

Effect of an Educational Intervention on Knowledge, Attitude, and Beliefs of Unmarried Healthy Females regarding Oocyte Cryopreservation

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Abstract

Background: Oocyte cryopreservation is a unique and significant advanced reproductive technology method for women who want to postpone conception for a particular time to preserve fertility and for those who are receiving chemotherapy. **Aim:** To investigate the effect of an educational intervention on knowledge, attitude, and beliefs of unmarried, healthy females regarding oocyte cryopreservation. **Settings:** The study was carried out at Shebin El-Kom, Menoufia University, in the faculties of science, commerce, and art. **Design:** This study employed quasi-experimental design. **Sample:** A purposive sample consisting of one hundred healthy and single women was chosen. **Instruments:** A structured interview questionnaire; unmarried, healthy females' beliefs and attitudes about oocyte cryopreservation. **Results:** This shows that 89% of the healthy females in the study knew very little about oocyte cryopreservation prior to the intervention, but 88% of them knew a lot about it a month later. Additionally, before establishing the intervention, only 19.0% of the participants had good opinions about oocyte cryopreservation; however, a month later, 95.0% of the individuals had the same beliefs. Furthermore, one month following the intervention, 95% of the participants had positive attitudes concerning oocyte cryopreservation, compared to 92% of those who had negative attitudes prior to the intervention. **Conclusion:** Implementation of an educational intervention was effective in increasing the studied unmarried, healthy females' knowledge and changing their attitudes and beliefs towards oocyte cryopreservation. **Recommendations:** A health education intervention regarding oocyte cryopreservation should be provided to all unmarried females of fertile age to help them make an informed decision to preserve their fertility.

Keywords: awareness, educational intervention, oocyte cryopreservation, unmarried, healthy females.

Introduction

Recently, there have been increasing numbers of females who delay marriage and childbirth until their thirties and forties, with an average age of 35 years old (Hasab Allah et al., 2021). Healthy females who postpone marriage, pregnancy, and childbearing to an older age are at risk for "involuntary childlessness," leading to a decrease in oocyte quantity and quality as well as changes in body systems (OECD, 2022). Also, delays in marriage, childbirth, and reproductive ageing affect females' fertility rate, perinatal morbidity, child wellbeing, and the whole community (Lazzari et al., 2023).

Also, Tazzo et al. (2019) stated that over the past thirty years, a progressive social trend has been observed towards delaying childbearing among women. They stated that there are a variety of causes for this, including changes in society and lifestyle, such as the increased options for women in the workplace and school, the necessity to provide for one's family,

financial hardships, and the desire for more financial stability. They also discussed individual factors, including aspirations for a profession, academic advancement, single status, or stable finances. They pointed out that because of these delays, women may experience age-related infertility when they choose to become pregnant, and as a remedy, fertility preservation procedures may be recommended to them.

Moreover, Chronopoulou et al. (2021) documented that fertility preservation means saving ova from the ovary using a specialized, advanced technique to have biological children in the future. Also, Muaygil (2023) explained that it is performed for "medical" and "non-medical or social" reasons and provides terms for egg freezing related to such reasons. Similarly, Hasab Allah et al. (2021) proposed that oocyte retrievals be performed trans-anally or with a laparoscope instead of the vagina to maintain virginity until marriage.

Correspondingly, Walker et al. (2022) recommended that oocyte cryopreservation (OC)

is a specific and important advanced reproductive technology for fertility preservation. But according to **Nicolette (2021)**, the egg harvesting process entails "10–14 days of hormone injections to motivate the ovaries and ripen numerous eggs" as well as "2-4 weeks of self-administered hormone injections and birth control pills to temporarily turn off natural hormones." Therefore, **Mahesan et al. (2019)** discovered that a woman must freeze at least 10 oocytes to have a greater than 50% chance of a live birth at age < 35. This number rises to 40 oocytes at 40 years of age.

The first type of OC is called medical ova cryopreservation (MOC), and it was primarily used for "medical" reasons, such as for females who have medical and oncological diseases, with the subsequent harmful effects of the diseases and their management on the fertility of the unmarried females, such as early loss of ovarian reserve, damaging effects of pathologic processes on the ovarian follicle reservoir, and poor quality of life. These findings are supported by **Kim et al. (2020)**, **Kato et al. (2021)**, **Kaja et al. (2021)**, and **Latif et al. (2022)**. Additionally, **Sunderam (2018)** noted that the second kind, known as nonmedical ova cryopreservation (NMOC), happens in women who are in good condition.

Furthermore, **Stevenson et al. (2021)** stated that attitudes of unmarried females towards oocyte cryopreservation are important issues that can be influenced by their sociodemographic characteristics, culture, fertility and other reproductive problems, ethical values or moral concerns, intention towards fertility, psychological factors, and fear of mortality. Thus, they added that it is crucial to provide education to unmarried, healthy females regarding oocyte cryopreservation.

Significance of the study

A keystone of the 2030 Agenda for Sustainable Development Goals (SDGs) is fertility (**Sallam, 2022**). Also, he discovered that the fertility rate gradually drops by 6% between the ages of 20 and 24, 9% between 25 and 29, 15% between 30 and 34, 30% between 35 and 39, and 64% between 40 and 44. Similarly, according to **Pritchard et al. (2022)**, Egypt's fertility rate in 2023 was 3.131 births per woman, a decrease of 1.26% from 2022. Furthermore, **Kocourková et al. (2021)** contended that Egypt's fertility rate in 2022 was 3.171 births per

woman, a decrease of 1.25% from 2021. They also stated that Egypt's fertility rate in 2021 was 3.211 births per woman, which was 1.2% less than in 2020. Therefore, **Esencan et al. (2022)** illustrated that delays in marriage and reproductive ageing have harmful effects on females' fertility, pregnancy, childbirth outcomes, maternal and perinatal morbidity and mortality rates, and the whole community.

