical care. In conjunction with this, there is a dire need for targeted public health

campaigns to improve fertility awareness among the general population. It would be beneficial for these campaigns to be disseminated via mainstream media, as well as promoted at hospitals and public health centres, as this is an accessible way for women to learn about fertility and is most commonly where women access their fertility information. Women may more directly benefit from campaigns that target age-related fertility decline, as this is a common barrier that leads to involuntary childlessness, and it is an area in which women appear to lack knowledge worldwide. For highly-educated women, who tend to favour childbearing after the age of 30 years (Garcia et al., 2015), accurate information about reproductive technologies, such as non-medical egg freezing, may be highly beneficial.

Previous studies have introduced the potential for distributing fertility knowledge in accordance with the Health Belief Model (Rosentock, 1990), indicating that this may be the most effective method for promoting change (Boivin, Bunting, & Gameiro, 2013). While it is an attractive, commonly mentioned option, no identifiable published studies have been conducted examining its efficacy concerning fertility information. It may be beneficial for more in-depth research to be conducted to explore the efficacy of fertility awareness campaigns developed using the Health Belief Model.

4.4.2 Cost of the procedure.

Participants in this study cited Medicare subsidisation as the most important factor in the decision to freeze eggs, demonstrating that cost is a barrier to accessing egg freezing procedures. Egg freezing is a multi-step procedure, with costs occurring at all stages. The initial cost of harvest and cryopreservation is high, estimated between $5000AUD to $6000AUD (Monash IVF, 2019; Pivet Medical Centre, 2020), with additional ongoing storage fees also required. Further, if women choose to utilise their eggs, there is an additional cost for thawing, fertilisation

and insertion which tends to cost thousands of dollars (Monash IVF, 2019; Pivet Medical Centre, 2020), with specific figures differing depending upon the clinic. In estimation, the entirety of the cost reaches well over $13,000AUD (Monash IVF, 2019; Pivet Medical Centre, 2020), though this may be a conservative estimate given that the procedure typically costs $10,419 Euros in the United Kingdom (van Loendersloot et al., 2011) and $25,000USD in the United States of America (Carroll & Kroløkke, 2017; Harwood, 2009); which equates to between $15,000-$35,000AUD when converted.

This cost can be quite financially straining, especially given the efficacy of egg freezing throughout the lifespan. While birth rates are relatively high until the age of 35 years, the most advantageous time to freeze eggs is in the early twenties (Anderson, Davies, & Lavery, 2020; Chian, 2010; Gook, 2011; Milman et al., 2017; Paramanantham et al., 2015). Despite this, most women are freezing their eggs between the ages of 36 years and 40 years, where the chance of a healthy live birth decreases to 19% (Anderson et al., 2020); compared to a success rate ranging between 60-90% when the eggs are frozen in the twenties and early thirties (Chian, 2010; Paramanantham et al., 2015). The modest success rates can deter women from footing the high cost, with a past study finding that 91% of sampled women from the USA would only consider paying the high costs if there was a minimum 50% chance of a successful delivery (Milman et al., 2017). Replication studies examining the relationship between cost and likelihood of success would be beneficial to determine whether this is true for other countries or if it is isolated to the USA.

The cost is also quite high given the low likelihood of egg usage, which is noted as being between 3.1-9.3% (Ben-Rafael, 2018); indicating many women conceive naturally or change their minds about reproducing, rendering the procedure unnecessary. The possibility of paying

thousands of dollars for a procedure that may not be required in the long-term may have longstanding financial detriments to individuals, and cost alleviation may be beneficial for reduction of these stressors. Though the biologically optimal time to freeze eggs is in the early twenties, many women of this age are not at a socially optimal time to start a family and consequently do not think about potentially freezing their eggs for future use. Those women looking to freeze eggs in their twenties, may not be in the financial position to do so, with many young women beginning their careers during this time. Although having the technology available to freeze eggs is beneficial, it is also increasingly important to ensure that women not only have the technology available to them to freeze their eggs, but they are also receiving accurate education about its likely success and its cost-effectiveness. The results of this study demonstrate the need for a comprehensive cost-analysis of egg freezing in Australia, whilst also considering the efficacy of the procedure and the age-related success rates.

4.5 Future Research

As this study is the first of its kind in Australia, there are ample opportunities for future study in the field. Firstly, while this study measured fertility knowledge as a whole and by freezer status, future research may benefit from measuring knowledge according to fertility status. Examining fertility knowledge in samples of women facing fertility struggles is likely to yield women that are more informed about their fertility and fertility in general. In a Japanese sample, women who had faced fertility issues scored 6.5 points higher on fertility knowledge tests than the general population of women (Maeda et al., 2015). If this were replicated in an Australian sample, the findings could aid in the development and production of targeted reproductive health campaigns. Secondly, for most couples, reproduction and childbearing is a collaborative decision. This study focused on the female experience of fertility and egg freezing

without considering the male experience. Studies targeting male knowledge and attitudes towards fertility and reproductive technologies could provide vital information into the male perspective, and how this influences a couple's decision to reproduce.

