

Effect of Nano-Educational Sessions on Awareness, Willingness and Barriers toward Elective Oocyte Cryopreservation among Unmarried Females

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Abstract

Background: For the preservation of fertility and the treatment of future infertility that arises from both medical and social factors, in assisted reproductive technology, elective oocyte cryopreservation is a critical component. **Aim:** The research aimed to investigate the effect of Nano-educational sessions on awareness, willingness and barriers toward elective oocyte cryopreservation among unmarried females. **Design:** quasi-experimental design (one group, pre-posttest) was used to attain the aim of the research. **Setting:** Six out of twelve non-medical faculties at Benha University in Qaliobyia governorate, Egypt. **Sample:** Following established inclusion criteria, a purposive sample of 130 unmarried females employed in the aforementioned research settings was selected. **Tools:** Data collection was conducted using four primary tools: a structured self-administered questionnaire, a modified Likert scale to assess unmarried females' attitudes, an unmarried females' barriers assessment questionnaire, and an unmarried females' willingness (intention) questionnaire. **Results:** The program demonstrated a significant increase in the awareness and willingness of unmarried females, as well as a reduction in the barriers associated with elective oocyte cryopreservation. A highly statistically significant difference was observed between the pre- and post-intervention phases. Statistically significant positive correlations were observed between the total knowledge and (total attitude & intention) scores during the pre- and post-intervention phases. Whereas, the total knowledge and total barriers scores demonstrated a statistically significant negative correlation during the pre- and post-intervention phases. **Conclusion:** Nano-educational sessions enhanced unmarried females' knowledge and positively changed attitude that subsequently improved willingness and reduced barriers regarding elective oocyte cryopreservation. **Recommendations:** Nano-educational sessions ought to be encouraged in order to empower unmarried females to practice their autonomy in making decision concerning oocyte cryopreservation.

Keywords: Awareness, Barriers, Elective oocyte cryopreservation, Nano-educational sessions and Willingness.

Introduction:

Many countries have observed a gradual social trend in which women of reproductive age are postponing reproduction over the past three decades. Numerous lifestyle and societal factors, such as the absence of a partner, the desire to establish a stable home, the need for financial security, economic challenges, enhanced

educational and professional opportunities for women, familial caregiving responsibilities, better access to contraception, and a sense of unpreparedness for parenthood, contribute to this postponement. Consequently, when these women eventually decide to conceive, they may encounter age-related infertility, which may

necessitate the implementation of fertility preservation techniques as a potential solution (Akhondi et al., 2023).

According to recent research, the reproductive capacity of women is restricted by ovarian senescence, whether it is physiological or pathological. Oocyte Cryopreservation (OC) is a developing field of reproductive medicine that may be increasingly employed by women to facilitate conception. As women age, their ovarian reserve, as well as the quantity and quality of their eggs, diminish. The most secure method for a woman to conceive is before the age of 35. Women may preserve their reproductive capacity as they age by preserving and storing ova, which has been suggested as a form of "fertility insurance" against age-related infertility (Cheng et al., 2022).

Social egg storage, planned ovarian cryopreservation, and Elective Fertility Preservation (EFP) are significant advancements in Assisted Reproductive Technology (ART). These methods have made a substantial contribution to the field, providing new options for individuals who are interested in preserving their fertility. The OC for potential future use by women who intend to postpone reproduction for personal reasons, including career aspirations, educational advancement, financial stability, absence of a partner, or personal reasons (Meernik et al., 2022). Women who desire to postpone motherhood and concentrate on their careers without jeopardizing their future fertility are provided with options through the EFP. Women can utilize their own oocytes for future pregnancies by cryopreserving them before the biological clock begins. The first effective human OC and fertilization, which led to a successful twin pregnancy, was reported by C Chen in 1986 (Walker et al., 2022).

Women who are undergoing ART benefit from OC. As a consequence of advancements in cryopreservation technique, the quantity of OC cycles for a diverse array of

indications has increased exponentially over the past three decades. The age-related decline in fertility has been mitigated by advocating for it as a form of fertility insurance, in addition to medical indications (Jorgensen et al., 2023).

Moreover, ART has entered a new era as a result of OC. The utilization of donor egg banking and social egg storage has expanded substantially since 2013 in order to mitigate age-related declines in fertility potential. Initially, the American Society for Reproductive Medicine (ASRM) authorized its use for fertility preservation in oncology patients, acknowledging that it was an experimental procedure at the time. It is now being used more frequently for a variety of medical, social, ethical, and legal reasons (Ozcan et al., 2023).

Preservation is a process that entails the retrieval of oocytes from the ovaries through trans-abdominal or trans-vaginal access, freezing of the oocytes using vitrification or gradual freezing methods, and storage at -196°C for an extended period. Hormonal stimulation is also used in this process. Cryopreservation of oocytes can be achieved through either controlled freezing (slow freezing) or ultrarapid freezing (vitrification) (Leung et al., 2021). The progressive freezing technique was employed to document the first live birth using frozen oocytes in 1986. Cellular dehydration is induced by extracellular ice formation in equilibrium cooling or gradual freezing. Cryoprotectants (CPAs) are employed to mitigate cryodamage by inhibiting the formation of ice crystals. During cryopreservation, a variety of permeating (e.g., glycerol, dimethyl sulfoxide or DMSO, 1,2 propanediol, PROH) and nonpermeating (e.g., glucose, sucrose, fructose, trehalose) CPAs may be implemented. Due to a progressive decrease in temperature, cells are exposed to a low concentration of CPA (Anderson, et al., 2022).

