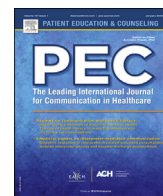


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# Women's attitudes and beliefs about using fertility preservation to prevent age-related fertility decline—A two-year follow-up

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## ABSTRACT

**Objective:** The health belief and transtheoretical model were used to describe how women make decisions about fertility preservation (FP) and identify factors that predict their decisions.

**Methods:** This is a two-year prospective study with 107 childless women aged 30–37. Women filled an *online* survey assessing individual factors, intentions to do FP, variables of the health belief model, FP decisional stage and FP behaviour.

**Results:** Women's intentions, desire and number of children wanted decreased, fertility knowledge and perceived susceptibility to infertility increased and perceived severity of infertility decreased. A low number of women progressed through the stages of the decision-making process. Only 14% reached a decision and all decided not to do FP. Women's baseline intentions to do FP predicted their decision.

**Conclusion:** Women at the optimal age range to do FP (28–35 years) do not engage in decision-making about it, which reflects their initial low intentions to do FP. Women's decision about FP is influenced by their perceptions about the technique.

**Practical implications:** Women with a high desire for parenthood and within the optimal age range to do FP should receive accurate information about it and could benefit from prompts to engage in active decision-making about doing it.

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## 1. Introduction

In England and Wales, the percentage of women who had children between 35 and 39 years old increased by 115.1% from 1990 to 2016, while for women aged 40 years and over increased by 200.0% [1]. The desire to reach personal, professional and economic stability is the main reason why women are postponing parenthood [2–6]. However, fertility declines with age, compromising women's ability to have children. In 2016, the UK average age at first birth was 29 [7], the age at which fertility starts to decline [8].

Fertility preservation (FP) is a reproductive technique that allows the cryopreservation of gametes (oocytes) and provides the opportunity to have genetic offspring later, by undergoing In Vitro Fertilization (IVF) [2,9]. Research suggests that the age range to harvest ones' oocytes that maximises chances of success is between

28 and 35 years [10,11], but women can choose to cryopreserve at later ages, according to their personal circumstances [10].

In the UK, the number of women doing FP increased from less than 100 in 2001 to 816 in 2014 (representing annual increases of 25–30%) [12]. However, according to research and data from the HFEA, one third of the women who cryopreserve their oocytes do it after the age of 37 [12], and on average at 38 years [13,14]. In 2016, the birth rate per embryo transfer for IVF treatment cycle using cryopreserved oocytes up to 37 years was 15–21%, and after this age was 6–10% [15]. Briefly, FP is currently being used at an age that undermines its success potential, which may result in undesired childlessness and low well-being [16].

According to the health belief model (HBM) [17,18], women's intentions to do FP depend on the perceived barriers to and benefits of doing it, their perceived susceptibility to infertility and how severe they evaluate its consequences. Specific cues to action may prompt women to consider FP or not, as exceeding their expected age to have their first biological child or trying to/achieving pregnancy, respectively. Women's FP perceptions are influenced by their background characteristics, as age or fertility knowledge [17], and their decision to do FP is directly predicted by

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their intentions. Research has been showing that the HBM is suitable to predict their decision. For instance, several perceived barriers have been identified, as financial constraints [6] (UK NHS does not support FP to prevent age-related fertility decline and the average cost is around £3,350 [15]), time commitment needed to undergo the procedures, and concerns about the technique [6] (FP was labelled as an experimental procedure until 2013 [19]). Perceived benefits associated with doing FP are ensuring one's future fertility and having more time to find a suitable partner [20,21]. In addition, women's lack of fertility knowledge (e.g., overestimation of the fertility life-span/ART success rates) seems to be associated with overly optimistic parenthood goals [4,20,22], low susceptibility to infertility [20] and delayed parenthood decision-making [4,22], including about doing FP [3,6,20].

According to the transtheoretical model (TTM) [23,24] women will progress through five stages that reflect increasing readiness to engage in FP decision-making: pre-contemplation, contemplation, preparation, action and maintenance. These stages reflect the progress of making a choice regarding FP and imply an increasing receptivity to reflect on different factors (e.g., barriers/benefits, as proposed in the HBM) that will influence the final decision [25]. As women engage more with decision-making (i.e., progress through the stages) they perform different practical steps (e.g., discuss FP with others or seek out information/specialised advice) to collect what they perceive can be useful information to inform their choice via shaping the HBM factors. Fertility research indicates that only a minority (4%) of the women who consider FP as a future option [26], actually do it (31.5–34.5%) [27,28], and the period from the moment they report an intention until they do FP takes on average two years [26]. The majority (72.3–79.0%) who have undergone FP, regret not have done it at an earlier age [3,21]. These results seem to suggest that FP decision-making process unfolds over time and that women's initial intentions have a low predictive power on their final decision to do FP.

In short, understanding FP decision-making implies understanding how women form their intentions to do FP and how these intentions evolve over time to shape their actual decision-making. This is the major goal of the present study.

In 2014, an *online* survey [11] was conducted to better understand how childless women, aged 28–35 years, form their intentions to do FP. The findings showed that women who expected to have children at a later age, perceived themselves as more susceptible to infertility, considered its implications as more severe, perceived the technique as more useful and had lower ethical concerns, were more likely to intend to do FP. Overall, these findings support the explanatory power of the HBM, however, women's intentions to do FP were overall low, indicating that most women did not consider FP as an option to achieve parenthood.

The present study is a two-year follow-up of the *online* survey. The specific goals were to (1) investigate changes over time in women's parenthood goals, (2) investigate changes over time in their intentions to do FP and the variables of the HBM used to predict these intentions, (3) describe changes in the TTM stages of women's decision-making process, and (4) test the HBM explanatory power to predict women's decision about doing FP.

