



Decision making processes of women who seek elective oocyte cryopreservation

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Abstract

Purpose The aim of this study is to analyze women's opinions and their decision making processes regarding elective oocyte cryopreservation (OC).

Methods One hundred twenty-four women who had elective OC counseling at the CHA Seoul Fertility Center were asked to complete a survey after their first visit. Data collection regarding age, marital status, monthly income, occupation, religion, reproductive history, questions about the participant's view on their own fecundity, and future parenthood were included. The modified Reproductive Concerns After Cancer scale and the Decisional Conflict Scale were used for analysis.

Results The participants' mean age was 37.1 ± 4.8 years old. Eighty-six percent of the participants had regular periods. Ninety-two percent thought it was important to have their own biological offspring, and 86% were willing to pursue OC. Forty-nine percent appeared to have high DCS scores regarding making a decision of OC. Sixty-eight percent pursued OC, and the mean number of oocytes cryopreserved per patient was 10.5 ± 8.3 . Multivariate analysis revealed that age was the only factor associated with high DCS scores ($P = 0.002$). Feeling less fertile than other women of same age and low DCS scores were the factors associated with pursuing OC ($P = 0.02$ and 0.004 , respectively) after adjusting for possible confounding factors, including age.

Conclusions Older women had more difficulties in making decisions about OC. Adjusting for age, women who thought that they were less fertile than other women of same age and those with lower decisional conflict were more likely to pursue OC. Further studies should focus on the validation of older women's decisional conflicts regarding OC.

Keywords Elective oocyte cryopreservation · Decision making · Conflict

Background

Over the past 10 years, advances in oocyte cryopreservation technique by vitrification procedure have led to a significant societal change in terms of women's reproductive choices. Based on the encouraging clinical outcomes

of oocyte vitrification [1, 2], the American Society of Reproductive Medicine (ASRM) removed the experimental classification of oocyte cryopreservation in 2012 [3], and now considers it a routine service offered to women. Accordingly, there has been increased awareness in elective oocyte cryopreservation [3] for the natural age-related infertility. In addition to the advances in technology of oocyte vitrification, the higher educational level of women, their increased entry into workforce, and the advanced age of women at marriage and child birth may play critical roles in their desire to ensure their fertility using oocyte vitrification, while of a younger age. According to the KOSTAT (Statistics Korea), the number of birth and live birth rate has been decreasing every year in South Korea, and it has been decreased by 11.9% since 2016 [4]. In addition, the average age of South Korean women at the first childbirth is 32.6 years, and the proportion of older women (> 35 years) is increasing continuously [4].

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Although clinical data support the technical efficacy of oocyte vitrification [5–13], there is no standard guideline for elective OC. Because elective OC is not a “treatment of a disease,” there are other factors which should be considered when a woman decides to pursue OC, such as the cost-effectiveness, ethical issues, and safety. Because health care-related decision making is subjective and value-laden [14], it is important to understand the decision making process regarding elective OC to help the individual make higher quality decisions [15]. Women’s reproductive concern and desire and their uncertainty about possible treatment options to ensure future fertility, may influence their decision making process [16–19]. The European Society for Human Reproduction and Embryology Task Force on Ethics and Law has recommended the need to collect data about the psychological aspects of fertility preservation for ovarian aging, including women’s motives for choosing the elective OC option [16]. Recently, several studies have investigated women’s opinions regarding OC [18, 20–23] and consistently reported that the majority of women have positive views about the procedure. A recent study investigating young women (< 35 years) evaluated factors associated the intentions of elective OC [22]. However, so far, no study has ever evaluated the decision-making process of women who seek for elective OC. With the increasing interest of women in elective OC, it is important to find out their views regarding the procedure and the factors that affect their decision making processes.

In this survey study, we aimed to objectively analyze the factors that affect women’s decision making about elective OC and their perspectives about age-related fertility decline and reproductive desire. In addition, we assessed the determinants of pursuing OC among women who were interested in it.