Therefore, it's critical to ascertain women's knowledge, attitudes, and beliefs that impact their decision-making on fertility preservation to provide appropriate counselling, especially for single women. Thus, it's critical to start learning about fertility preservation at a young age. Therefore, the purpose of the current study was to determine how an educational intervention affected the knowledge of single, healthy females about oocyte cryopreservation.

The aim of the study

The aim of this study was to investigate the effect of an educational intervention on knowledge, attitude, and beliefs of unmarried, healthy females regarding oocyte cryopreservation.

Research Hypotheses:

- It is anticipated that the level of knowledge among unmarried, healthy females about oocyte cryopreservation will increase following the intervention.
- It is anticipated that following the intervention, the attitudes of unmarried, healthy females towards oocyte cryopreservation will be more positive than they were previously.
- It is anticipated that following the intervention, the beliefs of unmarried, healthy females about oocyte cryopreservation will be more positive than they were previously.

Operational definitions:

An educational intervention is an organized series of learning exercises aimed at helping healthy, single women modify their attitudes and expand their understanding of oocyte cryopreservation.

The procedure known as "**oocyte cryopreservation**" involves stimulating ovarian follicles, extracting the follicular fluid, then isolating and vitrifying mature oocytes.

Method

Research Design: This study employed a quasi-experimental research design with a single group pre- and post-testing.

Setting: Three faculties at Shebin El-Kom, Menoufia University (the Faculty of Arts, the Faculty of Commerce, and the Faculty of Science) were the sites of the current study.

Sample:

From the research settings, a purposive sample of one hundred single, healthy working women was chosen (of whom thirty-two were from the Faculty of Arts, twenty-five from the Faculty of Commerce, and forty-three from the Faculty of Science). There was a total of 120 single females in the settings (9 declined to take part in the study, 100 agreed to take part, and 11 were part of the pilot study).

Under the following inclusion criteria:

1. Age ≥ 25 –40 years
2. Unmarried, healthy females

Exclusion criteria:

1. Married females

Sample Size:

The statistical package included in the Epi-Info software was used to determine the sample size and power analysis. A 95% confidence interval was used to estimate the sample size. The sample size, which was originally determined to be 85 females, was raised to 100 to enhance the quality of the study data.

The sample size calculation is:

$$x = Z (c/100) 2 r (100 r)$$

$$n = N x / ((N-1) E^2 + x)$$

$$E = \text{sqrt} [(N - n) x / n (N-1)]$$

Where N is the population size, r is the fraction of responses that the researchers are interested in, and $Z(c/100)$ is the critical value for the confidence level. The sample was carefully chosen based on their agreement to participate in the study. One hundred single healthy female participants took part in the study, based on the sample size that was measured.

Instruments for collecting data:

Throughout the current investigation, the following tools were used to gather data:

Instrument I: A questionnaire for structured interviews: To gather the required information on the study participants, the researchers designed it based on a survey of current related literature (Platts et al., 2021; Hong et al., 2019; and Tozzo et al., 2019). It was divided into two main sections:

Part I: Sociodemographic characteristics: comprising age, level of education, residence, occupation, and monthly income.

Part II: Assessment of unmarried, healthy females' knowledge about oocyte cryopreservation: It was created by the researchers to gauge the unmarried, healthy females' degree of knowledge regarding oocyte cryopreservation during pre- and post-tests based on a survey of recent relevant literature (Platts et al., 2021; Tozzo et al., 2019). It consisted of 29 closed-ended questions (10 MCQs and 19 true and false questions) including definition, types, indications of medical and non-medical, suitable age for freezing, number of oocytes to freeze, procedure of oocyte cryopreservation, including egg retrieval procedure, temperature required for the egg storage process, laboratory tests needed before technique, hormonal therapy for oocyte cryopreservation, complications, and statements of Dar Al-Ifta that permit using oocyte cryopreservation.

Knowledge scoring system:

Platts et al. implemented the scoring system in 2021. The literature was consulted to establish and code the 29 knowledge questions. Every knowledge question had a score: two for the right answer, one for the wrong response, and zero for the answer you don't know. All objects had a total score that varied from 0 to 58, and it was categorized as follows:

- High level of knowledge: $\geq 75\%$ (44-58)
- Moderate level of knowledge: 50-<75% (29-43)
- Low level of knowledge: <50% (0-28)

Instrument II: Unmarried, healthy females' beliefs about oocyte

cryopreservation. To find out what the examined female subjects thought about cryopreservation of oocytes during pre- and post-tests, researchers reviewed recent literature in the field (Jones et al., 2022; Hasab Allah et al., 2021). After that, they designed this instrument. It included 18 statements (4 negative statements), as follows: OC is forbidden by religion, OC is not accessible, OC is an emotional burden, the success rate is very low, and there are 14 positive statements, as follows: If a woman is not ready to have a child in her 20s or 30s, she should freeze her eggs; if she has cancer, is not ready to have a kid, or has not yet met a suitable partner, she should also protect her fertility. Premarital counselling and routine healthcare visits should include OC; women would consider accepting payment from parents or family to cover the cost of this procedure; frozen eggs are usable for approximately five to ten years; infants born through OC are normal and socially acceptable; confidence in doctors and laboratory staff involved in storage is important; legally, egg donation is prohibited; and culture may affect decision-making towards OC. The high cost is a barrier for OC.