## 2. Material and methods

### 2.1. Participants

257 women participated in the initial survey [11]. Inclusion criteria were being childless and at the optimal FP age range (28–35 years), having a child-wish and not being pregnant or trying to conceive. Additional criteria were nor them nor their partner having a disease/condition affecting fertility and having not undergone FP. From these, 214 consented to be contacted for future research.

### 2.2. Materials

This was a two-year follow-up study with two assessment moments. In the baseline study (Time 1, T1), the survey was organised in four sections and assessed women's individual factors, their intentions to do FP, the HBM variables expected to directly influence their intentions and the decisional stage that women were at concerning doing FP. The two-year follow-up (Time 2, T2) re-assessed all these variables, adding women's behaviour towards FP.

#### 2.2.1. Individual factors

**2.2.1.1. Socio-demographic variables.** At T1, participants were asked about their age, whether they were in a relationship, for how long and if they were living together, their sexual orientation, employment status, level of education and country of residence. At T2, the same variables were re-assessed, except women's age, and women were also asked whether they had biological children, were currently pregnant, and were trying to conceive.

**2.2.1.2. Parenthood goals.** At T1, participants were asked about how strong their desire to have a child was (from 1=*not desire at all* to 10=*very strong desire*), if they intended to have biological children in the future (from 1=*not at all* to 7=*very much*), the number of children (in total) they wanted to have and the age they intended and expected to have their first and last child. The exact same variables were re-assessed at T2.

**2.2.1.3. Fertility Knowledge.** At T1, participants were asked three general fertility knowledge (e.g., "A women is less fertile after the age of 36 years") and three specific FP knowledge (e.g., "The ideal age to freeze eggs is after the age of 35 years") questions [29,30]. The exact same questions were posed at T2. Correct answers were summed into a score varying from one to three, higher values indicating higher knowledge.

#### 2.2.2. Intentions to do FP

At T1, participants were asked about their intentions to do FP within the next two years and at some point in the future (from 1=*strongly disagree* to 7=*strongly agree*). The second question was re-assessed at T2. Higher values indicate stronger intentions to do FP.

#### 2.2.3. Health belief model variables

At T1, the HBM variables were perceived barriers (ethical concerns) assessed with three statements (e.g., "FP is morally and ethically wrong", Cronbach's  $\alpha = .69$ ) and perceived benefits (usefulness) assessed with three statements (e.g., "FP reduces the pressure for me to have children";  $\alpha = .55$ ), all from 1=*disagree* to 7=*agree* [31,32]; perceived susceptibility, assessed with four questions (e.g., "How likely do you think you currently are to be biologically infertile?", from 1=*extremely unlikely* to 7=*extremely likely*;  $\alpha = .92$ ) [31]; perceived severity, assessed with three questions (e.g., I can accept a life without biological children, from 1=*strongly disagree* to 7=*strongly agree*;  $\alpha = .71$ ); and a cue to action, assessed with one question: "At what age do you expect to have your first biological children?". The exact same questions were re-assessed at T2. Higher values indicate higher perceived barriers, benefits, susceptibility and severity.

#### 2.2.4. Fertility preservation decisional stage and behaviour

**2.2.4.1. FP decisional stage.** At T1, women's decisional stage was assessed with the stage of decision-making questionnaire [25], which assesses individuals' readiness to engage in decision-making about a particular behavioural decision, but does not assess actual

behavioural implementation of the decision. At T2, the exact same question was used. Additionally, women who indicated having reached a decision (last two stages) were asked about their decision: 'I decided not to freeze my eggs; I decided to freeze my eggs'.

At T2, a list of practical steps was presented, designed to measure women's behavioural engagement, regarding the first three TTM decisional stages. The pre-contemplation stage does not presuppose any behavioural steps; the contemplation stage presupposes the discussion of egg freezing with others (e.g., friends) and actively seeking out information or opinions about FP (e.g., consulting fertility clinic websites); and the preparation stage presupposes seeking specialised advice from fertility clinics (e.g., booking an initial consultation). Women were also asked about their satisfaction with the information available on three of the information sources above, when applied (from 1=*extremely dissatisfied* to 7=*extremely satisfied*).

**2.2.4.2. FP behaviour.** At T2, participants were asked about their actual behaviour "At what stage in the egg freezing process are you? I have not yet started the process to freeze my eggs; I have started the process to freeze my eggs; I have frozen my eggs".

### 2.3. Procedures

The Ethics Committee of the School of Psychology of Cardiff University approved the study. An email with an invitation letter and a link to the *online* survey was sent to the 214 women. The survey was posted *online* using Qualtrics software [33] from the 28<sup>th</sup> of July until the 14<sup>th</sup> of October of 2016.

### 2.4. Data analysis

The Statistical Package for the Social Sciences, version 24.0, and the R program, version 3.5.2, with recourse to the lavaan package (used to estimate Structural Equation Models; SEM), version 0.6-3, [34] were used for statistical analyses.

To describe our sample, differences in sociodemographic characteristics were assessed among women that did the follow-up survey, from T1 to T2 (McNemar's, paired-sample *t*-tests).

To investigate changes from T1 to T2 in parenthood goals, intentions to do FP and the HBM variables, one-way repeated measures ANOVAs were used. For the stages of decision-making, frequencies of affirmative answers (*n*, %), means and standard deviations were reported and a paired-sample *t*-test was performed. These analyses included all women in the sample regardless of they had achieved parenthood or not within the follow-up period, because FP can be performed by childless, primiparas and multiparas women.