This study predominantly focused on a Caucasian and heteronormative experience, and further studies into more diverse groups would aid in generalisability. The sample lacked LGBTQIA+ representation, and further research would benefit from examining this target population. As a large proportion of LGBTQIA+ women are involved in same-sex relationships and cannot biologically reproduce with their partner, they are more reliant on reproductive technologies to create a family (Klein et al., 2018). Thus, they might be a relevant sample for research regarding egg freezing and other ARTs. Further studies focusing on more culturally diverse groups would also provide valuable insight into the cultural experiences and attitudinal differences that are present within Australia's multicultural society with regards to fertility and fertility preservation techniques.

Finally, most participants came from urban areas, with less representation of women living in rural and remote areas. Appropriate healthcare access can be more difficult in non-urban settings due to lack of resources and funds (Wakerman et al., 2008), and thus these women may have lower fertility education and be at higher risk of involuntary childlessness. If fertility awareness and knowledge of fertility preservation techniques are to become more widespread, it would be advantageous to have comparisons between urban, rural and remote dwelling women, so more targeted information can be released where it is needed. Due to the significance of Medicare subsidisation found within this study, further studies focusing on cost and government subsidies for fertility treatments, including non-medical fertility preservation, may be beneficial

to determine the replicability of the results. If replicated, examining the importance of medical cost from a health-economic standpoint would be pertinent.

4.6 Conclusion

Previous evidence suggests lower levels of acceptance towards egg freezing for non-medical indications compared to medical indications, and generally low levels of fertility and reproductive knowledge overall. The present study attempted to draw upon the previous body of literature surrounding egg freezing and determine whether the findings were also reflected in a sample of Australian women of reproductive age. The findings added to the previous body of literature, demonstrating an increasingly important need for targeted, accurate and effective fertility information. The current study also indicated a moderate to high level of acceptance towards non-medical egg-freezing, with 61.3% of women positively endorsing the practice. The results provide valuable insight into the attitudes towards non-medical egg freezing and the factors that are indicative of Australian womens' decision to freeze eggs. Large scale future research is recommended to replicate the results and to determine the generalisability of the findings to the wider population, with the ultimate aim being to improve fertility knowledge generally and in regards to age-related fertility decline and preservation options, and to reduce the stigma associated with using ARTs for family creation.

References

Australian Bureau of Statistics. (2018). Births Australia 2018. Retrieved from: https://www.abs.gov.au/AUSSTATS/abs@.nsf/Latestproducts/3301.0Main%20Features32018?opendocument&tabname=Summary&prodno=3301.0&issue=2018&num=&view=

Abiodun, O., Alausa, K., & Olasehinde, O. (2016). Ignorance could hurt: an assessment of fertility awareness, childbirth intentions and parenting attitudes among university students. *International Journal of Adolescent Mental Health, 30*(2), 1-11. https://doi.org/10.1515/ijamh2016-0091

Almeida-Santos, T., Melo, C., Macedo, A., & Moura-Ramos, M. (2017). Are women and men well informed about fertility? Childbearing intentions, fertility knowledge and information-gathering sources in Portugal. *Reproductive Health, 14*(91), 1-9. https://doi.org/10.1186/s12978-017-0352-z

Anderson, R.A., Davies, M.C., & Lavery, S.A. (2020). Elective egg freezing for non-medical reasons, *International Journal of Obstetrics and Gynaecology, 63,* 114-121. https://doi.org/10.1111/1471-0528.16025

Baldwin, K. (2016). I suppose I think to myself, that's the best way to be a mother: how ideologies of parenthood shape women's use for social egg freezing technology. *Sociological Research Online, 22*(2), 1-15. https://doi.org/10.5153/sro.4187

Baldwin, K. (2018). Conceptualising women's motivations for social egg freezing and experience of reproductive delay. *Sociology of Health & Illness*, *40*(5), 859-873. https://doi.org/10.1111/1467-9566.12728

Baldwin, K., Culley, L., Hudson, N., Mitchell, H., & Lavery, S. (2015). Oocyte cryopreservation for social reasons: demographic profile and disposal intentions of UK users. *Reproductive Biomedicine Online, 31*, 239-245. https://doi.org/10.1016/j.rbmo.2015.04.010

Baldwin, K., Culley, L., Hudson, N., & Mitchell, H. (2018). Running out of time: exploring women's motivations for social egg freezing. *Journal of Psychosomatic Obstetrics & Gynecology, 40*(2), 166-173. https://doi.org/10.1080/0167482X.2018.1460352

Bell, K. (2013). Constructions of "infertility" and some lived experiences of involuntary childlessness. *Journal of Women and Social Work*, *28*(3), 284-295. https://doi.org/10.1177/0886109913495726

Ben-Rafael, Z. (2018). The dilemma of social oocyte freezing: usage rate is too low to make it cost-effective, *Reproductive Biomedicine, 37*(4), 443- 448. https://doi.org/10.1016/j.rbmo.2018.06.0241472-6483