The efficacy of oocyte cryopreservation is contingent upon a variety of factors, consisting of the age of the women at the moment of

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freezing, the indication, the total number of oocytes preserved, and the cryopreservation method (**Petersen and Hansen, 2022**). The most critical factor is the age at which the substance is frozen. Despite the absence of a definitive recommendation, it is generally advisable to be youthful. According to the estimates, the efficiency of live birth per thawed oocyte decreases with age (7.4% for individuals under the age of 30, 7.0% for those between the ages of 30 and 34, 6.5% for those between the ages of 35 and 37, and 5.2% for those aged 38 and older). Oocyte storage at an earlier age can optimize the quantity and quality of oocytes. Nevertheless, the woman is subjected to a greater physical, mental, and financial burden as the number of oocyte retrieval cycles required at an advanced age increases (**Pai et al., 2021**).

Complications associated with ovarian stimulation include adnexal torsion, thromboembolism, and Ovarian Hyper-Stimulation Syndrome (OHSS). The hallmark of OHSS is the internal fluid transfers from intravascular to extravascular spaces, which are the result of an increase in vascular permeability. Human Chorionic Gonadotropin (HCG), which is frequently used as the trigger medication, is believed to be a critical factor in the pathogenesis by promoting the release of vasoactive substances, particularly Vascular Endothelial Growth Factor (VEGF) (**Lambertini et al., 2020**). In moderate cases, abdominal distension, modest nausea, and diarrhea comprise the clinical characteristics. However, these symptoms may progress to severe/critical stages, which are further complicated by oliguria, extensive ascites, hemoconcentration, thromboembolism, arrhythmias, pleural effusions, adult respiratory distress syndrome, and/or sepsis (**Reich et al., 2022**).

Medical and nursing personnel are inconsistent in their awareness of elective egg storage among unmarried females. Therefore, it is imperative to instruct females at a tender age

about the preservation of fertility. Additionally, fertility preservation counseling is required for unmarried females to be informed of their fertility maintenance options (**Johnston et al., 2021**).

Barriers to use OC include lack of knowledge, and awareness about the technique, number of high-quality retrieved mature oocytes, concerns regarding long-term effects of the hormones and risks to females' health from the process of oocyte retrieval, and regarding disposition of oocytes, as well as possible risks to a child from frozen oocytes. Other factors include costs of the procedure for social and medical reasons, other illness, social relations, competence, and social stigma. Furthermore, awareness and barriers of unmarried females towards OC are important issues that can influence their willingness and intention toward fertility preservation (**Gambadauro et al., 2023**).

The nano-teaching approach is a recent educational trend that is intended to address a decrease in attention span. It is a bite-sized teaching method. It entails the provision of knowledge in a more condensed form over a shorter period of time, typically between 5 and 15 minutes, in order to enhance the capacity to absorb, retain, and pay attention to that information. Consequently, the nano-teaching session is considered a practicable and effective approach to raising women's awareness of specific issues, such as OC (**El-Kurdy et al., 2022**).

The importance of nurses in the care and education of females, as well as in the propagation of awareness regarding oocyte cryopreservation and the observance of females' rights, particularly the right to comprehend fertility preservation options, is widely acknowledged. Furthermore, nurses have a greater number of relationships with patients and families than other healthcare providers, in addition to their counseling and educational responsibilities within society. In recent years, the results of previous studies have indicated that the nursing profession is

accountable for the discussion of fertility preservation options from the perspective of physicians. (Yeshua et al., 2022).

Significance of the study:

A growing trend of delayed marriage and, as a consequence, reproduction until the 30s and 40s has been the result of the increased role of women in social participation and economic development. However, the risk of chromosomal abnormalities in oocytes increases considerably around the age of 35, resulting in a substantial increase in the propensity for infertility, miscarriage, high-risk pregnancy, and birth defects. Despite the fact that Egypt and other Islamic countries in the Middle East region have one of the most robust ART industries in the world, there is a scarcity of studies and a lack of data in this field (Han and Seifer, 2023).

The impact of age on the fertility of women has been the subject of numerous studies, which have demonstrated a lack of comprehension. The age at which eggs are frozen is the primary prognostic factor for success rates in fertility preservation. According to a meta-analysis, the most favorable outcomes are obtained when embryos are cryopreserved prior to the age of 36 (Jones et al., 2020). Using her own fresh eggs, the estimated success rate for a woman in her 40s who aspires to conceive is 6.6%. The success rate would have been over 40% per transfer if woman had preserved her embryos at the age of 30. However, the primary age group for cryopreservation is between the ages of 36 and 39, with a mean age of 37 to 38 at the time of freezing and 80% of patients being over the age of 35 (Chronopoulou et al., 2021).

Many studies conducted in Egypt have revealed a there is a significant knowledge gap among candidates for social egg freezing in Egypt regarding age-related fertility decline, fertility preservation options, and its associated complications. Furthermore, to the best of our knowledge, there is no available data on the acceptability of social indicators of fertility

preservation among unmarried Egyptian women. (El-Adham and Shaban, 2023). So, the aim of this research is to evaluate the effect of Nano-educational sessions on awareness, willingness and barriers toward elective oocyte cryopreservation among unmarried females as an increasing number of highly educated women are postponing reproduction in favor of professional endeavors.