In order to test the HBM explanatory power to predict women's FP decision-making, path analyses were computed using SEM. The model included four predicting variables: all the theoretical relevant variables at T1 (individuals factors that were significantly associated with at least one variable of the HBM in univariate correlations); the mediating variables: HBM variables and the intentions to do FP within two years (at T1) and the outcome: having reached a decision (do or not do FP) at T2. In addition, the following variable was also controlled: trying or having reached parenthood at T2 (currently trying to conceive or currently pregnant/having children). In line with previous evidence, women's decision was also directly predicted by perceived benefits and barriers [35]. Because the main outcome of the model was a dichotomous variable, the Weighted Least Squares Means and Variance adjusted estimation method was used, which is mostly used with categorical endogenous variables [36]. Model fitness was considered very good when the chi-square ( $\chi^2$ ) was not significant, Comparative Fit Index (CFI) >.95, Tucker-Lewis Index (TLI) >.95 and Root Mean Square Error of Approximation (RMSEA) <.07 [37,38].

## 3. Results

### 3.1. Participants

The final sample consisted of 107 women. From the 214 women, 115 filled out the questionnaire (53.74% response rate), but eight were excluded because they did not complete the main behavioural outcome variable.

Women who filled (*n* = 107) and did not filled (*n* = 150) the T2 survey did not differ in their socio-demographics and parenthood goals. The exception was sexual orientation, with less lesbians (*n* = 5, 3.33%; *n* = 0, 0.00%) and bisexual (*n* = 13, 8.67%; *n* = 4, 3.74%) and more heterosexual (*n* = 132, 88.00%; *n* = 103, 96.26%) women participating in the follow-up (Fisher's exact test, *p* < .05).

Table A1 presents the socio-demographic characteristics of the sample. At T2 women were on average 32 years old, the majority were living with their partner for more than five years, were heterosexual, employed, had university education and were resident in the UK. 16% of the women had reached parenthood and 7% were trying to conceive. In the time frame of two years, women's relationship duration and the number of women that were living with their partner increased significantly and more women were employed and resided in the UK.

### 3.2. Changes in women's parenthood goals

Table A2 presents the women's parenthood goals. At T2 all women had a considerable desire and intention to have children, although these decreased significantly over time. The number of children wanted also decreased significantly, but no up or downwards adjustment was observed on the ages that women intended/expected to have their first/last children.

### 3.3. Changes in women's intentions to do FP and the variables of the HBM used to predict these intentions

Table A3 presents the variables of the decision-making theory. From T1 to T2, women's fertility/FP knowledge increased significantly. No changes over time were noted in their intentions to do FP. From T1 to T2, women maintained their ethical concerns about FP and their perceptions about its utility, and a statistically significant increase in perceived susceptibility to and decrease in perceived severity of infertility were observed.

### 3.4. Changes in women's stages of the decision-making process

Table A4 presents the women's decision-making stages and behaviour. Most women (*n* = 81, 77.14%) remained in the first two decisional stages. A low number of women progressed through the stages. Only 10 more women had reached a decision at T2, with a minority being willing to reconsider it (*n* = 3, 20.00%). All women who reached a decision decided not to undergo FP.

Table A5 presents the women's practical steps. Four in each 10 women had discussed FP, mostly with friends and partner. Three in each 10 women had actively sought information about FP, in which google was the most used source followed by health information websites and *online* media outlets. Specialised sources were used to a less extent. Overall ratings of satisfaction with the information accessed were on average between four and five. Finally, only three women sought specialised advice.

### 3.5. HBM explanatory power to predict women's FP decision-making

The HBM SEM model tested is presented in Fig. A1. Only the statistically significant or marginally significant associations were reported (Supplementary Figure S1 presents the full figure). The

model showed a very good fit to the data,  $\chi^2(27, N = 101) = 24.81$ ,  $p = .59$ ; CFI = .99; TLI = 1.21; RMSEA = .00 (90% CI .00–.07). The model indicated that women with less ethical concerns ( $\beta = -.24$ ,  $p < .05$ ), who considered FP as more useful ( $\beta = .45$ ,  $p < .001$ ) and who tended to evaluate the consequences of infertility as more severe ( $\beta = .15$ ,  $p < .10$ ) were more likely to report higher intentions to do FP at T1. Women who reported lower intentions to do FP ( $\beta = -.33$ ,  $p < .05$ ) were more likely to have decided not to do it two years later. Older women ( $\beta = .34$ ,  $p < .01$ ), in a relationship and living together ( $\beta = .46$ ,  $p < .01$ ) and who reported stronger intentions to have biological children ( $\beta = .42$ ,  $p < .01$ ) at T1, were more likely to be trying to or having reached parenthood at T2.

## 4. Discussion and conclusion

### 4.1. Discussion

Results show that women do not actively engage in the decision-making process about FP, which remains an open option for the future. Over two-years, a minority of the women, who at baseline were within the optimal FP age range, engaged in decision-making, with only 14% reaching a decision, all of which deciding not to do FP. Women's lack of engagement reflect their initial low intentions to do FP (which remained unchanged) and the decision to do it is more related with women's perceptions about the technique than about their fertility. An overall downward revision of parenthood goals may have predisposed women even less to engage in FP decision-making.

The majority of women (77%) did not engage in the process of decision-making, remaining in the pre-contemplation stage. According to the TTM searching for information is one of the first behavioural steps in decision-making. In our sample, almost half of the women looked for information, however, they mostly accessed general sources (social network and internet), which may not be accurate or target the relevant factors (e.g., FP barriers and benefits) [39,40] that enable women to make informed decisions [3,6]. Only a minority of the women (less than 7%) consulted with their GP or sought specialised advice. Overall, it could be argued that women's information seeking strategy was superficial. Indeed, although their knowledge about fertility/FP increased and 93% were aware that cryopreserving does not mean success, 61% did not know that they had to undergo hormonal stimulation to collect oocytes and 28% thought that the ideal age to do it was after 35 years (data not shown).