Boivin, J., Bunting, L., Collins, J.A., & Nygren, K.G. (2007). International estimates of infertility prevalence and treatment-seeking: potential need and demand for infertility medical care. *Human Reproduction, 22*(6), 1506-1512. https://doi.org/10.1093/humrep/dem046

Boivin, J., Bunting, L., & Gameiro, S. (2013). Cassandra's prophecy: a psychological perspective. Why we need to do more than just tell women. *Reproductive Biomedicine Online, 27,* 11-14. https://doi.org/10.1016/j.rbmo.2013.03.021

Bower, C., & Hansen, M. (2005). Assisted reproductive technologies and birth outcomes: overview of recent systematic reviews. *Reproduction, Fertility and Development, 17*, 329-333. https://doi.org10.1071/RD04095

Bretherick, K.L., Fairbrother, N., Avila L., Harbord, S.H.A., & Robinson, W.P. (2010). Fertility and aging: do reproductive-aged Canadian women know what they need to know? *Fertility and Sterility, 93*(7), 2162-2168. https://doi.org/10.1016/j.fertnstert.2009.01.064

Bunting, L., Tsibulsky, I., & Boivin, J. (2012). Fertility knowledge and beliefs about fertility treatment: findings from the international fertility decision-making study. *Human Reproduction, 28*(2), 385-397. https://doi.org/10.1093/humrep/des402

Carroll, K., & Krolokke, C. (2018). Freezing for love: enacting 'responsible' reproductive citizenship through egg freezing. *Culture, Health & Sexuality, 20*(9), 992-1005. https://doi.org/10.1080/13691058.2017.1404643

Chian, R. (2010). Cryopreservation of human oocytes: an overview. In R. Chian & P. Quinn (Eds), *Fertility Cryopreservation* (pp. 114-119). Cambridge, UK: Cambridge University Press.

Cooke, A., Mills, T., & Lavender, T. (2012). Advanced maternal age: delayed childbearing is rarely a conscious choice: a qualitative study of women's views and experiences. *International Journal of Nursing Studies, 49*(1), 30-39. https://doi.org/10.1016/j.ijnurstu.2011.07.013

Daniluk, J. C., & Koert, E. (2016). Childless women's beliefs and knowledge about oocyte freezing for social and medical reasons. *Human Reproduction, 31*(10), 2313-2320. https://doi.org/10.1093/humrep/dew189

Daniluk, J.C., Koert E., & Cheung, A. (2012). Childless women's knowledge of fertility and assisted human reproduction: identifying the gaps. *Fertility and Sterility, 97*(2), 420-426. https://doi.org/10.1016/j.fertnstert.2011.11.046

Datta, M. (2020). Egg freezing on company dollars: making biological clock irrelevant. *Depaul Journal of Women, Gender and the Law, 6*(1), 119-146.

Declercq, E., Luke, B., Belanoff, C., Cabral, H., Diop, H., Gopal, D., Hoang, L., Kotelchuck, M., … Hornstein, M.D. (2015). Perinatal outcomes associated with assisted reproductive technology: the Massachusetts Outcomes Study of Assisted Reproductive Technologies (MOSART). *Fertility and Sterility, 103*(4), 888-895. https://doi.org/10.1016/j.fertnstert.2014.12.119

Espirito Santo, E.V., Dieamant, F., Petersen, C.G., Mauri, A.L, Vagnini, L.D., Renzi, A,… & Franco, J.G. (2017). Social oocyte cryopreservation: a portrayal of Brazilian women. *Assisted Reproduction*, *21*(2), 101-104. https://doi.org/10.5935/1518-0557.20170024

Garcia, G., Vassena, R., Trullenque, M., Rodriguez A., & Vernaeve, V. (2015). Fertility knowledge and awareness in oocyte donors in Spain. *Patient Education and Counselling, 98,* 96-101. https://doi.org/10.1016/j.pec.2014.10.009

Gook, D.A. (2011). History of oocyte cryopreservation. *Reproductive Biomedicine Online*, *23,* 281-289. https://doi.org/10.1016/j.rbmo.2010.10.018

Harwood, K. (2009). Egg freezing: a breakthrough for reproductive autonomy? *Bioethics, 23*(1), 39-46. https://doi.org/10.1111/j.1467-8519.2008.00680

Hirshfield-Cytron, J., Grobman, W.A., & Milad, M.P. (2012). Fertility preservation for social indications: a cost-based decision analysis. *Fertility and Sterility, 97*(3), 665-670. https://doi.org/10.1016/j.fertnstert.2011.12.029

Hodes-Wertz, B., Druckenmiller, S., Smith, M., & Noyes, N. (2013). What do reproductive age women who undergo oocyte cryopreservation think about the process as a means to preserve fertility. *Fertility and Sterility, 100*(5), 1343-1349. https://doi.org/10.1016/j.fertnstert.2013.07.201

Huang, J., & Rosenwaks, Z. (2014). Assisted Reproductive Technologies. In Z. Rosenwaks & P.M Wassarman (Eds.), *Human Fertility: Methods and Protocols* (pp. 171-231). New York, NY: Springer Science & Business Media.