Materials and methods

Study design and study population

This study is a single-center cross-sectional survey study. One hundred and twenty-four women who had elective OC counseling at the CHA Seoul Fertility Center from February 2016 until November 2017 were asked to complete a survey after their first visit. Ninety-one women agreed and completed the survey (73% of response rate). Women who sought oocyte cryopreservation due to scheduled gonadotoxic treatment such as cancer treatment were excluded. Each survey was completed anonymously and encoded with a serial number, and the patient’s name and identification number were not included. Clinical and laboratory data were extracted from their corresponding medical records.

Survey

The questionnaire was developed by reproductive specialists of our center who are familiar with elective OC. The survey included questions regarding the individuals demographics, reproductive history, views about their fertility and parenthood, and the elective OC consultation, as well as the index measures of reproductive concerns and decisional conflicts, using a multistage process [24]. The questions were reviewed by survey experts and physicians for content. In addition, non-physician staffs reviewed the survey for clarity. The entire survey was piloted for feasibility, acceptability, and clarity. The results were used to revise the survey before enrolling the subjects.

The survey was conducted after the first OC consultation by the reproductive specialist who counseled the patient.

Demographics and general data collection

Data regarding reproductive history (i.e., menstrual cycle, past history of a gynecological surgery, and pregnancy) were collected. The survey also included demographic information regarding age, ethnicity, education level, and marital status.

Views about own fertility and future parenthood

The survey included questions regarding the participants’ view about their current fertility and parenthood. The questions included the following: “How do you feel about your fecundity compared to women of the same age? (choose one of the followings: better than other women of the same age; similar to other women of the same age; worse than other women of the same age; no chance of getting pregnant)”; “How important is it to have your biological child/children? (choose one of the followings: very important; important; neither important nor unimportant; unimportant; very unimportant)”; “How soon do you want to become pregnant? (choose one of the following: as soon as possible; within 1 year; within 1 to 2 years; within 3 to 5 years; more than 5 years later; I don’t have a pregnancy plan yet)”. A free text question is included: “How old is the maximum age that you think pregnancy is manageable?”. The survey included a section designed to elucidate the specific values that played a role in the patient’s decision making regarding undergoing elective OC. The subjects were asked to rank the top three factors that were most influential in their decision (1 = most influential to 3 = least influential) among 10 possible given answers. The participants were asked if they would pursue OC or not and the reasons why they made those decisions.

Reproductive concern scale

Previously, Gorman et al. developed a multidimensional RCAC scale for cancer patients regarding their concerns about fecundity, relationships with their partners, health of their child/children, personal health, and becoming pregnant [24]. In our study, reproductive specialists modified the RCAC scale, making it suitable for our elective OC population by rephrasing the cancer-related words into oocyte cryopreservation and selecting only questions suitable for elective OC (e.g., “I am cautious about having children because I might not be around to raise them” was rephrased into “I am cautious about having children because I might not be around to raise them (because of old age)”) (Supplemental Table 1). The 15-item validated measure included six subscales: fertility potential, partner disclosure, child’s health, personal health, acceptance (reverse-coded), and becoming pregnant [24]. The responses were measured on a 5-point scale from “strongly agree” to “strongly disagree,” ranging 0–100, with a higher score indicating higher concerns.

Decisional conflict scale (DCS) for elective OC

The DCS was used to evaluate the health care consumer’s decision making processes [8]. The DCS is consisted of 16 items with subscales of uncertainty, effective decision making, and factors contributing to uncertainty [14, 25] (e.g., “I know the risks and side effects of each option, either OC or not”). Choose one of the following: strongly agree, agree, neither agree nor disagree, disagree, strongly disagree). The responses were measured on a 5-point scale from “strongly agree” to “strongly disagree,” ranging from 0 to 100, with a higher score indicating higher decisional conflicts. Scores > 37.5 indicated increased uncertainty and less satisfaction with decisions, while scores < 25 indicated confidence in the decisions made.