Women's lack of engagement with FP decision-making seems to reflect an unwillingness to consider the technique all together. Intentions to do FP remained low across the two-year period. Such intentions are mainly shaped by views of the technique and although the women do not seem to have concerns about FP, they also do not perceive the technique to be particularly useful. Research shows that women find FP useful because it buys them time to have children later, when they have met the preconditions for parenthood [e.g., 4]. The women in our sample are highly educated, 63% live with their partner and 82% are employed. This indicates that they may already perceive to have met the preconditions for parenthood, and indeed around 22% were trying/had achieved parenthood. Nonetheless, the remaining 78% were not trying to have children neither engaging in the decision to do FP. This may be related with a downgrade of their parenthood goals. Being older and having better fertility knowledge might have led women to perceive themselves as more susceptible to infertility and therefore revise down their parenthood goals. This hypothesis is in accordance with previous research that showed that one of the reasons leading to parenthood postponement is the accommodation to the possibility of not having or having less children than desired [41–44].

However, it needs to be noted that changes in parenthood goals were averaged across the total sample. Previous research says that

women who achieve parenthood report higher intentions and desire to have more children (e.g., [45]). These assumption were tested post hoc by investigating changes over time in the parenthood goals and HBM variables of these two groups (childless; pregnant or with children), using a mixed ANOVA (Supplementary Tables S1 and S2). The only significant interaction showed that women's susceptibility to infertility increased over time for childless women. The results support the idea that, regardless of having children or not, women revise down their parenthood goals as they get older.

Fourteen percent of the women made a decision about doing FP and all decided not to do it. Results from the SEM analysis suggest that women's decision-making is not or is less influenced by their parenthood seeking behaviour at the time (trying/having achieved parenthood) than by their FP baseline intentions. It also suggests that decisions about FP are more strongly related with women's perceptions about the technique than about their fertility, although perceived severity does play a role. Despite the fact that the HBM does not capture the dynamics in parenting decision-making over time, it seems logic that if women have stable concerns about FP and beliefs that it is not very useful and feel less threatened by infertility/childlessness, then they will not report more intentions to do FP over time and will also be more likely to decide not to do it. These results do not corroborate the literature that suggests that women's intentions to do FP have a low predictive power on their decision [26]. One the one hand, this could be due to the characteristics of the sample. This sample included any childless women with a child-wish and at the optimal age range to do FP (not especially interested in FP and, in fact, reporting low baseline intentions to do it). On the other hand, might be due to the outcome variable. Sage et al. [26] studied the behaviour (do it; do not do it) and not the decision-making, and they did not also established a causality relation, women could have not done FP by other factors that were not considered (e.g., decreased their intentions over time, by progressing in the decision-making process).

In sum, across a two-year time span, childless women who desire to have children do not actively engage with FP decision making, and those who do, decide not to do it. This seems to reflect, on the one side, a perceived sense of readiness to have children in the present and therefore the absence of need to postpone parenthood and, on the other sense, a move towards disengaging from having (more) children. These seem plausible explanations for our results, but do not explain the current trend of women doing FP later in life, around the age of 38 [e.g., 14]. Two hypotheses can be proposed to explain this discrepancy with current knowledge. First, women still have a moderate to high desire to have children, and 86% of them still consider FP as an open option for the future. According to the Motivational Theory of Life-Span Development [46], when women get closer to their biological deadline (i.e. menopause) they become more engaged in achieving their desired goal. Therefore, women may at this point do FP as an engagement strategy or a way to delay their biological deadline [21]. Second, as the HBM results suggest, the observed late decision about FP may reflect the decision-making of a subgroup of women in the sample who have high desire for children and positive perceptions of FP, but will not achieve their preconditions to have children (e.g., lack of a suitable partner) as they become older.

This study is timely given the increasing use of FP and the need to understand how women make decisions about it. It is theoretical-driven, using decision-making theories that have been proved useful to explain an array of health behaviours and capturing decision-making as it unfolds. Half of the initial sample replied to this follow-up and there was no indication of participation bias. However, women's spontaneous FP decision-making may have been affected by their participation in the baseline survey, which may have acted as a cue to action to consider FP. Additionally, women in this sample were highly educated, which may have led to an overestimation of



their fertility knowledge, and the small sample size may have resulted in low power to detect weak correlations.

Future research should focus on better clarifying the current discrepancy between our findings and trends of late observed use of the technique. Two years is a limited time to capture reproductive decision-making and it would be interesting to study FP decision-making within a wider time-frame and as women approach their reproductive deadline. The TTM steps presupposed in this study were useful to describe women’s movement through the stages of the decision-making process and it may be worth using again.

4.2. Conclusion

FP is a relatively new technique that allows women to cryopreserve their oocytes for later use. Many childless women, with a child-wish and at the optimal FP age range, are not actively engaging in decision-making about doing it, remaining an open option for the future. More emphasis should be put in presenting FP as a preventive option that requires cryopreserving oocytes while women are still fertile, as well as highlighting that, as with all reproductive techniques, its effectiveness decreases as women age. As decisions about using FP are strongly influenced by views of the technique, it is important to provide clear and correct information, for instance, on which medical procedures women have to undergo, their side effects and risks, on success rates within different age groups, among others.