Aim of the research

The research aimed to investigate the effect of nano-educational sessions on awareness, willingness and barriers toward elective oocyte cryopreservation among unmarried females

Research Hypotheses:

H1: The implementation of nano-educational sessions will reveal an increase in the level of awareness that unmarried females possess regarding elective oocyte cryopreservation.

H2: After the implementation of nano-educational sessions, unmarried females will have a more favorable attitude toward elective oocyte cryopreservation.

H3: Following the implementation of nano-educational sessions, unmarried females will demonstrate significantly reduced barriers to elective oocyte cryopreservation.

H4: Following the implementation of nano-educational sessions, unmarried females will demonstrate a greater willingness (intention) to undergo elective oocyte cryopreservation.

Operational definitions:

Nano-Educational Sessions: Nano Learning is a concept that refers to a technique of imparting educational content in small, manageable portions. These segments are typically presented in the form of brief videos or other multimedia and are intended to be ingested within a few minutes to facilitate the rapid and efficient acquisition of new knowledge without the need to devote a significant amount of time or attention to a single subject.

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Oocyte cryopreservation: is a fertility preservation technique that could prolong fertility beyond a woman's natural reproductive cycle. Utilizing Assisted Reproductive Technology (ART), eggs are obtained.

Subjects and method:

Research Design:

This research was conducted using a quasi-experimental study design, which involved a pre-posttest and a single group. This form of study is an empirical interventional approach that is designed to evaluate the causal impact of an intervention on a target population without the use of randomization. Despite its resemblance to conventional experimental designs or randomized controlled trials, quasi-experimental research does not involve the random assignment of subjects to treatment or control groups (**Iowa State University of Science and Technology, 2020**). The dependent variable is assessed twice in a pretest-posttest design: once prior to the intervention and again subsequent to it (**Spurlock, 2018**).

Study Setting:

Six non-medical faculties (Faculty of Computing and Information, Faculty of Applied Arts, Faculty of Art, Faculty of Education, Faculty of Physical Education, and Faculty of Commerce) where the research was conducted in Benha University in Qaliobya governorate, Egypt, which is the only university for Qaliobya Governorate and serves all districts of it. Benha University is an Egyptian university that was established by a decision issued on November 25, 1976 AD as a branch of Zagazig University in the city of Benha, which includes many different colleges. Then the university became independent from Zagazig University and became an independent university after it had been a branch of it. Each Faculty building is divided into different sections which are administrative offices; the

staff offices, the lecture halls that used for each academic year and practical laboratories.

Sampling:

Sample type and criteria: A purposive sample of unmarried females working at above-mentioned research settings were chosen according to following **inclusion criteria:** unmarried healthy females, age 30-40, able to use social media such as WhatsApp in order to benefit from electronically designed Nano-educational sessions and at least can read and write.

Sample Size and technique: The researchers compiled a list of non-medical faculties at Benha University. Six faculties were randomly selected (systematic random sample; one by one) from the list of 12 non-medical faculties. These faculties are as follows: Faculty of Computing and Information, Faculty of Applied Arts, Faculty of Art, Faculty of Education, Faculty of Physical Education, and Faculty of Commerce. The research was conducted in six non-medical faculties after the exclusion of females who did not satisfy the inclusion criteria. The research included all unmarried females employed at the previous settings, which amounted to **130** females.

Tools of data collection:

Data collection was conducted using four tools:

Tool I: A structured self-administered questionnaire that is structured: Following a review of relevant literature (**Hasab Allah et al., 2021; El-Adham and Shaban, 2023 and Mohamed et al., 2023**), it was developed by researchers and translated into the Arabic language. Two components will be included:

Part (1): Personal characteristics of unmarried females: It included eight items, including age, residence, level of education, occupation, religion, monthly income, having any background about ova cryopreservation and sources of information).

Part (2): Unmarried females' knowledge questionnaire (pre/posttest): After conducting a review of pertinent literature, researchers developed it and translated it into Arabic. It was intended to evaluate the level of knowledge that unmarried females possess regarding elective oocyte cryopreservation; it comprised of (18 questions) such as: (definition of oocyte cryopreservation, appropriate age, indications, advantages, side effect, complications, preparation, laboratory investigation, steps, duration of procedure, suitable number of eggs to frozen, survival rate of frozen egg, temperature degree for storage, methods of oocyte cryopreservation, affecting factors, legal procedures and females' rights, relationship between egg freezing and the risk of birth defects and the first unmarried Egyptian girl to undergo oocyte cryopreservation).

Scoring system:

The score of all knowledge questions except the source of knowledge were determined by the number of solutions provided in each question (multiple choice questions "MCQ"). The correct answer was assigned a score of one for each item, while the incorrect answer or "don't know" was assigned a score of zero. The sum of the scores of all questions was used to determine the total score. The knowledge of unmarried females was evaluated on a scale of 0 to 18.

Total knowledge score was categorized as following:

- Adequate knowledge: ($\geq 60\%$ correct answer).
- Inadequate knowledge: ($<60\%$ correct answer).