Statistical analysis

Descriptive statistics were calculated as frequency and percentage for categorical data and median and interquartile ranges (IQR) for continuous data. Variables associated with high decisional conflict such as demographics, factors associated with pursuing elective OC, RCAC score, and influential factors in decision making were assessed using Wilcoxon rank sum tests. A value of $P < 0.05$ was considered statistically significant. Statistical analyses were conducted using SAS version 9.3 (SAS, Cary, NC, USA).

Results

Participants’ characteristics

In total, 91 women completed the survey between February 2016 and November 2017. The participant characteristics are presented in Table 1. The mean age was 37.1 ± 4.8 years (range, 23–46 years). Most participants were 35–37 years

Table 1 Participants’ characteristics

Characteristic	Mean \pm SD (min, max) or N (%) ($N = 91$)
Age (years)	37.1 \pm 4.8 (23, 46)
AMH (ng/mL)	1.9 \pm 1.6 (0.02, 8.4)
FSH (mIU/mL)	12.2 \pm 13.3 (1.9, 87.5)
Antral follicle count	9.3 \pm 6.8 (0, 27)
Relationship status	
Married	2 (2)
Single, in a relationship	22 (25)
Single, not in a relationship	63 (72)
Monthly income (USD)	
< 3000	19 (23)
3000– 5000	38 (45)
> 5000	27 (32)
Occupation	
Professionals ^a	26 (30)
Education	5 (6)
Management	6 (7)
Office/administrative support	26 (30)
Others	12 (14)
Religion	
Christianity	21 (24)
Atheism	40 (45)
Catholic	21 (24)
Buddhism	7 (8)
Ever been pregnant before	
Yes	13 (14)
No	78 (86)
Regular period ^b	
Yes	78 (86)
No	13 (14)
Previous ovarian surgeries	
Yes	8 (9)
No	83 (91)

Participants were allowed not to answer questions which they felt uncomfortable to answer

^a Includes legal occupations (lawyer, attorney, and judge), medical doctors and dentist

^b Having eight or more periods a year

and 40–45 years of age. Seventy-two percent of the participants (63/91) were not currently in a serious relationship. Forty-five percent of the participants had monthly incomes of \$3000–\$5000 [26]. Most of the participants had regular menstrual periods (having eight or more periods per year) and had never been pregnant (Table 1). Only 9% had previous ovarian surgeries (partial cystectomy or unilateral oophorectomy).

Participants' views about their current fertility, parenthood, and elective OC

Sixty-six percent of the participants felt that they were as fertile as women of the same age. Most (92%) participants answered that it was important to have their own biological offspring. Thirty-three percent of the participants wanted to get pregnant within 2 years, and 22% wanted to conceive as soon as possible. The maximum age that the subjects thought pregnancy was manageable in terms of their social and economic status was 39.5 ± 6.2 years. The mean RCAC score was 52.2 ± 8.9 (range, 37–73, Cronbach α 0.82) (Table 2).

Eighty-six percent of the participants answered that they were willing to pursue elective OC. The most common reason for pursuing the procedure was as an insurance against future infertility, while the second most common reason was the lack

Table 2 Participants' view about their current fertility and parenthood, Reproductive Concerns After Cancer (RCAC) scale and Decisional Conflict Scale (DCS)

	<i>N</i> (%) or Mean \pm SD (min, max) (<i>N</i> = 91)
Feeling about own fertility	
Fertile	56 (66)
Less fertile or infertile	29 (34)
Important to have biologic offspring	
Yes	80 (92)
No	7 (8)
When do you want to get pregnant?	
As soon as possible	19 (22)
In 2 years	29 (33)
In 5 years	21 (24)
Not sure	15 (17)
Maximum age that you think pregnancy is manageable (years)	39.5 ± 6.2 (25.0, 60.0)
RCAC summary score ^a	52.2 ± 8.9 (37.0, 73.0)
DCS	39.4 ± 11.8 (12.5, 71.9)
High DCS (> 37.5)	40 (49)
Low DCS (\leq 37.5)	42 (51)

^a Overall RCAC summary score, range 18–86

of a partner. Most (94%) participants thought that the optimal age for elective OC was under 37 years. Seventy-eight percent answered that they would feel disappointed but could tolerate a failure to become pregnant (Table 3).