4.3. Practical implications

This study highlights that women with a high desire for parenthood and at the optimal FP age range are not considering this option. Many valid reasons are suggested. However, considering the observed lack of knowledge about fundamental aspects of FP, the lack of decisional engagement in our sample, the evidence that many women do FP at an age that does not maximise its benefits [13,14], and finally, the negative impact of undesired

childlessness [16], it is important to ensure that women have access to accurate information about FP at an age where they can still maximise its potential. Many women consult their GP to discuss parenthood plans or reproductive health more generally and this constitutes a good opportunity to introduce the topic. At the minimum GPs should introduce and explain the technique (medical procedures, side-effects, risks), present its success rates per year of age, and provide contacts or information sources that women may choose to access if they wish to consider FP in more depth. Fertility charities and scientific societies in the UK have advocated that fertility education (i.e., accurate information about fertility and reproductive choices) should be an integral part of comprehensive sex and relationships education (SRE) in schools, so that men and women are empowered to make realistic and well-informed reproductive choices and less likely to inadvertently miss their reproductive chance [47]. This implies prompting them to advance beyond the contemplative stage of decision-making about parenthood and, more specifically, their preferred reproductive options, which may or may not include FP. Therefore, it seems logical to include FP in such educational campaigns. As all assisted reproductive methods, FP success rates are generally low and highly dependent on women’s age [15]. It is therefore important for young women to be well-informed about this and other aspects of FP when considering their reproductive choices, and in particular if they are contemplating delaying parenthood.

Declarations of interest

None.

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Appendix A

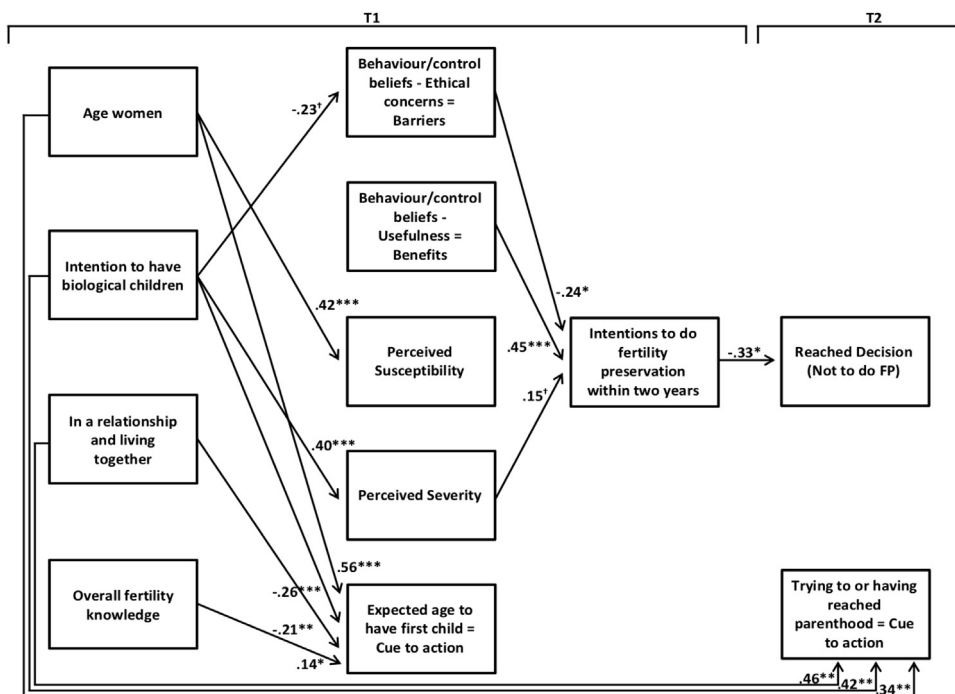


Fig. A1. Final structural equation modeling for the Health Belief Model:  $\chi^2 (27, N = 101) = 24.81, p = .59; CFI = .99; TLI = 1.21; RMSEA = .00 (90\% CI .00-.07)$ . Black represent significant ( $p < .05$ ) or marginally significant ( $p < .10$ ) standardized regression weights. † $p < .10$ ; \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

**Table A1**  
Sociodemographic characteristics (N = 107).

Sociodemographics	Time 1	Time 2	$\chi^2$ / <sup>c</sup> paired-t
Age (years) <i>M</i> ( <i>SD</i> )	30.36 (2.22)	32.36 (2.22)	
In a relationship <i>n</i> (%)	78 (72.90)	87 (81.31)	28.56***
Duration of relationship, in years <i>M</i> ( <i>SD</i> )	4.55 (3.70)	5.62 (4.21)	-6.70***
Living together <i>n</i> (%)	51 (65.38)	67 (77.01)	9.32**
Sexual orientation			
Heterosexual <i>n</i> (%)	103 (96.26)	99 (92.52)	51.42
Lesbian <i>n</i> (%)	0 (0.00)	0 (0.00)	
Bisexual <i>n</i> (%)	4 (3.74)	8 (7.48)	
Employed <i>n</i> (%)	73 (68.22)	88 (82.24)	10.50**
University education <i>n</i> (%)	102 (95.33)	103 (96.26)	84.77
UK-resident <sup>b</sup> <i>n</i> (%)	74 (89.16)	81 (83.51)	39.02 <sup>c</sup>
Have biological children or currently pregnant <sup>a</sup> <i>n</i> (%)		17 (15.89)	
Have foster or adopted children <sup>a</sup> <i>n</i> (%)		0 (0.00)	
Trying to conceive <sup>a</sup> <i>n</i> (%)		7 (6.54)	

Note. *M* = Mean; *SD* = Standard deviation.

<sup>a</sup> Exclusion criteria at Time 1.

<sup>b</sup> valid answers (some participants did not report on their residence) <sup>c</sup>McNemar's test was used.

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ .

**Table A2**  
Parenthood Goals (N = 107).

Parenthood goals	Time 1		Time 2		<i>F</i>	$\eta_p^2$
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Desire to have a child	7.22	2.16	6.50	2.73	9.16**	0.08
Intention to have biological children	5.94	1.20	5.25	1.73	20.68***	0.17
Number of children wanted (in total)	2.04	0.53	1.87	0.63	7.58*	0.07
Age to have first biological child, in years - intend <sup>a</sup>	33.10	3.10	33.79	4.65	2.21	0.03
Age to have first biological child, in years - expect <sup>a</sup>	34.63	2.64	35.18	4.56	2.27	0.03
Age to have last biological child, in years - intend	36.34	3.00	36.30	5.67	0.15	0.00
Age to have last biological child, in years - expect	37.48	2.82	36.90	5.87	1.00	0.01

Note. *M* = Mean; *SD* = Standard Deviation.