Tool II: Modified Likert scale "Unmarried females' attitudes": It was translated into Arabic language and derived from (Abbass et al., 2023; Al Ghaithi et al., 2023 and Tozzo et al., 2019). It served to evaluate the attitudes of unmarried females toward elective oocyte

cryopreservation; it has been modified by adding some sentences to be more comprehensive, deleting some duplicate sentences, and sometimes rewording some other sentences to be clear. it consisted of (21 statements as listed in the table "3") such as: (importance of information about ovum freezing to woman, preserving woman's fertility through ova cryopreservation for future pregnancy, discussing fertility preservation with newly women used egg freezing as a high priority, the influence of social acceptance and culture on the decision-making process regarding ova cryopreservation, feeling the test to check ovarian reserve should be freely available, freezing eggs in certain cases, whether medically or when marrying at a late age...etc.)

Scoring system:

The three-point Likert scale continuum was used to evaluate each statement. Each statement was assigned a score of two if it was "agree," one if it was "uncertain," and zero if it was "disagree." The statement-by-statement scores were combined to determine the cumulative dispositions score. The attitudes of unmarried females were given a cumulative score ranging from 0 to 42, with higher scores indicating more positive attitude. **Total attitudes score was categorized into:**

- Positive attitude: ($\geq 60\%$ -100%).
- Negative attitude: ($< 60\%$).

Tool III: Unmarried females' barriers assessment questionnaire: The researchers were responsible for its development and informed by the most recent pertinent literature (Tozzo et al., 2019; Malhotra et al., 2022 and Mohamed et al., 2023) to evaluate the participants' obstacles to ova cryopreservation. It featured (16 barriers as listed in the table "4") with 3 possible answers (agree, to some extent or disagree); including

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barriers such as: (fear of future husband refusal, getting older due to the fear of death and leaving the children alone, fear of the possibility of egg mixing with those of another woman, ova cryopreservation is very expensive and therefore cannot be feasible to anyone, constraints on my time, fear of ova cryopreservation may decrease future fertility...etc.)

Scoring system:

The three-point Likert scale was used to evaluate each barrier. Each barrier was given a score (2) if it was "agree", a score (1) if it was "to some extent", in the event that it was "disagree"; a score of zero. The total score of unmarried females' barriers ranged from (0 to 32); and the higher score indicates more obstacles or barriers. **Total barriers score was categorized into:**

- Satisfactory response: (< 60 %).
- Unsatisfactory response: ($\geq 60\%$ -100%).

Tool IV: Unmarried females' willingness (intention) questionnaire (pre/posttest): it had been adopted from (Greenwood et al., 2018; Fahmy and Mohamed, 2021 and Platts et al., 2020) and used to assess unmarried females' willingness regarding elective oocyte cryopreservation; it included (7 items) to as: (interested in checking the ovarian reserve, paying for a test to check ovarian reserve, the decision to freeze ova is a valid decision, the decision to freeze ova is a wise decision, being in favor of ovum freezing, being ashamed of making the decision to freeze ova, making the decision to freeze ova would cause me a lot of trouble).

Scoring system:

Each item was evaluated in accordance with a five-point Likert scale. The scores for each item were assigned as follows: strongly agree = 5, agree = 4, neutral = 3, disagree = 2, and strongly disagree = 1. The total score of unmarried females' willingness ranged from (7 to 35); and the higher score indicates more

willingness or intention regarding oocyte cryopreservation. Total willingness score was categorized into:

- High willingness: ($\geq 75\%$).
- Moderate willingness: (50 - <75%).
- Low willingness: (<50%)

Tools validity and reliability:

In order to guarantee the precision, relevance, comprehensiveness, and the questionnaires' validity, the tools were evaluated by a panel of five jury experts in the field of obstetrics and gynecology nursing and community health nursing at Benha University, who evaluated the tools' applicability. Minor modifications were required for sentences. The tools were deemed valid by the experts.

The internal consistency of the knowledge questionnaire for unmarried females was 0.82, and the attitudes questionnaire for unmarried females was 0.85, as determined by the Cronbach's Alpha coefficient test, unmarried females' barriers assessment questionnaire was 0.79 and unmarried females' willingness (intention) questionnaire was 0.80.

Ethical consideration:

Prior to commencing the research, the subsequent ethical considerations will be assessed: The scientific research ethical committee of the nursing faculty at Benha University provided its endorsement for the research, which was conducted with official sanction from the designated study settings. The researchers provided a detailed explanation of the research's objectives and significance prior to the applications of the tools in order to establish the confidence and trust of female participants. The researchers obtained oral consent from female participants to participate in the study, and confidentiality was ensured. The female participants were not subjected to any physical, social, or psychological hazards during the investigation. In order to safeguard the confidentiality of the

female participants, all data collection instruments were destroyed following statistical analysis. The study instruments were designed to prevent any damage to females during the data collection process. Additionally, there were unethical statements and human rights were upheld. The women were permitted to discontinue their studies at any point.

Pilot study:

In order to assess the lucidity, objectivity, feasibility, and applicability of the tools, as well as to identify potential impediments and issues that could impede data collection and impact the researcher, the pilot study was conducted on 10% of the total sample set (13 females). Additionally, to identify any distinctive issues with the statements, such as the sequence of queries and clarity, the study was devised. The estimation of the time necessary for data collection was also facilitated by this. In an effort to prevent contamination of the sample, the prototype sample was excluded from the primary sample size, and the main sample size was adjusted in accordance with the pilot results.