Scoring system:

The scoring system was adopted by Jones et al. (2022). According to the beliefs towards ova cryopreservation, which include 18 questions, they reflect unmarried, healthy females' beliefs, each with 3 responses (agree, uncertain, or disagree). Two points were awarded for the acceptable response, one point was provided for the doubtful response, and zero points were awarded for the disagreeable response. Of them, 14 have "agree" as the correct response, and 4 have "disagree" as the proper response. All objects had a total score that varied from 0 to 36, and it was categorized as follows:

- Positive beliefs: $\geq 60\%$ (21-36).
- Negative beliefs: $< 60\%$ (0-20).

Instrument III: Unmarried, healthy females' attitude towards oocyte cryopreservation. Following a study of pertinent literature during pre- and post-tests (Hafezia et al., 2022; Fahmy et al., 2021; Platts et al., 2021; Yeung et al., 2020; Hong et al., 2019; and Tozzo et al., 2019), the researchers constructed this instrument. It included 18

statements (6 negative statements), as follows: worried about the cost of ovum withdrawal, retrieval, and storage; worried about the wrong use of frozen ovum; worried about poor storage of frozen ovum; worried about the long storage period; fear of not using frozen ovum in the future; I would consider oocyte cryopreservation for medical reasons only; and 12 positive statements as follows: oocyte cryopreservation may be a possible option for unmarried girls; oocyte cryopreservation should be encouraged; information about ovum freezing is important to me; freezing and storage operations must be monitored; ovum freezing banks must be certified and have standards; oocyte cryopreservation should be followed up; oocyte cryopreservation is applicable in Egypt; infection control precautions should be used during freezing and storage operations; I would consider oocyte cryopreservation for social and career reasons; I would consider oocyte cryopreservation if its cost were suitable for me; it is very expensive and therefore not feasible for anyone; and I feel the test to check ovarian reserve should be freely available.

Scoring system:

The scoring system was adopted by Hafezia et al. (2022). The scoring system for unmarried, healthy females' attitudes about oocyte cryopreservation was as follows: The response that was agreed upon received a score of 2, while the answer that was disagreed with received a score of 1. 12 of them were positive as the correct answer, and 6 of them were negative as the correct answer (numbers 3,4,5,6,7,11). The total score of unmarried, healthy females' attitudes was calculated as follows: Positive attitude $\geq 60\%$ (21 to 36) and negative attitude $< 60\%$ (0 to 20).

Validity:

Three experts (one from the obstetrics and gynecology department at the Faculty of Medicine and two professors in maternal and newborn health nursing at the Faculty of Nursing) determined the validity of the instruments. They examined the tools to ensure the internal validity and correctness of the content. They were also asked to rate the items' clarity and completeness. Modifications and suggestions were integrated into the instruments.

Reliability:

The researchers employed test-retest reliability to assess the internal consistency of the instruments. It was accomplished by giving the same instruments to the same subjects in comparable circumstances two or more times. The knowledge questionnaire's Alpha Cronbach's values were 0.79, beliefs' values were 0.83, and attitudes' values were 0.89. The coefficient indicates that the items seem appropriate and have an average internal consistency.

Approval letter: The Dean of the Faculty of Nursing at Menoufia University sent an official letter outlining the purpose of the study to the pertinent authorities in the study locations. The deans of the previously listed settings formally approved our plan to carry out the study.

Ethical considerations:

It was approved by the Menoufia University Faculty of Nursing's Ethics and Research Committee. Additionally, methods to guarantee ethics were considered in the study with reference to informed consent and confidentiality. The single women were contacted one-on-one or in groups of three to four, where the researchers introduced themselves, described the nature and goal of the study, and extended an invitation to take part. The participants were given assurances by the researchers that the study was not intended to cause any harm or pain and that the data acquired would be used exclusively for this purpose, with confidentiality and privacy respected.

All the ladies gave their informed consent after being given information prior to their involvement in the study. Every woman was told that she could opt out of the study at any time and that participation in it was entirely voluntary. Every lady had the option to voluntarily decline to take part. They were permitted to inquire about any aspect of the study.

A pilot study: To evaluate the viability and clarity of the instruments and ascertain the required time to respond to the questions, a total of 10% of the single female population 11 females were included in the pilot study in the previously indicated settings. To ensure the stability of the results and make the required adjustments, they were removed from the research intervention. The required adjustments

were made prior to the main trial based on the findings of the pilot study. At that point, the tools were prepared to gather the data required for the research.

Study Fieldwork: The current study was conducted in five stages in order: planning, implementation, assessment, evaluation, and preparation. Six months passed between the beginning of July 2021 and the end of December 2021, during which time the data was gathered.

1. Preparatory phase

The study field was thoroughly reviewed, encompassing electronic dissertations, books, papers, the internet, scientific publications, and periodicals. A survey of literature in local, global, historical, and contemporary contexts was done. This was necessary to create a knowledge foundation pertinent to the field of study. It also helped with the production of an instructional manual and the choice of a suitable and trustworthy data collection tool.

2. Assessment phase:

The researchers greeted each female participant, gave a brief introduction, and stated that the goal of the study was to gain their cooperation and acceptance at the start of the interview. Participants were also told by the researchers that they might choose to leave the study at any time and that their participation was completely voluntary. Each female who satisfied the inclusion criteria was given a pretest questionnaire and interviewed in a specific office in the faculty after giving their informed consent. This was done to gather information about sociodemographic traits and gauge each woman's knowledge, attitudes, and views regarding the cryopreservation of oocytes. Each female took about thirty minutes to complete the interview.