<sup>a</sup> Women that achieved parenthood (had children or currently pregnant) were excluded.

\*\*  $p < .01$ ; \*\*\*  $p < .001$ .

**Table A3**  
Variables of the Decision-Making Theory (N = 107).

Decision-making variables	Time 1		Time 2		<i>F</i>	$\eta_p^2$
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Knowledge						
Fertility	1.08	0.27	1.85	0.77	92.21***	0.47
Fertility preservation	1.08	0.27	2.04	0.81	122.91***	0.54
Intentions						
Intend to freeze their eggs at some point in the future	2.76	1.48	2.98	1.38	0.07	0.00
Health belief model						
Behaviour/control beliefs - ethical concerns = barriers	2.33	1.25	2.21	1.19	0.76	0.01
Behaviour/control beliefs - usefulness = benefits	4.37	1.31	4.43	1.19	0.25	0.00
Perceived susceptibility	2.94	1.15	3.31	1.21	9.78**	0.08
Perceived severity	3.58	1.49	3.19	1.48	10.06**	0.09
Expected age to have first child = cue to action <sup>a</sup>	34.63	2.64	35.18	4.56	2.27	0.03

Note. *M* = Mean; *SD* = Standard Deviation.

<sup>a</sup> Women that achieved parenthood (had children or currently pregnant) were excluded.

\*\*  $p < .01$ ; \*\*\*  $p < .001$ .

**Table A4**  
Women's Decision-Making Process and Behaviour toward Fertility Preservation (N = 107).

Decision-making process and behaviour	Time 1		Time 2 <sup>a</sup>		paired-t
	<i>n</i>	%	<i>n</i>	%	
Fertility preservation decisional stage					-2.23 <sup>c</sup>
Have not begun to think about the choices	60	56.07	56	53.33	
Have not begun to think about the choices, but was interested in doing so	33	30.84	25	23.81	
Was considering the option	8	7.48	9	8.57	
Was close to selecting an option	1	0.93	0	0.00	
Have already made a decision, but was willing to consider	2	1.87	3	2.86	
Have already made a decision and was unlikely to change her mind	3	2.80	12	11.43	

**Table A4** (Continued)

	Time 1		Time 2 <sup>a</sup>		paired- <i>t</i>
	<i>n</i>	%	<i>n</i>	%	
Decision-making process and behaviour					
Fertility preservation decision					
Decided not to freeze their eggs			15	100.00	
Decided to freeze their eggs			0	0.00	
Fertility preservation behaviour					
Have not yet started the process of freezing their eggs			105	100.00	
Have initiated the process of freezing their eggs			0	0.00	
Have frozen their eggs			0	0.00	

Note. <sup>a</sup>two participants did not report on their behaviour.

<sup>\*</sup> *p* < .05.

**Table A5**

Practical Steps, According to the First Three Decisional Stages of the Transtheoretical Model (N = 107).

Practical steps	<i>n</i>	%
Discuss egg freezing	44	41.12
Friends	27	25.23
Your partner <sup>a</sup>	19	18.10
Family	12	11.21
Your GP <sup>a</sup>	3	2.86
Other <sup>a</sup>	0	0.00
Actively seek out information or opinions <sup>a</sup>	32	30.19
Google <sup>a</sup>	21	19.81
Health information websites <sup>a</sup>	17	16.04
Online media outlets (e.g., BBC websites) <sup>a</sup>	10	9.43
Academic sources <sup>a</sup>	7	6.66
Fertility clinic websites <sup>a</sup>	7	6.60
Fertility forums <sup>a</sup>	3	2.86
Other (e.g., spoke with friends that donated their eggs and university's webpage) <sup>a</sup>	2	2.38
Satisfaction with the information available [scale 1-7]	<i>M</i> ( <i>SD</i> ) [range]	
Health information websites	4.75 (1.36) [2,3,4,5,6,7]	
Fertility clinic websites	4.47 (0.87) [3,4,5,6]	
Fertility forums	4.27 (0.79) [3,4,5,6]	
	<i>n</i>	%
Seek specialised advice from fertility clinics	3	2.80
Booking an initial consultation	2	1.87
Making an online enquiry	1	0.93
Requesting a brochure or other written information	1	0.93
Making an enquiry by telephone	1	0.93
Booking further consultations	1	0.93
Other <sup>a</sup>	0	0.00

Note. *M* = Mean; *SD* = Standard Deviation; GP = General Practitioner.

<sup>a</sup> valid answers (some participants did not report on their behaviour).

## Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.pec.2019.03.019>.