Field work:

The Faculty of Nursing Ethical Committee at Benha University agreed to the conduct of the research. Dean of the nursing faculty provided written official sanction for the conduct of this study, which was subsequently transmitted to the responsible authorities (Deans of faculties of 6 faculties) in order to secure their consent to conduct the study after clarifying its purpose. To be eligible for participation, each unmarried female was required to provide oral assent.

The research was conducted over a six-month period, commencing in June 2023 and concluding in December 2023. The researchers conducted the study at the aforementioned settings on Saturdays, Mondays, and Wednesdays until the

predetermined sample size was collected, which occurred from 9:00 a.m. to 1:00 p.m. The researchers conducted interviews with the females in small groups to facilitate the implementation of Nano-educational sessions on oocyte cryopreservation and fertility preservation. The (booklet) comprising concise information that was presented during the sessions was distributed to each unmarried female at the conclusion of this research. Additionally, the designed Nano-videos were sent to all unmarried females. Therefore, the advantage is disseminated.

The following phases were implemented to attain the objectives of this research: the preparatory phase, the interviewing and assessment phase, the planning phase, the implementation phase, and the evaluation phase.

Preparatory phase:

The preparatory phase is the initial phase of the research, during which the researchers review local and the international literature that is relevant to the research problem. This assistance was instrumental in the researchers' comprehension of the issue's magnitude and severity, as well as in the creation of the requisite data collection instruments. The jury's verdicts were rendered.

In this phase, the researchers developed the needed learning courses with assistance of technology specialists (from information technology unit at Benha university¹) to assist researchers in developing a technological proficiency that enables them to generate dynamic infographics, brief videos, podcasts, and social media postings, as well as to provide them with training and familiarity with applications used for micro and Nano-learning WhatsApp; to be applied in educational sessions

Interviewing and assessment phase:

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Those who were female were praised by the researchers at the outset of the interview, introduced themselves to each unmarried female participant, clarified the purpose of the study, furnished the female with all pertinent inform. It was administered to all unmarried female. Action, and obtained oral consent for her to participate in the research. All females were administered **the Tool (I): A structured self-administered questionnaire form** was used to evaluate the general characteristics of the female participants and their knowledge of elective oocyte cryopreservation. Then, the researchers used **Tool (II): Modified Likert scale "Unmarried females' attitudes"** to assess unmarried females' attitude toward elective oocyte cryopreservation, **Tool III: Unmarried females' barriers assessment questionnaire** to evaluate the participants' obstacles to ova cryopreservation; and **Tool IV: Unmarried females' willingness (intention) questionnaire** to assess unmarried females' willingness regarding elective oocyte cryopreservation. The questionnaires were completed on average in 25-35 minutes. In order to assess the efficacy of Nano-educational sessions, the data acquired during this phase was employed as the basis for subsequent comparisons.

Planning phase:

The researchers devised the Nano-educational sessions on oocyte cryopreservation and fertility preservation in the form of dynamic infographics, brief videos, podcasts, and social media the results acquired during the assessment phase were the basis for the posts. It was created with the intention of specifically for unmarried females regarding fertility preservation and oocyte cryopreservation, in a straightforward Arabic language that is appropriate for the level of comprehension and to address the knowledge deficit of the unmarried females

being studied. The number of sessions, their contents, the instructional media and the diverse methodologies of nano-teaching are all determined. Researchers created a group on the WhatsApp application, and all the unmarried females included in the research were added.

After the Nano-educational sessions were completed, objectives were established to be achieved. The primary goal was to ensure that every unmarried female has the opportunity to obtain fundamental knowledge and a positive attitude, a decreased number of barriers, and an increased willingness to participate in elective oocyte cryopreservation by the end of the Nano-educational sessions.

Implementation phase

The researchers devised the Nano-educational sessions to assess knowledge, attitude, barriers and willingness of unmarried females regarding elective oocyte cryopreservation. It was conducted face to face or through a created group on the WhatsApp application immediately following the conclusion of the assessment phase. As stated earlier, bringing Nano-education required creating new multimedia lessons. The intervention was executed over a two-week period for each group through six scheduled Nano-educational sessions, with the following guidelines for Nano-educational sessions: **(Hudovernik, 2021)** **(Arpana, 2023)**

- Duration of each: is generally 5–10 minutes.
- Scope: Highly targeted; covers an only one or two objectives.
- Multimedia: include text, video, sound, images and animation, in addition to booklet illustrated with colorful pictures. Despite the brief duration of the videos, the recording process requires a significant amount of time.