3. Planning phase:

During this stage, the researchers develop the contents of the educational intervention and establish the aims and objectives of the study. The goal of the teaching intervention was to enhance the oocyte cryopreservation knowledge, attitudes, and beliefs of single, healthy females.

The aim of the study was to enhance the knowledge, beliefs, and attitudes of single, healthy females about cryopreservation of oocytes. To meet the program's goals and objectives, the researchers assessed the knowledge, attitudes, and beliefs of single women during the assessment phase prior to

intervention sessions, and they used pertinent literature to develop and prepare the information contained in an educational booklet. The researchers also prepared different teaching aids, such as PowerPoint presentations, pictures, and a guiding booklet.

4. Implementation phase:

The educational sessions were held to implement the educational intervention, which concentrated on information regarding oocyte cryopreservation. After the pre-test, instruments were used to examine the unmarried girls' knowledge, beliefs, and attitudes regarding oocyte cryopreservation. Each female received two scheduled Arabic sessions. For eight weeks, the sessions were conducted by the researchers twice a week at the previously indicated study locations. Three to four women make up each of the subgroups that were created from the single female population.

To make it easier for the women to attend the sessions, these groups were formed based on their availability and preparedness; if the group was not available, the sessions were offered to each woman individually. Every session lasted roughly thirty to forty-five minutes, with a portion dedicated to open conversation and a PowerPoint presentation discussion. At the start of every session, feedback was evaluated to make sure the women understood. The goals for the upcoming session were then introduced. The researchers set a time for the following session at the conclusion of each one. One-on-one instruction or group conversations were the modes of instruction. To help demonstrate teaching, there were visual aids such as images, a PowerPoint presentation, and an instructional booklet.

First Session:

The researchers provided a lecture that included general knowledge regarding oocyte cryopreservation, supported by pre-prepared teaching and aiding methods. Each study participant received a pre-made booklet from the researchers to enhance their attitudes, knowledge, and convictions regarding oocyte cryopreservation.

Second session:

The researchers provided a lecture that included knowledge about the procedure of oocyte cryopreservation and the care before and after the technique. Following this session, the

researchers arranged to interview the healthy, single female participants in the study again a month later to administer the post-test utilizing instruments I, II, and III.

❖ Evaluation phase:

In this stage, the educational sessions' impact on enhancing knowledge, attitudes, and beliefs about oocyte cryopreservation was evaluated using a post-test given a month following the intervention's implementation. Further to evaluate the variation between the pre- and post-test. The post-test (instrument I, part 2) and instruments II and III were administered using the same instruments as the pretest.

Data Analysis

The Statistical Package for Social Sciences (SPSS) version 25 was used to code, classify, computerize, tabulate, and analyze the data that had been collected.

The following two categories of statistics were applied:

1) For quantitative data, descriptive statistics were expressed as mean and standard deviation ($X \pm SD$), and for qualitative data, as numbers and percentages.

2) To compare two qualitative variables, analytical statistics were expressed as the paired sample t-test and Pearson correlation. A significant level of 0.05 was set for the P-value.

Results:

The sociodemographic details of the examined single, healthy females are displayed in **Table 1**. It shows that women between the ages of 25 and 34 made up 60% of the examined unmarried, healthy female population. The participants' average age was 32.08 ± 3.79 years. About 70% of the participants have postgraduate studies, which speaks to their educational background. Staff personnel made up 68% of the participants as well. Moreover, 52% of them were from rural areas, which made up >50% of them. Furthermore, 43% of them made a sufficient living.

The distribution of the examined single, healthy females based on their experience with oocyte cryopreservation is depicted in **Figure 1**. The results showed that 67.0% of the research participants had prior knowledge of oocyte

cryopreservation, compared to 33.0% who did not.

The distribution of the examined single, healthy females is depicted in **Figure 2**, together with their background information about oocyte cryopreservation. It was discovered that the primary sources are the internet and social media, which account for 32.8% and 28.3% of the total; books represent 19.4%, television for 16.4%, and friends for 2.9%.

Figure 3 shows the total level of knowledge of the unmarried, healthy females towards oocyte cryopreservation before and after the intervention. It shows that, prior to the educational intervention, 89% of the unmarried, healthy females in the study had a low level of knowledge regarding oocyte cryopreservation, whereas, one month later, 88% of them had a high level of knowledge.

Figure 4 shows the total belief categories of the unmarried, healthy females towards oocyte cryopreservation before and after the intervention. As evidence shows, before the implementation of an educational intervention, 19.0% of the study participants had good opinions regarding oocyte cryopreservation; however, after the intervention was implemented, 95.0% of the participants had the same beliefs.

Figure 5 shows the total attitude categories of the unmarried, healthy females towards oocyte cryopreservation before and after the intervention. It identifies that 92% of the studied unmarried, healthy females had negative attitudes towards oocyte cryopreservation before the program, compared to 95% of them having positive attitudes one month after the program.

The unmarried, healthy females' mean scores for knowledge, attitude, and belief regarding oocyte cryopreservation before and after the intervention are displayed in **Table 2**. It was shown that the total mean knowledge, attitude, and belief scores of the unmarried, healthy females towards oocyte cryopreservation before the intervention was 15.58 ± 10.55 , 14.34 ± 3.64 , 16.78 ± 5.06 , respectively, and 52.60 ± 5.55 , 31.08 ± 2.59 , 32.07 ± 2.96 , respectively, post-one month.