## References

- [1] Births in England and Wales, Office for National Statistics, 2016. 2017 <http://www.ons.gov.uk>.
- [2] A.P. Cil, L. Turkgeldi, E. Seli, Oocyte cryopreservation as a preventive measure for age-related fertility loss, *Semin. Reprod. Med.* 33 (2015) 429–435, doi:<http://dx.doi.org/10.1055/s-0035-1567819>.
- [3] B. Hodes-Wertz, S. Druckenmiller, M. Smith, N. Noyes, What do reproductive-age women who undergo oocyte cryopreservation think about the process as a means to preserve fertility? *Fertil. Steril.* 100 (2013) 1343–1349, doi:<http://dx.doi.org/10.1016/j.fertnstert.2013.07.201>.
- [4] L.L. Mortensen, H.K. Hegaard, A.N. Andersen, J.G. Bentzen, Attitudes towards motherhood and fertility awareness among 20–40-year-old female healthcare professionals, *Eur. J. Contracept. Reprod. Health Care* 17 (2012) 468–481, doi:<http://dx.doi.org/10.3109/13625187.2012.728015>.
- [5] T. Tydén, A.S. Svanberg, P.O. Karlström, L. Lihoff, C. Lampic, Female university students' attitudes to future motherhood and their understanding about fertility, *Eur. J. Contracept. Reprod. Health Care* 11 (2006) 181–189, doi:<http://dx.doi.org/10.1080/13625180600557803>.
- [6] E.A. Will, B.S. Maslow, L. Kaye, J. Nulsen, Increasing awareness of age-related fertility and elective fertility preservation among medical students and house staff: a pre- and post-intervention analysis, *Fertil. Steril.* 107 (2017) 1200–1205, doi:<http://dx.doi.org/10.1016/j.fertnstert.2017.03.008>.
- [7] Births by Parents' Characteristics in England and Wales, Office for National Statistics, 2016. 2017 <https://www.ons.gov.uk>.
- [8] P.D. Sozou, G.M. Hartshorne, Time to pregnancy: a computational method for using the duration of non-conception for predicting conception, *PLoS One* 7 (2012)e46544, doi:<http://dx.doi.org/10.1371/journal.pone.0046544>.
- [9] C.E. Argyle, J.C. Harper, M.C. Davies, Oocyte cryopreservation: where are we now? *Hum. Reprod. Update* 22 (2016) 440–449, doi:<http://dx.doi.org/10.1093/humupd/dmw007>.
- [10] A.P. Cil, H. Bang, K. Oktay, Age-specific probability of live birth with oocyte cryopreservation: an individual patient data meta-analysis, *Fertil. Steril.* 100 (2013) 492–499, doi:<http://dx.doi.org/10.1016/j.fertnstert.2013.04.023>.
- [11] A. ter Keurst, J. Boivin, S. Gameiro, Women's intentions to use fertility preservation to prevent age-related fertility decline, *Reprod. Biomed. Online* 32 (2016) 121–131, doi:<http://dx.doi.org/10.1016/j.rbmo.2015.10.007>.
- [12] Fertility Treatment 2014. Trends and Figure, Human Fertilisation & Embryology Authority [HFEA], 2016. <https://www.hfea.gov.uk/>.
- [13] E. Gold, K. Copperman, G. Witkin, C. Jones, A.B. Copperman, A motivational assessment of women undergoing elective egg freezing for fertility preservation, *Fertil. Steril.* 86 (2006) S201, doi:<http://dx.doi.org/10.1016/j.fertnstert.2006.07.537> P-187.
- [14] D.P. Nekkebroeck, J. D. Stoop, A preliminary profile of women opting for oocyte cryopreservation for non-medical reasons, *Hum. Reprod.* 25 (2010) i15–i16, doi:<http://dx.doi.org/10.1093/humrep/de.25.s1.7>.
- [15] Egg Freezing in Fertility Treatment. Trends and Figures: 2010–2016, Human Fertilisation & Embryology Authority [HFEA], 2018. <https://www.hfea.gov.uk/>.
- [16] S. Gameiro, A. Finnigan, Long-term adjustment to unmet parenthood goals following ART: a systematic review and meta-analysis, *Hum. Reprod. Update* 23 (2017) 322–337, doi:<http://dx.doi.org/10.1093/humupd/dmx001>.
- [17] I.M. Rosenstock, Historical origins of the health belief model, *Health Educ. Monogr.* 2 (1974) 328–335.