Ikhena-Abel, D.E., Confino, R., Shah, N.J., Lawson, A.K., Klock, S.C., Robins, J.C., & Pavone, M.E. (2017). Is employer coverage of elective egg freezing coercive?: a survey of medical students' knowledge, intentions, and attitudes toward elective egg freezing and employer coverage. *Journal of Assisted Reproduction and Genetics, 34*, 1035-1041. https://doi.org/10.1007/s10815-017-0956-9.

James, S.S & Singh, A.K. (2018). Grief and bereavement in infertility and involuntary childlessness. *Journal of Psychosocial Research*, *13*(2), 297-305. https://doi.org/10.32381/JPR.2018.13.02.4

Jones, B.P., Saso, S., Mania, A., Smith, J.R., Serhal, P., & Ben Nagi, J. (2018). The dawn of a new ice age: social egg freezing. *Acta Obstetrica Gynelogica Scandinavia*, *97,* 641-647. https://doi.org/10.1111/aogs.13335

Kilic, A., & Gocmen, I. (2018). Fate, morals and rational calculations: Freezing eggs for non-medical reasons in Turkey. *Social Science & Medicine, 203*, 19-27. https://doi.org/10.1016/j.socscimed.2018.03.014

Klein, D.A., Berry-Bibee, E.N., Keglovitz Baker, K., Malcolm, N.M., Rollison, J.M., & Frederiksen, B.N. (2018). Providing quality family planning services to LGBTQIA

individuals: a systematic review. *Contraception, 97*, 378-391. https://doi.org/h10.1016/j.contraception.2017.12.016 0010-7824/

Lallemant, C., Vassard, D., Andersen, A.N., Schmidt., L & Macklon, N. (2016). Medical and social egg freezing: internet based survey of knowledge and attitudes among women in Denmark and the UK. *Acta Obstetrica Gynelogica Scandinavia*, *95,* 1402-1410. https://doi.org/10.1111/aogs.13024

Lampic, C., Svanberg, A., Karlstrom, P., & Tyden, T. (2006). Fertility awareness, intentions concerning childbearing, and attitudes towards parenthood among female and male academics. *Human Reproduction, 21*(2), 558-564. https://doi.org/10.1093/humrep/dei367

Lechner, L., Bolman, C., & van Dalen, A. (2007). Definite involuntary childlessness: associations between coping, social support and psychological distress. *Human Reproduction, 22*(1), 288-294. https://doi.org/10.1093/humrep/del327

Levi-Setti, P.E., Patrizio, P., & Scaravelli, G. (2016). Evolution of human oocyte cryopreservation: slow freezing versus vitrification. *Current Opinion Endocrinology, Diabetes, Obesity, 23*(6), 445-450. https://doi.org/10.1097/MED.0000000000000289

Lewis, E.I., Missmer, S.A., Farland, L.V., & Ginsburg, E.S. (2016). Public support in the United States for elective oocyte cryopreservation. *Fertility and Sterility, 106*(5), 1183-1189. https://doi.org/10.1016/j.fertnstert.2016.07.004

Lockwood, G.M. (2011). Social egg freezing: the prospect of reproductive immortality or a dangerous delusion? *Reproductive Biomedicine Online, 23*, 334-340. https://doi.org/10.1016/j.rbmo.2011.05.010

Long, J.S. (1997). Regression models for categorical and limited dependent variables. advanced quantitative techniques in the social sciences. Sage Publications: Thousand Oaks, CA.

Lundsberg, L.S., Pal, L., Gariepy, A.M., Xu, X., Chu, M.C., & Illuzi J.L. (2014). Knowledge, attitudes, and practices regarding conception and fertility: a population-based survey among reproductive-age United States women. *Fertility and Sterility, 101*(3), 767-774. https://doi.org/10.1016/j.fertnstert.2013.12.006

Maeda, E., Sugimori, H., Nakamura, F., Kobayashi, Y., Green, J., Suka, M., Okamoto, M., Boivin., & Hidekazu, S. (2015). A cross sectional study on fertility knowledge in Japan, measured with the Japanese version of Cardiff Fertility Knowledge Scale (CFKS-J). *Reproductive Health, 12*(10), 1-12. https://doi.org/10.1186/1742-4755-12-10

Mertes, H. (2015). Does company-sponsored egg freezing promote or confine women's reproductive autonomy?, *Journal of Assisted Reproductive Genetics, 32*(8),1205–1209. https://doi.org.10.1007/s10815-015-0500-8

Milman, L.W., Senapati, S., Sammel, M.D., Cameron, K.D., & Gracia, C. (2017). Assessing reproductive choices of women and the likelihood of oocyte cryopreservation in the era of elective oocyte freezing. *Fertility and Sterility, 107*(5), 1214-1222. https://doi.org/10.1016/j.fertnstert.2017.03.010

Monash IVF. (2019). Egg freezing cost: what is the cost to freeze your eggs? Retrieved from: https://monashivf.com/fertility-treatments/fertility-preservation/egg-freezing/egg-freezing-cost/