The link between the study's unmarried, healthy female participants' overall knowledge, attitude, and belief ratings regarding oocyte cryopreservation before and after the intervention is displayed in **Table 3**. It made clear that the correlation between the study's unmarried, healthy female participants' overall knowledge, attitude, and belief ratings regarding oocyte cryopreservation before the intervention was $r=0.332$ and 0.679 , respectively, compared to 0.253^{**} and 0.572^{**} , respectively, post-one month.

Table 1 lists the sociodemographic characteristics of the 100 healthy, single female participants in the study.

Variables	The studied unmarried, healthy females	
	No.	%
Age		
25-<35 years	60	60.0%
35-40 years	40	40.0%
Mean± standard deviation	32.08±3.79	
Level of education		
Read and write	6	6.0%
Primary school	4	4.0%
Secondary school	1	1.0%
University	19	19.0%
Postgraduate's studies	70	70.0%
Occupation		
Workers	10	10.0%
Employers	22	22.0%
Staff members	68	68.0%
Residence		
Urban	48	48.0%
Rural	52	52.0%
Monthly income		
Enough	43	43.0%
Not enough	32	32.0%
Enough and saving	25	25.0%

Figure 1: The distribution of single, healthy females under study based on their experience with oocyte cryopreservation.

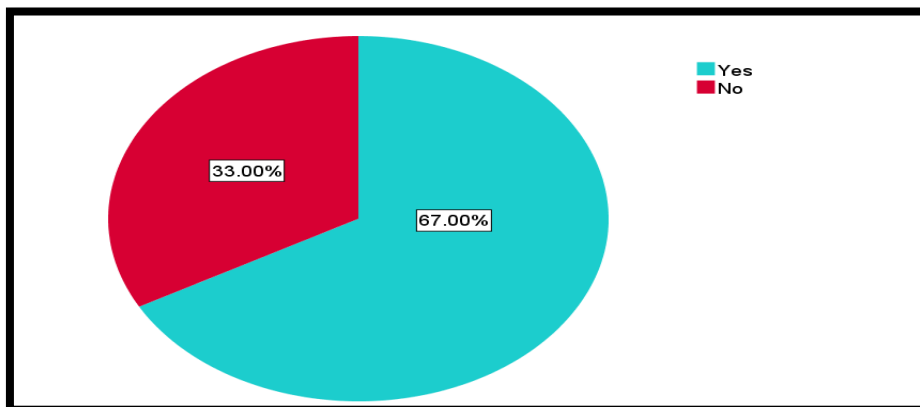


Figure 2: Distribution of the examined single, healthy females based on their background information regarding oocyte cryopreservation.

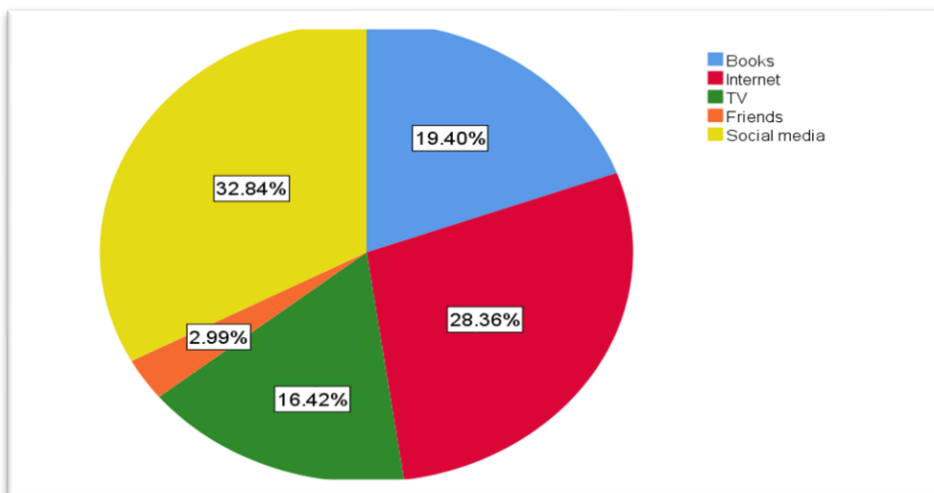


Figure 3: Total level of knowledge of the unmarried, healthy females towards oocyte cryopreservation before the intervention and post-one month

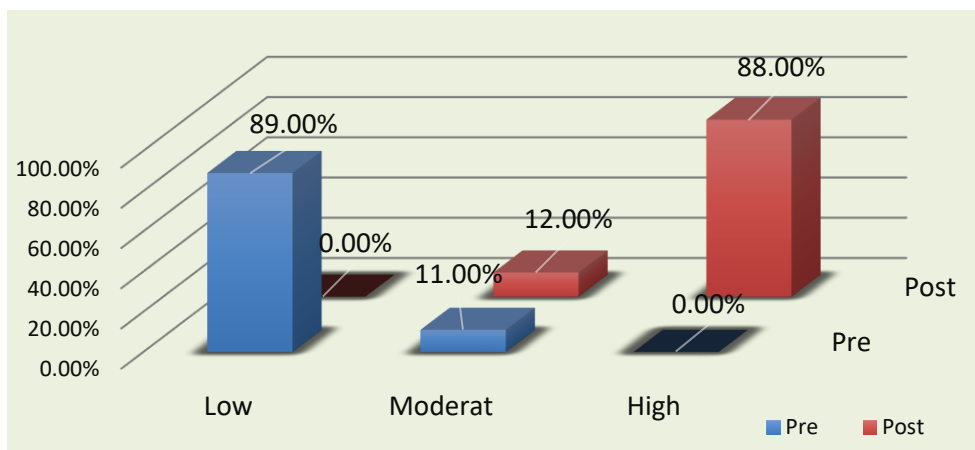


Figure 4: Total belief categories of the unmarried, healthy females towards oocyte cryopreservation before the intervention and post-one month