Decisional conflict scale associations

Eighty-two participants completed the DCS questions. The median DCS score was 24 out of 100 possible points (IQR 9.0, range 38.0, Cronbach α 0.74). Forty participants (49%) had scores consistent with high decisional conflict (> 37.5), 34 (41.4%) were in the moderate range (25–37.5), and 8 (9.8%) subjects had low decisional conflict (< 25). Univariate analysis of participants' demographics revealed that subjects who were older than 37 years were more likely to have higher decisional conflicts compared to younger subjects ($P = 0.005$). After multivariate analysis including age, monthly income, feelings about own fertility, and RCAC scores, age was the only factor associated with a high DCS score ($P = 0.002$) (Tables 4).

Table 3 Participants' view about elective oocyte cryopreservation (OC) and results of elective OC

	<i>N</i> (%) or Mean \pm SD (min, max) (<i>N</i> = 91)
Willing to pursue elective OC?	
Yes	75 (86)
Not sure	12 (14)
Reason for pursuing elective OC ^a	
Lack of partner	36 (46)
Professional reasons	15 (15)
'insurance' against future infertility	47 (59)
Optimal age that you think for pursuing elective OC (years)	
< 35	33 (38)
35–37	48 (56)
> 37	5 (5)
How do you think you will feel if you fail to get pregnant through elective OC?	
Desperate	15 (17)
Disappointed but tolerable	68 (78)
Acceptable	6 (7)
Totally fine	0
Pursued elective OC	62 (68)
Age (years)	37.1 ± 4.6 (23, 46)
Basal AMH (ng/mL)	1.8 ± 1.6 (0.02, 6.06)
No. of elective OC cycles performed per patient	1.5 ± 1.2 (1, 8)
No. of frozen oocytes per patient	10.5 ± 8.3 (0, 30)

^a Multiple choices

Table 4 Multivariable analysis of factors associated with high Decisional Conflict Scale score

	Univariate analysis	<i>P</i> value	Multivariate analysis	<i>P</i> value
Age (> 37 years)	1.18 [1.05, 1.32]	0.005	1.20 [1.07, 1.35]	0.002
Monthly income	0.62 [0.24, 1.57]	0.31	0.63 [0.22, 1.85]	0.41
Feeling about own fertility	0.53 [0.21, 1.36]	0.19	0.52 [0.17, 1.66]	0.27
RCAC summary score	1.19 [0.92, 1.52]	0.18	1.17 [0.89, 1.56]	0.27

Elective OC results and factors associated with pursuing OC

Sixty-two patients (68%) pursued OC. Their mean age was 37.1 ± 4.6 years, and the mean anti-Mullerian hormone (AMH) level was 1.8 ± 1.6 ng/mL. In total, 649 oocytes were cryopreserved, and the mean number of oocytes cryopreserved per subject was 10.5 ± 8.3. On average, each participant underwent 1.5 ± 1.2 cycles of OC.

In univariate analysis, only high DCS was significantly associated with pursuing elective OC. However, in multivariable analysis, a lower DCS score (*P* = 0.004), and thinking that one was less fertile compared to other women (*P* = 0.02), were the factors associated with pursuing elective OC after adjusting for age, monthly income, serum levels of AMH, and RCAC scores (Table 5).

Discussion

To the best of our knowledge, this is the first study to evaluate women’s decision making processes and determinants of pursuing elective OC using validated survey scales. Our findings helped to identify possible impediments for women when making decisions regarding elective OC. We investigated factors including annual income, menstrual irregularity, perceptions about current fertility, and reproductive concerns. Recently, internet-based surveys have addressed the reproductive choices

and factors associated with the importance of having a biologically related child, and the likelihood of considering elective OC in reproductive-age women in the USA [18]. In that study, Asian race, single status, and age-related infertility increased the likelihood of considering elective OC. In particular, our study focused on the willingness to consider or pay for the procedure in a general reproductive-age female population. In a recent study assessing women who completed more than one elective OC treatment cycle [20], most women wished that they had undergone OC at an earlier age. However, both studies did not assess the decision making process and the determinants of pursuing elective OC in women who seriously considered pursuing the procedure [18, 20].