- The in-depth lessons that unmarried females require to gain a comprehensive understanding of the underlying issues should be provided during nano-sessions.
- Nano-sessions provide too much attraction and sometimes more effective modes of teaching.
- Nano-learning achieves enhanced levels of comprehension and retention due to its highly focused, chunked-down teachings. Additionally, Nano-learning enhances attentional appeal and sometimes more effective modes of teaching because each Nano-sessions is short.
- Nano-learning is a concise, in-and-out approach to learning, as the learner is aware that the lesson will be brief. Consequently, they are more inclined to devote their full attention, energy, and time to brief learning surges. Quite essentially, the concept is that nano-learning results in increased productivity.
- Nano Learning, or bite-sized learning, is a solution that meets the requirements of the younger generation, who desire knowledge that is more concise and precise in this digital era.; **So, the following sessions was conducted:**
 - The **first session** was about (definition of oocyte cryopreservation, appropriate age and indications).
 - The **second session** was about (advantages of oocyte cryopreservation, side effect and complications).
 - The **third session** was about (preparation, laboratory investigation and steps of oocyte cryopreservation).
 - The **fourth session** was about (duration of procedure, suitable number of eggs to frozen, survival rate of frozen egg and temperature degree for storage).
 - The **fifth session** was about (methods of oocyte cryopreservation, affecting factors and

relationship between egg freezing and the risk of birth defects).

- The **sixth session** was about (legal procedures and patient's rights).

Evaluation phase:

The researchers evaluated the effect of the nano-educational sessions using the same format of tools (Tool I "part 2", Tool II, Tool III, and Tool IV) following their implementation which used during the assessment phase and the researchers evaluate unmarried females' knowledge and attitude, barriers and willingness one-month after intervention from the last session by visiting the previously mentioned study settings a month after implementing Nano-educational sessions, or by publishing the data collection form on the previously created WhatsApp group using Google Form.

Statistical analysis:

Before the data was entered into the computer system, it was verified. Statistical methods and tests were employed to organize, classify, computerize, and analyze the data that has been collected. The analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 22.0. These descriptive statistics comprised means, standard deviations, frequencies, and percentages. The study hypothesis was tested using inferential statistics, specifically the Chi-square test and the paired t-test. The relation between knowledge scores and the variables of attitude, intention, and barriers was investigated using the correlation coefficient. A p-value of 0.05 or less indicated a statistically significant difference, while a p-value of 0.001 or less indicated a highly statistically significant difference. Therefore, a p-value greater than 0.05 indicated no statistically significant difference.

Limitations

Sometimes, it was difficult to gather all the sample members present in the same

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college at one time due to their work duties. The researchers also found it difficult to provide a place to conduct the study, so the researchers sometimes replaced that by creating a WhatsApp group to improve communication between researchers and research participants to upload videos and other educational media through this group

Results:

Table (1): Demonstrates the personal characteristics of the sample under investigation. It was determined that the majority of the sample (52.3%) was between the ages of 35 and 40, with a mean age of 35.02 ± 7.57 years. In terms of domicile, urban areas were the home of over half of them (55.4%). Additionally, over half of them (57.7%) pursued postgraduate studies. In relation to occupation, more than half (50.8%) of them was staff member. Additionally, majority of them (93.1%) were Muslims. Also, (45.4%) of them had insufficient monthly income. As well as, Fewer than seventy-five percent (74.6%) of them had any prior knowledge regarding ova cryopreservation.

Figure (1): Displays that, (54.6%) (40.0%) (25.4%) of studied sample obtain their information from internet and social media, health care provider and friends & relatives respectively.

Table (2): Demonstrates that, there was a marked change in knowledge of studied sample regarding elective oocyte cryopreservation after implementation of the nano-educational sessions with a highly statistical significant difference ($p < 0.001$) between pre and post- intervention phases.

Figure (2): Displays that, (39.2%) and (84.6%) of studied sample had adequate knowledge regarding elective oocyte cryopreservation at pre and post-intervention phases respectively. While, it was revealed that (60.8%) and (15.4%) of them had inadequate

knowledge Pre and Post-intervention phases respectively.

Table (3): Clears that, there was a notable change in attitude of examined sample regarding elective oocyte cryopreservation following execution of the program with a highly statistically significant difference ($p < 0.001$) between pre and post- intervention phases.

Figure (3): Indicates that in the pre-intervention and post-intervention phases, 32.3% and 81.5% of the sample exhibited a positive attitude toward elective oocyte cryopreservation, respectively. Conversely, 67.7% and 18.5% of the sample exhibited a negative attitude toward elective oocyte cryopreservation in the pre- and post-intervention phases.

Table (4): It is evident that the barriers associated with elective oocyte cryopreservation in the studied sample were significantly reduced following the implementation of the program, with a highly statistically significant difference ($p < 0.001$) between the pre- and post-intervention phases.

Figure (4): Demonstrates that the pre-intervention and post-intervention phases of the studied sample had satisfactory responses to barriers to elective oocyte cryopreservation, with a (27.7%) and (76.9%) response rate, respectively. At the pre-intervention and post-intervention phases, it was discovered that (72.3%) and (23.1%) of the participants had a satisfactory response to the barriers to elective oocyte cryopreservation, respectively.

Table (5): It is evident that the total mean score for willingness items of the analyzed sample was greater than the score before the program was implemented, with a highly statistically significant difference ($p \leq 0.001$) between the pre- and post-intervention phases. Significant differences were also observed in all items of willingness (intention) ($p \leq 0.001$).