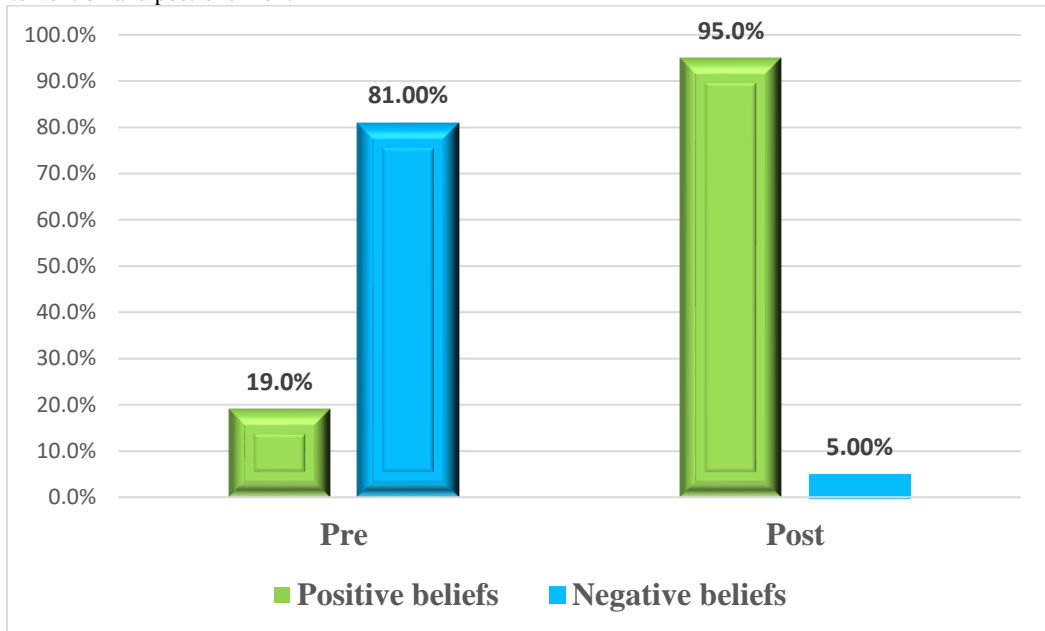


Figure 5: Total attitude categories of the unmarried, healthy females towards oocyte cryopreservation before the intervention and post-one month

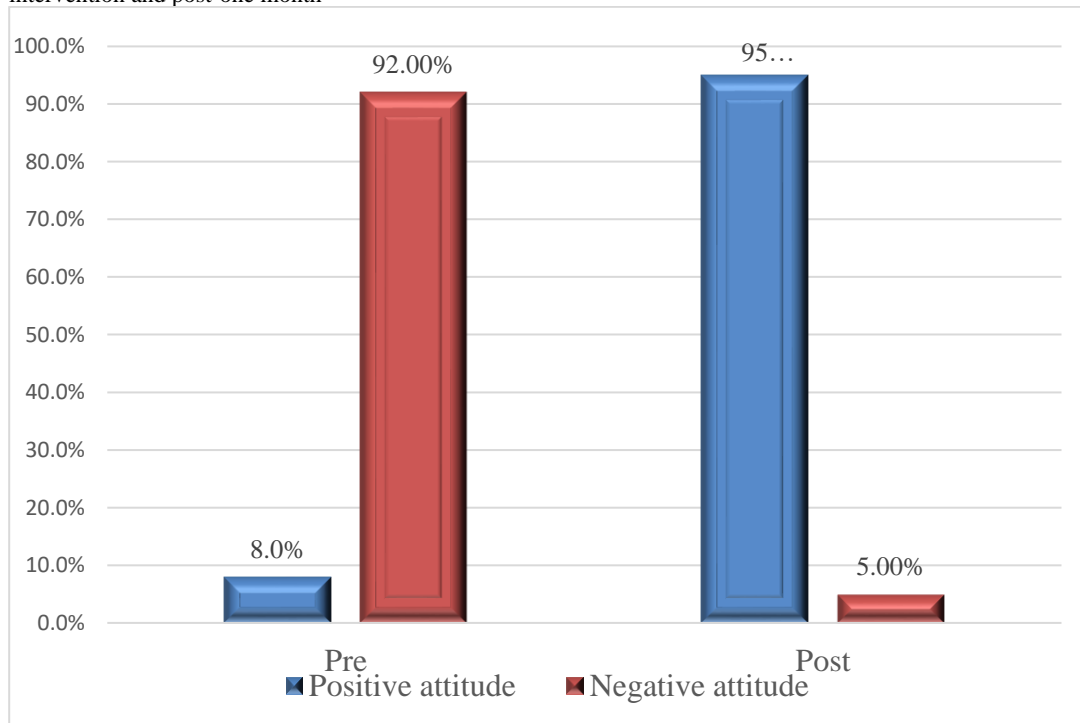


Table 2: Total mean knowledge, attitude, and belief scores of the unmarried, healthy females before the intervention and post-one month towards oocyte cryopreservation (n=100).