O'Brien, Y., Martyn, F., Glover, L.E., & Wingfield, M.B. (2017). What women want? A scoping survey on women's knowledge, attitudes and behaviours towards ovarian reserve testing and egg freezing. *European Journal of Obstetrics & Gynecology and Reproductive Biology, 217*, 71-76. https://doi.org/10.1016/j.ejogrb.2017.08.024 0301-2115

Paramanantham, J., Talmor, A.J., Osianlis, T., & Weston, G.C. (2015). Cryopreserved oocytes: update on clinical applications and success rates. *Obstetrical and Gynecological Survey, 70*(2), 97-114. https://doi.org/10.1097/OGX.0000000000000152

Peng, C.J., Lee, K.L., & Ingersoll, G.M. (2002). An introduction to logistic regression: analysis and reporting, *The Journal of Educational Research, 96*(2), 3-14. https://doi.org/10.1080/00220670209598786

Peterson, B. D., Pirritano, M., Tucker, L., & Lampic, C. (2012). Fertility awareness and parenting attitudes among American male and female undergraduate university students. *Human Reproduction, 27*(5), 1375-1382. https://doi.org/10.1093/humrep/des011

Pivet Medical Centre. (2020). Egg freezing. Retrieved from: https://www.pivet.com.au/products/fertility-treatment/egg-freezing/

Pritchard, N., Kirkman, M., Hammarberg, K., McBain, J., Agresta, F., Bayly, C.,… & Fisher, J. (2017). Characteristics and circumstances of women in Australia who cryopreserved their oocytes for non-medical indications. *Journal of Reproductive and Infant Psychology, 35*(2), 108-118. https://doi.org/10.1080/02646838.2016.1275533

Ranganathan, P., Pramesh, C.S., & Aggarwal, R. (2020). Common pitfalls in statistical analysis: logistic regression, *Perspectives in Clinical Research, 8*(3), 148-151. https://doi.org/10.4103/picr.PICR_87_17

Royal Australian College of General Practitioners. (2019). Mothers and babies in Australia. Retrieved from: https://www.racgp.org.au/

Rosenstock, I. (1990). The health belief model: explaining health behavior through expectancies. In K. Glanz, F.M. Lewis, F.M., & B. Rimers (Eds.), *Health Behavior and Health Education.* Jossey-Bass, San Francisco, CA.

Skoog, A., Lampic, C., Bergh, T., & Lundkvist, O. (2003). Public opinion regarding oocyte donation in Sweden. *Human Reproduction, 18*, 1107-1114. https://doi.org/10.1093/humrep/deg222

Schochow, M., Rubeis, G., Buchner-Mogling, G., Fries, H., & Steger, F. (2018). Social freezing in medical practice: experiences and attitudes of gynecologists in Germany. *Science and Engineering Ethics, 24*, 1483-1492. https://doi.org/10.1007/s11948-017-9970-7

Stoop, D., Nekkebroeck, J., & Devroey, P. (2011). A survey on the intentions and attitudes towards oocyte cryopreservation for non-medical reasons among women of reproductive age. *Human Reproduction, 26*(3), 655-661. https://doi.org/10.1093/humrep.deq367

Tan, S.Q., Tan., A.W.K., Lau, M.S.K., Tan, H.H., & Nadarajah, S. (2014). Social oocyte freezing: a survey among Singaporean female medical students. *Journal of Obstetrics and Gynaecology Research, 40*(5), 1345-1352. https://doi.org/10.1111/jog.12347

Tozzo, P., Fassina, A., Nespeca, P., Spigarolo, G., & Caenazzo, L. (2019). Understanding social oocyte freezing in Italy: a scoping survey on university female students' awareness and attitudes. *Life Sciences, Society and Policy, 15*(3), 1-14. https://doi.org/10.1186/s40504-019-0092-7

van Loendorsloot, L.L., Moolenar, L.M., Mol, B.J.W., Repping, S., van der Veen, F., & Goddjin, M. (2011). Expanding reproductive lifespan: a cost-effectiveness study on oocyte freezing. *Human Reproduction, 26*(11), 3054.3060. https://doi.org/10.1093/humrep/der284

van Smeden, M., Moons, K.G.M., de Groot, J.A.H., Collins, G.S., Altman, D.G., Eijkemans, M.J.C., Reitsma, J.B. (2019). Sample size for binary logistic prediction models: beyond events per variable criteria, *Statistical Methods in Medical Research, 28*(8), 2455-2474. https://doi.org/10.1177/0962280218784726

Vittinghoff, E., & McCulloch, C.E. (2006). Relaxing the rule of ten events per variable in logistic and cox regression, *American Journal of Epidemiology, 165*(6), 710-718. https://doi.org/10.1093/aje/kwk052

von Wolff, M., Germeyer, A., & Nawroth, F. (2015). Fertility preservation for non-medical reasons. *Deutsches Ärtzeblatt International, 112*, 27-32. https://doi.org/10.3238/arztebl.2015.0027

von Wolff, M., Germeyer, A., Liebenthron, J., Korrell, M., & Nawroth, F. (2018). Practical recommendations for fertility preservation in women by the FertiPROTEKT network. Part II: fertility preservation techniques. *Archives of Gynecology and Obstetrics, 297*, 257-267. https://doi.org/10.1007/s00404-017-4595-2