In the current study, older age (> 37 years) was the only factor associated with high decisional conflict. This finding can be explained by several factors. First, the pregnancy rate using frozen oocytes obtained from older women has not been validated. Most previous studies comparing pregnancy rate between frozen and fresh oocytes included young women, especially oocyte donors [8, 9, 11]. Recent studies reported that older age at the time of oocyte collection was related to the lower pregnancy and live birth rates compared to younger age [3, 27]. Second, the cost-effectiveness of an elective OC cycle dramatically decreases as women age. Recent studies reported that 12.1 oocytes were needed per live birth before age 36 years, 29.6 oocytes between age 36–39 years [28], and 55.5 oocytes for age ≥ 40 years [29]. This was mainly due to a decreased oocyte quality and higher prevalence of aneuploidy

Table 5 Multivariable analysis of factors associated with pursuing elective OC

	Univariate analysis	<i>P</i> value	Multivariate analysis	<i>P</i> value
Age (> 37 years)	1.00 [0.91, 1.10]	0.95	1.13 [0.99, 1.29]	0.07
AMH	0.96 [0.72, 1.26]	0.75	1.14 [0.81, 1.61]	0.45
High DCS	0.27 [0.10, 0.74]	0.01	0.15 [0.04, 0.54]	0.004
Feeling about own fertility	0.38 [0.12, 1.13]	0.08	0.19 [0.05, 0.79]	0.02
RCAC summary score	0.98 [0.76, 1.26]	0.87	0.99 [0.72, 1.35]	0.94

as women age [30]. In addition to the decline of oocyte quality, oocyte numbers significantly declined over the reproductive life span [30]. In turn, older women must pursue more OC cycles to preserve enough number of oocytes. A recent study showed that only 26% of US clinics offer elective OC to women older than 40 years of age because of the low cost-effectiveness [31]. Third, the utilization rate of frozen oocytes may be lower in older women [17]. In a recent study, most women returned to use frozen oocyte at ages 37–39 years (63%), while 16.2% returned at ages ≥ 40 years [11]. This may be because older women have a lower tendency to use vitrified oocytes. Most participants who were older than 37 years of age answered that they wanted to get pregnant before age 40 years. Women over 40 years may have thought it was already too late for them to conceive naturally or with OC procedure.

Interestingly, in our study, a woman's reproductive concerns were not related to decisional conflict or pursuing elective OC. However, our study group had generally high RCAC scores based on the breast cancer survivors' RCAC scores reported previously [32]. These findings may reflect the characteristics of our study population because women who pursued OC consultation may have had higher reproductive concerns, which would lead to pursuing the consultation.

Elective OC is increasing in popularity in South Korea; however, little is known about the intention of considering OC. In current study, the most common reason for pursuing elective OC was as an insurance against future infertility, and the second most common reason was the lack of a partner, which was consistent with previous studies [17, 20, 21, 33]. Only 15 participants (16%) answered that they pursued OC for professional reasons. These findings may have been affected by the social and cultural environment and should be verified in populations with different cultural backgrounds. In our study, most participants understood that they could still fail to conceive using cryopreserved oocytes, even with the advances in laboratory technology. This is an important finding because elective OC may give women an unrealistic expectation about their future fertility.

Although most participants answered that they would pursue OC in the near future, only 68% of the women who had had a counseling finally pursued OC. Interestingly, AMH levels were not different between women who pursued OC cycle and who did not, while women who thought that they were less fertile compared to other women were more likely to pursue OC. It means that women make a decision regarding OC based not on their ovarian function, but on their perceived fertility which may be affected by various factors such as menstrual cycle regularity and family history of subfertility or premature menopause. Women who had more difficulties in making decisions about OC were less likely to pursue the procedure. This finding still existed after adjusting for the women's age. This is an important finding indicating that

individualized counseling based on a woman's ovarian function is necessary to provide an objective guide for pursuing OC and may facilitate elective OC treatment by decreasing decisional conflicts.