Variables	The studied unmarried, healthy females (n=100)		t-test	P value
	Before the intervention	Post one month		
Knowledge				
Mean \pm SD	15.58 \pm 10.55	52.60 \pm 5.55	31.05	< 0.001**
Attitude				
Mean \pm SD	14.34 \pm 3.64	31.08 \pm 2.59	37.43	< 0.001**
Belief				
Mean \pm SD	16.78 \pm 5.06	32.07 \pm 2.96	26.03	< 0.001**

** = highly statistically significant

Table 3: Correlation between the study's unmarried, healthy female participants' overall knowledge, attitude, and belief ratings regarding oocyte cryopreservation before the intervention and post-one month (n=100).

	Total knowledge			
	Before the intervention		Post one month	
	r	P value	r	P value
Total attitude	0.332	0.061	0.253**	< 0.001**
Total belief	.0679	0.065	0.572**	< 0.001**

**Correlation is significant at the 0.01 level (2-tailed)

** = highly statistically significant

Discussion:

World-wide, fertility preservation is an advanced emerging technology field in reproductive health that has gained growing attention for both medical and non-medical causes. This technology has made childbearing possible for healthy females who want to delay marriage and progeny, as well as for non-healthy females who suffer from diseases or treatments that can limit their fertility (Al Ghaithi et al., 2023).

According to the study's findings, the participants' average age was thirty-two years old. This could be explained by the fact that every study participant is single, a graduate, and employed by the institution. It is also a well-known fact that most participants were employees, given the significant increase in marriageable age during the past few decades. The average age of first-time moms has grown due to the rise in women with greater levels of education and the value placed on a career as a source of income in this unstable economic environment. The extremely high expense of getting married in Egypt, which has only increased with the depreciation of the Egyptian Pound, is another recent factor contributing to the country's

rising female and marital ages. Over fifty percent of them originated from rural regions.

This report is consistent with the findings of El-Adham and Shaban (2023) and Fahmy and Mohammed (2021), who examined the knowledge, attitudes, and barriers of unmarried female bridging intervention nurses regarding egg freezing at South Valley University, Egypt, as well as the effect of the educational intervention on the intentions, knowledge, and attitudes of healthy, single females regarding oocyte cryopreservation in Tanta, Egypt. With a mean age of twenty-five, they stated that over half of them is under twenty-five and reside in rural areas.

These results are at odds with the research carried out in Italy by Tozzo et al. (2019), who looked at the knowledge of female students on social oocyte freezing. Most respondents, who ranged in age from eighteen to twenty-two, were reported to be almost half single, three percent married or cohabiting, and roughly half engaged.

According to the current study's findings on occupation and education, postgraduate students made up most of the participants. Employees made up more than half of the participants. This is

consistent with the findings of **Hasab Allah et al. (2021)** and **El-Adham and Shaban (2023)**. According to their findings, slightly over half of the study participants were staff members, and the majority possessed postgraduate degrees or higher education levels.

When the current study investigated the knowledge of single, healthy females about oocyte cryopreservation, it found that, compared to after the educational intervention, the study participants' understanding of oocyte cryopreservation was lacking. About oocyte cryopreservation, there was a highly statistically significant difference between the pre- and post-intervention in all knowledge items.

Even graduates of the faculty of science do not study these kinds of medical matters; thus, it is not surprising that they lack knowledge about the subject given their education in non-medical universities. These results might be explained by the fact that none of the study participants had children, and most of them had no prior knowledge or experience with these subjects. This could also be explained by the cultural custom that views fertility concerns as delicate and rarely brings them up in public.

This is consistent with the findings of **El-Adham and Shaban (2023)** and **Mohammed et al. (2023)**. The results showed that, prior to intervention implementation, most of the studied unmarried, healthy females answered knowledge questions about the previous items completely and correctly, and nearly two-thirds of them correctly answered one month later. In contrast, more than three-quarters of the studied women did not know about the steps involved in oocyte cryopreservation, the length of time an ovum survives after cryopreservation, advantages, factors affecting it, laboratory tests required before the technique, complications, and the effect of ageing on women's fertility.

These findings were consistent with those of **Hong et al. (2019)**, who investigated reproductive unmarried women in Korea's awareness and knowledge of elective oocyte cryopreservation. Most of the study participants' responses to egg freezing were found to be accurate.

The present results were inconsistent with research carried out in Egypt by **Hasab Allah et al. (2021)** and in the UK, USA, and Denmark by

Khattak et al. (2022). According to their results, during the pretest, fewer than one-fourth and almost one-fourth, respectively, of the study participants correctly answered the following questions: why oocyte cryopreservation is necessary, how ageing affects a woman's fertility, what benefits oocyte cryopreservation offers, how many eggs should be saved for future conception, and what obstacles or risks oocyte cryopreservation presents.

The current study found that there was a significant improvement in the unmarried, healthy females' overall belief score regarding oocyte cryopreservation after implementing an educational intervention, with a highly statistically significant difference between the total belief score before and after the intervention. As proof, before and after an educational intervention was implemented, about one-fifth of the study participants had positive opinions about oocyte cryopreservation; these beliefs increased to most of the participants after the intervention was implemented. Following the intervention's execution, the overall mean belief score significantly improved.

Abass et al. (2023) provided confirmation for these findings, stating that a highly statistically significant difference was observed in the overall improvement of students' beliefs regarding ova cryopreservation following the implementation of an educational intervention. As evidence shows, before conducting an educational intervention, forty-two percent of the investigated students had good ideas regarding ova cryopreservation; after completing the intervention, most of the students had better beliefs.