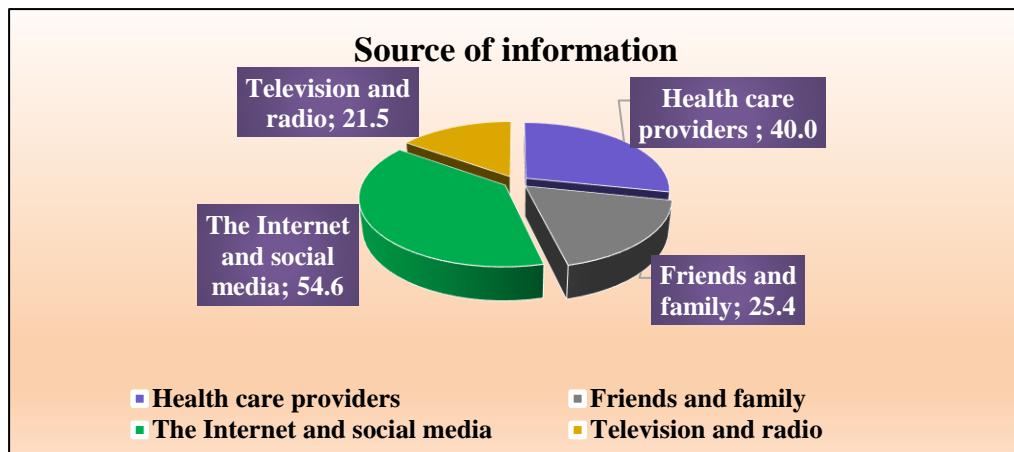
Figure (5): The results of the study indicate that a high level of willingness (intention) regarding elective oocyte cryopreservation was present in the pre- and post-intervention phases of the sample, with a percentage of (20.7%) and (63.1%), respectively. Although, it was discovered that (43.1%) and (11.5%) of them exhibited a low level of willingness (intention) during the pre- and post-intervention phases, respectively.

Table (6): Indicate that the total knowledge and (total attitude & intention) scores exhibited a highly significant statistical positive correlation during the pre- and post-intervention phases ($P \leq 0.001$). A statistically significant negative correlation was observed between the total knowledge and total barriers scores during the pre- and post-intervention phases ($P \leq 0.001$).

Table (1) Distribution of the studied sample according to their personal characteristics (n=130).

Personal characteristics	No	%
Age:		
30 – >35	62	47.7
35-40	68	52.3
Mean ± SD = 35.02±7.57		
Residence:		
Urban	72	55.4
Rural	58	44.6
Level of education:		
Read and write (basic education)	9	6.9
Secondary or technical education	15	11.5
University education	31	23.8
Postgraduate studies	75	57.8
Occupation:		
Workers	18	13.8
Employers	46	35.4
Staff members	66	50.8
Religion:		
Muslim	121	93.1
Cristian	9	6.9
Monthly income:		
Insufficient	59	45.4
Fairly enough	46	35.4
Enough and saving	25	19.2
Having any background about ova cryopreservation		
Yes	33	25.4
No	97	74.6

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* Results not mutually exclusive

Figure (1): Distribution of the studied sample source of information regarding elective oocyte cryopreservation (n =130).

Table (2): Distribution of studied sample regarding their knowledge about elective oocyte cryopreservation at Pre and Post-intervention phases (n=130).

Knowledge items	Pre-intervention		Post-intervention		X ² P-value
	Correct answer	Incorrect answer	Correct answer	Incorrect answer	
	No %	No %	No %	No %	
Definition of oocyte cryopreservation	63 48.5	67 51.5	112 86.2	18 13.8	41.96 0.000**
Appropriate age for oocyte cryopreservation	58 44.6	72 55.4	97 74.6	33 25.4	24.29 0.000**
Indications of oocyte cryopreservation	39 30.0	91 70.0	93 71.5	37 28.5	44.87 0.000**
Advantages of oocyte cryopreservation	30 23.1	100 76.9	83 63.8	47 36.2	43.96 0.000**
Side effect oocyte cryopreservation	36 27.7	94 72.3	78 60.0	52 40.0	27.55 0.000**
Complications of oocyte cryopreservation	40 30.8	90 69.2	84 64.6	46 35.4	29.84 0.000**
Preparation before oocyte cryopreservation	25 19.2	105 80.8	92 70.8	38 29.2	69.75 0.000**
Laboratory investigation required before the procedure.	37 28.5	93 71.5	105 80.8	25 19.2	71.75 0.000**
Steps of oocyte cryopreservation	29 22.3	101 77.7	94 72.3	36 27.7	65.18 0.000**
Duration of oocyte cryopreservation procedure	39 30.0	91 70.0	87 66.9	43 33.1	35.48 0.000**
Suitable number of eggs to frozen	37 28.5	93 71.5	80 61.5	50 38.5	28.73 0.000**
Survival rate of frozen egg in a woman with less than 35 years	44 33.8	86 66.2	79 60.8	51 39.2	18.90 0.000**
Temperature degree for storage of eggs	18 13.8	112 86.2	62 47.7	68 52.3	34.95 0.000**
Methods of oocyte cryopreservation	38 29.2	92 70.8	77 59.2	53 40.8	32.71 0.000**
Factors affect oocyte cryopreservation	54 41.5	76 58.5	95 73.1	35 26.9	26.42 0.000**
Legal procedures and patient's rights for egg freezing operations	51 39.2	79 60.8	103 79.2	27 20.8	43.06 0.000**
Relationship between egg freezing and the risk of birth defects	33 25.4	97 74.6	86 66.2	44 33.8	43.52 0.000**
The first unmarried Egyptian girl to undergo oocyte cryopreservation	28 21.5	102 78.5	69 53.1	61 46.9	27.64 0.000**