- [18] D.F. Ragin, Theories and models of health behavior change, in: D.F. Ragin (Ed.), *Health Psychology: An Interdisciplinary Approach to Health Psychol*, first ed., Pearson Education, Boston, 2011, pp. 110–114.
- [19] American Society for Reproductive Medicine, Society for Assisted Reproductive Technology, mature oocyte cryopreservation: a guideline, *Fertil. Steril.* 99 (2013) 37–43, doi:http://dx.doi.org/10.1016/j.fertnstert.2012.09.028.
- [20] M. de Groot, E. Dancet, S. Repping, M. Goddijn, D. Stoop, F. van der Veen, T. Gerrits, Perceptions of oocyte banking from women intending to circumvent age-related fertility decline, *Acta Obstet. Gynecol. Scand. Suppl.* 95 (2016) 1396–1401, doi:http://dx.doi.org/10.1111/aogs.13019.
- [21] D. Stoop, E. Maes, N.P. Polyzos, G. Verheyen, H. Tournaye, J. Nekkebroeck, Does oocyte banking for anticipated gamete exhaustion influence future relational and reproductive choices? A follow-up of bankers and non-bankers, *Hum. Reprod.* 30 (2015) 338–344, doi:http://dx.doi.org/10.1093/humrep/deu317.
- [22] C. Lampic, A.S. Svanberg, P. Karlström, T. Tydén, Fertility awareness, intentions concerning childbearing, and attitudes towards parenthood among female and male academics, *Hum. Reprod.* 21 (2006) 558–564, doi:http://dx.doi.org/10.1093/humrep/dei367.
- [23] J.O. Prochaska, C.C. DiClemente, J.C. Norcross, In search of how people change. Applications to addictive behaviors, *Am. Psychol.* 47 (1992) 1102–1114.
- [24] J.M. Prochaska, J.O. Prochaska, A stage approach to enhancing adherence to treatment, in: D.I. Mostofsky (Ed.), *The Handbook of Behavioral Medicine*, John Wiley & Sons Inc., Hoboken, New Jersey, 2014, pp. 58–75.
- [25] A. O'Connor, *User Manual - Stage Decision Making*, (2000). [https://decisionaid.ohri.ca/docs/develop/user\\_manuals/um\\_stage\\_decision\\_making.pdf](https://decisionaid.ohri.ca/docs/develop/user_manuals/um_stage_decision_making.pdf).
- [26] C.F.F. Sage, B.A. Kolb, S.L. Treiser, K.M. Silverberg, J. Barritt, A.B. Copperman, Oocyte cryopreservation in women seeking elective fertility preservation: a multi-center analysis, *Obstet. Gynecol.* 111 (2008) 205.
- [27] J.C. Daniluk, E. Koert, Childless Canadian men's and women's childbearing intentions, attitudes towards and willingness to use assisted human reproduction, *Hum. Reprod.* 27 (2012) 2405–2412, doi:http://dx.doi.org/10.1093/humrep/des190.
- [28] D. Stoop, J. Nekkebroeck, P. Devroey, A survey on the intentions and attitudes towards oocyte cryopreservation for non-medical reasons among women of reproductive age, *Hum. Reprod.* 26 (2011) 655–661, doi:http://dx.doi.org/10.1093/humrep/deq367.
- [29] L. Bunting, I. Tsibulsky, J. Boivin, Fertility knowledge and beliefs about fertility treatment: findings from the International Fertility Decision-making Study, *Hum. Reprod.* 28 (2013) 385–397, doi:http://dx.doi.org/10.1093/humrep/des402.
- [30] J.C. Daniluk, E. Koert, A. Cheung, Childless women's knowledge of fertility and assisted human reproduction: identifying the gaps, *Fertil. Steril.* 97 (2012) 420–426, doi:http://dx.doi.org/10.1016/j.fertnstert.2011.11.046.
- [31] B. Fulford, L. Bunting, I. Tsibulsky, J. Boivin, The role of knowledge and perceived susceptibility in intentions to optimize fertility: findings from the International Fertility Decision-Making Study (IFDMS), *Hum. Reprod.* 28 (2013) 3253–3262, doi:http://dx.doi.org/10.1093/humrep/det373.
- [32] B. Fulford, The Role of Health-Related Cognitions in Willingness to Optimise Health in the Fertility Context, Cardiff University, 2019 (unpublished results).
- [33] Qualtrics, Qualtrics, (2016) .
- [34] Y. Rosseel, Lavaan: an R package for structural equation modeling, *J. Stat. Softw.* 48 (2012) 1–36, doi:http://dx.doi.org/10.18637/jss.v048.i02.
- [35] C.J. Carpenter, A meta-analysis of the effectiveness of health belief model variables in predicting behavior, *Health Commun.* 25 (2010) 661–669, doi:http://dx.doi.org/10.1080/10410236.2010.521906.
- [36] Y. Rosseel, The Lavaan Tutorial, Department of Data Analysis, Ghent University, Belgium, 2018.
- [37] D. Hooper, J. Coughlan, M.R. Mullen, Structural equation modelling: guidelines for determining model fit, *Electron. J. Bus. Res. Methods.* 6 (2008) 53–60.
- [38] R.B. Kline, *Principles and Practice of Structural Equation Modelling*, third ed., The Guildford Press, New York, 2005.
- [39] M.E. Abusief, M.D. Hornstein, T. Jain, Assessment of United States fertility clinic websites according to the American Society for Reproductive Medicine (ASRM)/Society for Assisted Reproductive Technology (SART) guidelines, *Fertil. Steril.* 87 (2007) 88–92, doi:http://dx.doi.org/10.1016/j.fertnstert.2006.05.073.
- [40] H. Mertes, G. Pennings, Social egg freezing: for better, not for worse, *Reprod. Biomed. Online* 23 (2011) 824–829, doi:http://dx.doi.org/10.1016/j.rbmo.2011.09.010.
- [41] A. Berrington, Perpetual postponers? Women's, men's and couple's fertility intentions and subsequent fertility behaviour, *Popul. Trends* 117 (2004) 9–19.
- [42] F. van Balen, Late parenthood among subfertile and fertile couples: motivations and educational goals, *Patient Educ. Couns.* 59 (2005) 276–282, doi:http://dx.doi.org/10.1016/j.pec.2004.09.002.
- [43] A.C. Liefbroer, Changes in family size intentions across young adulthood: a life-course perspective, *Eur. J. Popul.* 25 (2009) 363–386, doi:http://dx.doi.org/10.1007/s10680-008-9173-7.
- [44] E. Gray, A. Evans, A. Reimondos, Childbearing desires of childless men and women: when are goals adjusted? *Adv. Life Course Res.* 18 (2013) 141–149, doi:http://dx.doi.org/10.1016/j.alcr.2012.09.003.
- [45] Y. Stöbel-Richter, M.E. Beutel, C. Finck, E. Brähler, The 'wish to have a child', childlessness and infertility in Germany, *Hum. Reprod.* 20 (2005) 2850–2857, doi:http://dx.doi.org/10.1093/humrep/dei121.
- [46] J. Heckhausen, C. Wrosch, R. Schulz, A motivational theory of life-span development, *Psychol. Rev.* 117 (2010) 32–60, doi:http://dx.doi.org/10.1037/a0017668.
- [47] J. Harper, J. Boivin, H.C. O'Neill, K. Brian, J. Dhingra, G. Dugdale, G. Edwards, L. Emmerson, B. Grace, A. Hadley, L. Hamzic, J. Heathcote, J. Hepburn, L. Hoggart, F. Kisby, S. Mann, S. Norcross, L. Regan, S. Seenan, J. Stephenson, H. Walker, A. Balen, The need to improve fertility awareness, *Reprod. Biomed. Soc. Online* 8 (2017) 18–20, doi:http://dx.doi.org/10.1016/j.rbms.2017.03.002.