Wakerman, J., Humphrey, J.S., Wells, R., Huipers, K., Entwistle, P., & Jones, J. (2008). Primary health care delivery models in rural and remote Australia – a systematic review. *BioMed Central Health Services Research, 8*(276), 1-10. https://doi.org/10.1186/1472-6963-8-276

Wennberg, A. L., Rodriguez-Wallberg, K. A., Milsom, I., & Brännström, M. (2016). Attitudes towards new assisted reproductive technologies in Sweden: a survey in women 30–39 years of age. *Acta Obstetricia et Gynecologica Scandinavica, 95*(1), 38- 44. https://doi.org/10.1111/aogs.12781

APPENDICES

Appendix A

Survey Questions

Part 1: Demographics

1. What is your age in years? (open text box)
2. What is your Sexual Orientation?
   - Straight
   - Gay
   - Lesbian
   - Bisexual
   - Pansexual
   - Asexual
   - Other: Please specify (open text box)
3. What is your post code? (open text box)
4. Which of the following best represents your ethnic heritage? (Peoples ethnicity describes their feeling of belonging and attachment to a distinct group of a larger population that shares their ancestry, colour, language or religion)
   - Australian
   - American
   - Asian
   - African
   - European
   - Indigenous Australian
   - Maori or Pacific Islander
   - Middle Eastern
   - Other: please specify (open text box)
5. What is your current relationship status?
   - Single
   - In a relationship

- Married/Defacto/Engaged
- Separated/Divorced

6. What is the highest level of education you have completed?
    - High School
    - Apprenticeship
    - Bachelor Degree
    - Honours Degree
    - Masters Degree
    - PhD
7. If you are studying now, what level of education are you currently completing?
    - High School
    - Apprenticeship
    - Bachelor Degree
    - Honours Degree
    - Masters Degree
    - PhD
8. What area are you studying? (open text box)
9. What year of studying are you currently undertaking? (open text box)
10. What is your current employment status?
    - Unemployed
    - Full time
    - Part time
    - Casual/Temporary

Part 2: Reproductive Intention

11. Do you currently have children? Yes/No
12. Do you plan on having children? Yes/No
13. How many children do you desire? (open text box)
14. At what age would you like to/did you have your first child?
15. At what age would you like to/did you have your last child?

16. How important is/was it for you to have children?
    - Very important
    - Important
    - Moderately Important
    - Slightly important
    - Not at all important
17. What would you do if you or your partner could not get pregnant?
    - Fertility Treatment
    - Adopt
    - Foster
    - Refrain from having children
18. How confident are you that you will have your desired number of children?
    - Very confident
    - Confident
    - Moderately Confident
    - Slightly confident
    - Not confident

Part 3: Fertility Knowledge

19. How would you rate your knowledge on fertility and infertility issues?
    - Not educated at all
    - Somewhat educated
    - Educated
    - Very educated
    - Extremely Educated
20. From which of the following sources do you receive your fertility knowledge? (Please select all options that apply)
    - Books
    - Magazines

- Brochures
- Newspapers
- Internet
- Radio
- Video
- TV
- Public health centres
- Health professionals
- Family members
- Friends
- Other: please specify (open text box)

21. Have you previously sought a consultation about your fertility? (This includes seeking advice from a doctor, undergoing fertility diagnostic testing, ovulation induction, insemination, surgery, and treatment with Assisted Reproductive Technologies) Yes/No
22. At what age are women the most fertile?
    - 15-19 years
    - 20-24 years[a]
    - 25-29 years
    - 30-44 years
23. At what age is there a slight decrease in women's ability to become pregnant?
    - 15-24 years
    - 25-29 years[a]
    - 30-34 years
    - 35-39 years
24. At what age is there a marked decrease in women's ability to become pregnant?
    - 25-34 years
    - 34-39 years[a]
    - 40-44 years
    - 45-49 years

25. A young woman (<25 years) and a man have unprotected intercourse at the time of ovulation- how large is the chance that she will then become pregnant?
    - 0-29%
    - 30-39%[a]
    - 40-49%
    - 50-100%
26. A woman and a man who regularly have unprotected intercourse during a period of one year: How large is the chance that she will then become pregnant if she is 25-30 years old?
    - 0-69%
    - 70-79%[a]
    - 80-89%
    - 90-100%
27. How large is the chance that she will then become pregnant if she is 35-40 years old?
    - 0-49%
    - 50-59%[a]
    - 60-69%
    - 70-100%
28. Couples that undergo treatment with IVF- what is their chance, on average, of getting a child?
    - 0-19%
    - 20-29%[a]
    - 30-39%
    - 40-100%