In a recent study, it was shown that providing education regarding fertility preservation techniques altered the decision making in a substantial proportion of women [18]. A final decision regarding choosing medical services should be made by the patient. In other words, a medical staff should not force one to take the treatment but should be able to help the patient to make a right decision by providing enough information to the patients. Therefore, it may be possible that counseling older women, who are more likely to have higher decisional conflict, regarding age-related fertility decline, and the concurrent risk of infertility and miscarriage as well as the relatively low cost-effectiveness of an elective OC cycle could influence the number of women who would undergo OC by making their own choices. They should also be informed that, so far, there is no result of the success rate of OC in older age women based on large database. In contrast to a previous study [18], cost was not a significant determinant of pursuing OC in our study. In that survey study in the USA [18], the amount of money that women were willing to pay for elective OC was less than the average amount charged in the US. In South Korea, the cost of one cycle of OC is approximately US\$3000–US\$5000, which is less than 50% of the cost in the USA.

Several factors affect the recent sharp increase of OC in South Korea. Oocyte donation is strictly regulated by law in South Korea, and oocyte bank is unavailable because any commerce of oocytes is outlawed. In addition, cultural background of strong desire for biologic offspring may have an influence to an increased demand for elective OC in South Korea. Finally, relatively low cost plays a critical role in increasing women's accessibility to elective OC. Based on these social, cultural, and financial factors in South Korea which are favorable to pursuing elective OC, the results of this study may elucidate the essential issues in counseling women who are interested in elective OC.

This is the first study to evaluate the decision making process of elective OC using validated scales and factors affecting the commencement of OC treatment in South Korean population. Our results can be used to guide physicians to provide more detailed and individualized information when counseling women considering elective OC to help them make better decisions. The result may further facilitate future studies investigating an effective counseling system for this specific population.

Our study has several limitations. We included a small number of women, which made it unable to draw any population-based conclusions. In addition, individuals who came to the clinic for elective OC counseling might tend to have a positive opinion about it, which would lead to a sampling bias in the current study. Because 97% of participants were single and most of them (72%) were unpartnered in this

study, it was not feasible to validate non-single women's decision-making process. However, our findings that even women with a positive view about OC had decisional conflicts, which were mainly related to older age at counseling, may suggest a critical need to improve the counseling.

The unmet needs of information and support during a decision making process can increase distress, decisional conflict, and future regrets [34]. Providing women who have more difficulties in making decision with more detailed counseling about estimated age-specific success rate and their ovarian reserve may facilitate and improve their decision making process which would lead to a better use of elective OC. Given the age-related high decisional conflicts shown in our study, it is important to provide sufficient information, especially for a subgroup of older women who have surpassed the optimal age for an elective OC cycle. The individual's ovarian function should also be assessed and discussed thoroughly before making a decision regarding OC. Larger studies including both older and younger age group regarding the decision making process and analysis of important factors affecting the decision will provide clinicians with more detailed information to help women make better decisions about elective OC.

Conclusion

Older women had more difficulties in making decisions about elective OC compared to younger women. Perceived own fertility and individual's decisional conflict are important determinants of pursuing elective OC in this study population. Providing women who have more difficulties in making decision with more detailed counseling about estimated age-specific success rate and their ovarian reserve may facilitate and improve their decision making process which would lead to a better use of elective OC. Further studies should focus to validate older women's decisional conflict and to help them making a better decision about OC. Finally, investigating women with various cultural backgrounds may be helpful to understand women's decision-making process and to validate common factors facilitating elective OC.

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Compliance with ethical standards

The study was approved by the Institutional Review Board at the CHA Seoul Fertility Center, CHA Gangnam Medical Center, CHA University, and informed consent was obtained from all participants.

Conflict of interest The authors declare that they have no conflict of interest.

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