The present study findings made it clear that there was a highly statistically significant difference between the pre- and posttests of the educational intervention implementation for most variables, including: information about ovum freezing is important to me; freezing and storage operations must be monitored; and ovum freezing banks must be certified and have standards. These findings pertain to the attitudes of the studied unmarried, healthy females regarding oocyte cryopreservation.

Research by **El-Adham and Shaban (2023)** and **Hasab Allah et al. (2021)** corroborated these results. The findings demonstrated that a little under seventy-five percent of the students who participated in the study stated that egg preservation

should be promoted, over two-thirds indicated that oocyte freezing might be a viable solution, and over fifty percent believed that egg preservation is extremely costly and unaffordable for anyone. However, a countrywide survey carried out in the USA by **Esfandiari et al. (2019)** found that while the participants wished to undergo oocyte cryopreservation, they were worried about the costs involved, the length of time required, the surgery itself, and the potential hazards associated with oocyte freezing.

In terms of the unmarried, healthy females' overall attitude score towards oocyte cryopreservation before and after the intervention, the current study revealed that ninety-two percent of the unmarried, healthy females under study had negative attitudes towards the practice prior to the intervention, but most of them had positive attitudes one month later, and their overall mean attitude score significantly improved after the intervention was put into place.

This is consistent with research conducted by **Hasab Allah et al. (2021)**, **Khattak et al. (2022)**, and **El-Adham and Shaban (2023)**. According to their results, just one-fourth of the students under study had favorable attitudes regarding egg freezing during the pretest, but those attitudes rose to more than one-half during the posttest and showed statistically significant gains.

Furthermore, research by **Mohammed et al. (2023)** in Egypt and **Nasab et al. (2020)** in Houston, USA, corroborated similar results. They stated that following the implementation of the educational intervention, there was a significant increase in the study respondents' overall posttest scores related to attitudes. In the pretest, just a quarter of respondents were positive about oocyte cryopreservation; in the posttest, this number increased to most respondents. According to the researchers, this might be because of how well the instructional guidelines that are provided to students work to alter their knowledge, attitudes, and beliefs about egg freezing.

Fahmy and Mohamed (2021), **Johnston et al. (2020)**, who studied attitudes towards access to EF in Australia, and **Shimizu et al. (2019)**, who studied fertility-related practices for young breast cancer patients and evaluated healthcare provider factors that influence physicians' behavior towards fertility preservation in Japan, all employed descriptive research designs, in contrast. Less than

two-thirds of the sample under study showed a positive attitude towards EF, and attitudes towards EF were not significantly correlated with age or educational attainment.

The present study found a highly statistically significant relationship between the studied unmarried, healthy females' total knowledge and their socio-demographic characteristics, such as age, education, occupation, and whether they had prior knowledge of oocyte cryopreservation before and after the intervention. This relationship pertains to the relationship between the total knowledge score and these characteristics regarding oocyte cryopreservation.

The results of this investigation are consistent with those of studies carried out in Egypt by **Mohammed et al. (2023)** and **Hasab Allah et al. (2021)**. They found that, based on information from both the pretest and posttest, there is a strong statistically significant relationship between students' overall knowledge of oocyte cryopreservation and their age, academic standing, marital status, and mother's educational background.

The results of this study did not agree with those of studies carried out in Egypt by **Abass et al. (2023)** and **Rafei et al. (2020)** in Iran. They showed that following an educational intervention, knowledge scores are not different for individuals of different genders, living situations, or marital status.

Regarding the relationship between the participants' total knowledge, total belief, and total attitude before and after the intervention, the current study found that, although there was a positive statistically significant correlation between knowledge, total attitude, and total belief before and after the intervention, there was no statistically significant correlation between the participants' total knowledge, total belief, and total attitude before the intervention. The participants' knowledge of oocyte cryopreservation may increase as a result, and this may have a positive effect on their attitudes and beliefs. This is because raising awareness can help participants overcome misconceptions, clear up any confusion regarding the subject, and become more familiar with and capable of utilizing modern technologies.

This outcome was in line with the findings of **Mohammed et al. (2023)** and **Hasab Allah et al.**

(2021). Throughout the intervention phase, they showed a statistically significant association between the study subjects' total knowledge and total attitude ratings. The study subjects' attitude score improved in the posttest, just as their overall knowledge increased.

These results, however, were at odds with a study by **El-Adham and Shaban (2023)**, which found no statistically significant relationship between the unmarried, healthy female participants' total knowledge, total attitude, and total intention regarding oocyte cryopreservation before and after the educational intervention was put into place.

Conclusion:

The present study's findings support the following conclusions: most of the examined single, healthy females had a better understanding of oocyte cryopreservation, which resulted in favorable attitudes and opinions regarding the practice. Based on the current study's findings, we are unable to accept the null hypothesis, indicating that unmarried, healthy females' knowledge, beliefs, and attitudes regarding oocyte cryopreservation were effectively increased and changed because of an educational intervention.

Recommendations:

The present study's conclusions led the researchers to recommend the following courses of action:

- Health education programs regarding oocyte cryopreservation should be provided to all unmarried females of fertile age to help them make an informed decision to preserve their fertility and be pregnant during their preferred or appropriate time.
- Oocyte cryopreservation should be made available to encourage unmarried females to actively consider preserving their fertility for future reasons.

Further research is required to be performed:

- An educational program about cryopreservation should be implemented for fertility nurses in the fertility centers as a step towards disseminating such knowledge among the infertile couple.
- Integrate the counselling about cryopreservation practice into the ART protocol by using booklets and illustrated pamphlets.

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