Part 4: Attitudes towards non-medical egg freezing

29. Would you consider freezing your eggs for non-medical reasons?
    - Yes
    - No
    - Maybe

- I don’t know

30. At what age would you consider freezing your eggs for non-medical reasons?
    - 21-25 years
    - 26-30 years
    - 31-36 years
    - 36-40 years
    - >40 years
31. Would the following reasons alter your decision to freeze your eggs? Does not affect my future fertility
    - Very Unlikely
    - Unlikely
    - Neutral
    - Likely
    - Very Likely
32. Would the following reasons alter your decision to freeze your eggs? Complexity of treatments
    - Very Unlikely
    - Unlikely
    - Neutral
    - Likely
    - Very Likely
33. Would the following reasons alter your decision to freeze your eggs? Likelihood of success
    - Very Unlikely
    - Unlikely
    - Neutral
    - Likely
    - Very Likely

34. Would the following reasons alter your decision to freeze your eggs? Financial Reimbursement
    - Very Unlikely
    - Unlikely
    - Neutral
    - Likely
    - Very Likely
35. Would the following reasons alter your decision to freeze your eggs? Absence of a suitable partner
    - Very Unlikely
    - Unlikely
    - Neutral
    - Likely
    - Very Likely
36. Would the following reasons alter your decision to freeze your eggs? Desire for a child
    - Very Unlikely
    - Unlikely
    - Neutral
    - Likely
    - Very Likely
37. Would the following reasons alter your decision to freeze your eggs? Health of offspring
    - Very Unlikely
    - Unlikely
    - Neutral
    - Likely
    - Very Likely
38. Would the following reasons alter your decision to freeze your eggs? Unsure of desire to have children
    - Very Unlikely
    - Unlikely

- Neutral
- Likely
- Very Likely

39. Who do you think should pay for the costs of non-medical egg freezing?
    - The woman looking to undergo the procedure
    - Private health insurance
    - Medicare
    - Employers
40. If the Australian Medicare system would pay for this procedure, would you be more inclined to freeze your eggs for non-medical reasons?
    - Yes
    - Maybe
    - No
    - I don’t know

Appendix B

Permission for use of the SFAQ in the current study (questionnaire was adapted to be suitable towards an Australian sample)

from: XXXX

to: claudia.lampic@ki.se

date: 17 Mar 2020, 17:35

subject: Permission for use of SFAQ

Dear XXXX,

You are welcome to use our questionnaire from the 2006 HR-study.
Please find enclosed the full English version of the questionnaire for women.

Best regards,
Claudia

Claudia Lampic | Associate Professor

Appendix C

Participant Information Sheet

PARTICIPANT INFORMATION SHEET

PROJECT TITLE: Australian women's knowledge of and attitudes towards non-medical oocyte cryopreservation
HUMAN RESEARCH ETHICS COMMITTEE APPROVAL NUMBER: 20/09
PRINCIPAL INVESTIGATOR: XXXX
STUDENT RESEARCHER: XXXX
STUDENT'S DEGREE: Bachelor of Psychological Science (Honours)

Dear Participant,

You are invited to participate in the research project described below.

What is the project about?
This research project aims to examine Australian women's knowledge of and attitudes towards non-medical oocyte cryopreservation (egg freezing) and to determine the factors associated with Australian women's reported intention to engage in non-medical egg freezing.

Who is undertaking the project?
This project is being conducted by XXXX. This research will form the basis for the degree of Honours in Psychological Science at the University of Adelaide under the supervision of XXXX.

Why am I being invited to participate?
You are being invited as you are an Australian woman between the ages of 18 and 44 years who is fluent in the English language.

What am I being invited to do?
You are being invited to complete an online survey about your fertility knowledge, reproductive intentions and attitudes towards non-medical egg freezing. The survey also includes demographic questions. As this is an online survey, you are able to complete it on any device from any location with internet access.

How much time will my involvement in the project take?
The survey is anticipated to take approximately 20 minutes of your time.

Are there any risks associated with participating in this project?
It is possible that you may experience emotional distress in reviewing information regarding your reproductive intentions and fertility. However, you have the option to not answer specific questions. Should you require support you can contact Lifeline on 13 11 14 or Beyond Blue on 1300 224 636.

What are the potential benefits of the research project?
Although answering questions about fertility knowledge, reproductive intentions and egg freezing may cause distress to participants who may have experienced infertility difficulties, understanding knowledge and attitudes to methods of fertility preservation is important. The findings of this study may generate information for health professionals to better understand women's knowledge and attitudes about egg freezing which may be used to improve information and services available to women.

Can I withdraw from the project?
Participation in this project is completely voluntary. If you agree to participate, you can withdraw from the study at any time before submitting your survey responses.

What will happen to my information?

Confidentiality and Privacy
Participation in the research is anonymous; no names will not be used in this research. Participants will not be identified in any publication or presentation resulting from the research.
Storage
All information and data for this project will be stored securely. All electronic data collected will be stored according to the University of Adelaide's policy, on a secure server with password protection. This data will be stored for a period of five years post-publication and will only be accessible by the researchers.
Publishing
You will not be identified in any publications; only summary data will be published. Findings from the research may be published as a book, thesis, journal article, news article, report, on a website and in conference presentations.
Sharing
Data will be made available for use in future studies as indicated on your consent form. Only your de-identified information will be used in the future. This de-identified data may be shared with other researchers.

Should you wish to receive a copy of the research findings you may provide an email address at the end of the survey. Your information will only be used as described in this Participant Information Sheet and it will only be disclosed according to the consent provided, except as required by law.

Who do I contact if I have questions about the project?
Should you have any further questions about the project, please contact XXXX (email: XXXX or XXXX (email: XXXX)

What if I have a complaint or any concerns?
The study has been approved by the School of Psychology Research Ethics Committee at the University of Adelaide (20/09). This research project will be conducted according to the NHMRC National Statement on Ethical Conduct in Human Research 2007 (updated 2018). If you have questions or problems associated with the practical aspects of your participation in the project, or wish to raise a concern or complaint about the project, then you should consult the Principal Investigator.

If you wish to speak with an independent person regarding concerns or a complaint, the University's policy on research involving human participants, or your rights as a participant, please contact the Convenor, Human Research Ethics Sub-Committee (School of Psychology) on:

Phone: +61 8 8313 4936 Email: paul.delfabbro@adelaide.edu.au

Any complaint or concern will be treated in confidence and fully investigated. You will be informed of the outcome.

If I want to participate, what do I do?
Continue to the following page where you will be directed to an online consent form. Once you have given your consent, you will be directed through to an online survey.

Yours sincerely,
XXXX and
XXXX

Appendix D

Consent Form (placed at the beginning of the survey; if participants did not consent to their de-identified data being used, they were skipped to the end of the survey)

Human Research Ethics Committee (HREC)

CONSENT FORM

1. I have read the attached Information Sheet and agree to take part in the following research project:

Title:	Australian women's knowledge of and attitudes towards non-
Ethics Approval	Number 20/09

2. I have had the project, so far as it affects me, and the potential risks and burdens fully explained to my satisfaction by the research worker. I have had the opportunity to ask any questions I may have about the project and my participation. My consent is given freely.

3. I have been given the opportunity to have a member of my family or a friend present while the project was explained to me.

4. Although I understand the purpose of the research project, it has also been explained that my involvement may not be of any benefit to me.

5. I agree to participate in the activities outlined in the participant information sheet.

6. I understand that as my participation is anonymous, I can withdraw any time up until submission of the survey

7. I have been informed that the information gained in the project may be published in a book/journal article/thesis/news article/website/report and in conference presentation.

8. I have been informed that in the published materials I will not be identified and my personal results will not be divulged.

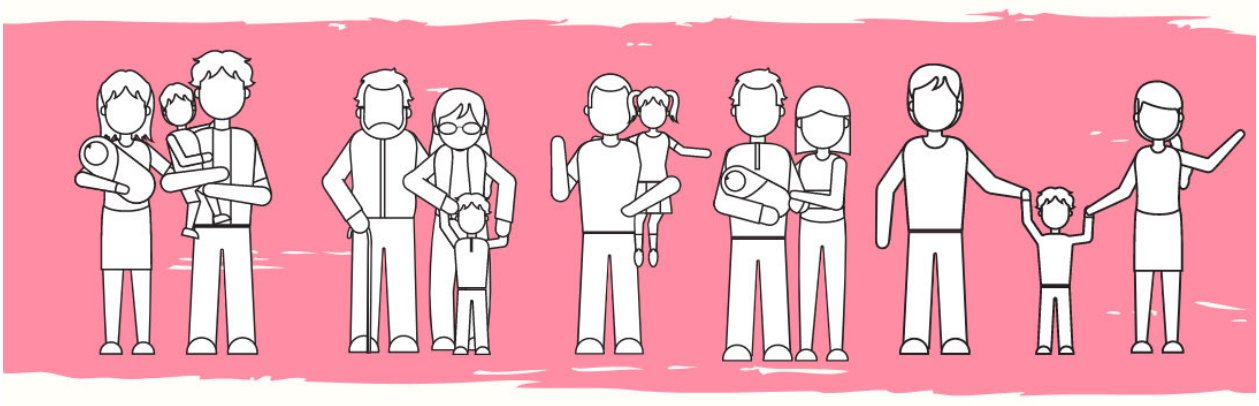
9. I understand my information will only be disclosed according to the consent provided, except where disclosure is required by law.

Appendix E

Social Media advertisement

We are seeking women aged 18-44 years to take part in a

Study of Australian women's knowledge of and attitudes towards non-medical oocyte cryopreservation (egg freezing)



Preserving Fertility: Oocyte Cryopreservation

Over the past twenty years, more women have extended their higher education and focused on career development. As a result, many women are considering Assisted Reproductive Technologies (ART's) to delay motherhood and prolong their chances of conceiving. One such ART increasingly available to women is oocyte cryopreservation, known as egg freezing. The research aims to examine knowledge of and attitudes towards non-medical egg freezing among Australian women of reproductive age (18-44 years). Little research has been conducted about freezing eggs for non-medical reasons

This study has been approved by the School of Psychology Research Ethics Committee, The University of Adelaide, 20/09.