*A Statistical significant $p \leq 0.05$

**A Highly Statistical significant $p \leq 0.001$

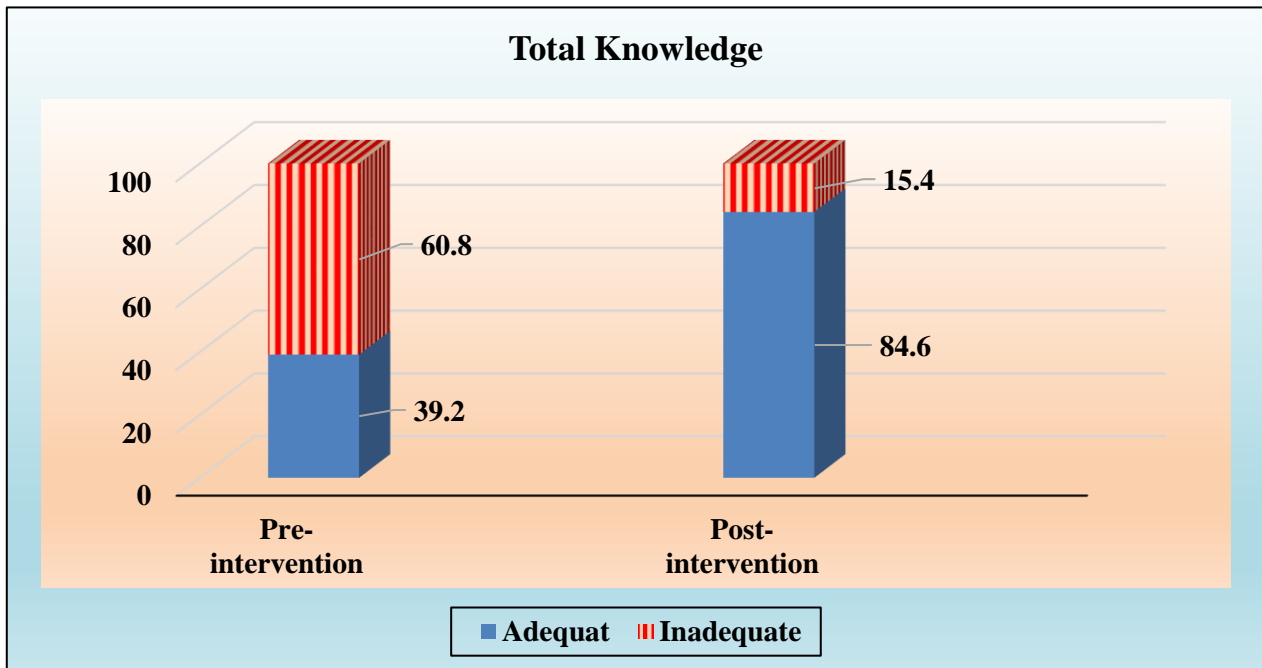


Figure (2): Percentage distribution of studied sample regarding their total knowledge score about elective oocyte cryopreservation at Pre and Post-intervention phases (n=130).

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Table (3): Distribution of studied sample regarding their attitude toward elective oocyte cryopreservation at Pre and Post-intervention phases (n=130).

Attitude items	Pre-intervention			Post-intervention			X ² P-value
	Agree	Uncertain	Disagree	Agree	Uncertain	Disagree	
	No %	No %	No %	No %	No %	No %	
Information about ovum freezing is important	44 33.8	52 40.0	34 26.2	87 66.9	21 16.2	22 16.9	29.58 0.000**
Preserving fertility through ova cryopreservation for future pregnancy.	30 23.0	60 46.2	40 30.8	81 62.3	15 11.5	34 26.2	50.91 0.000**
Discussing fertility preservation with newly women used egg freezing is a high priority	46 35.4	49 37.7	35 26.9	69 53.1	22 16.9	39 30.0	15.08 0.001**
Social acceptance and culture may effect on decision making toward ova cryopreservation	98 75.4	29 22.3	3 2.3	125 96.2	5 3.8	0 0.0	23.21 0.000**
Feeling the test to check ovarian reserve should be freely available.	48 36.9	50 38.5	32 24.6	89 68.4	30 23.1	11 8.5	27.52 0.000**
Freezing eggs in certain cases, whether medically or when marrying at a late age.	67 51.6	32 24.6	31 23.8	99 76.2	24 18.4	7 5.4	22.46 0.000**
The freezing process is not completely prohibited by religion, but it is permitted in certain cases	60 46.2	28 21.5	42 32.3	98 75.4	14 10.8	18 13.8	23.40 0.000**
Egg donation after freezing is legally prohibited	56 43.1	43 33.1	31 23.8	91 70.0	19 14.6	20 15.4	19.99 0.000**
Babies born using ova cryopreservation are socially acceptable.	49 37.7	48 36.9	33 25.4	100 76.9	30 23.1	0 0.0	54.61 0.000**
Not important to confine the physicians and the laboratory staff who are involved in the storage.	29 22.3	46 35.4	55 42.3	90 69.2	31 23.9	9 6.9	67.25 0.000**
Freezing and storage operations must be monitored,	33 25.4	37 28.5	60 46.2	101 77.7	11 8.5	18 13.8	71.20 0.000**
Ovum freezing settings must be certified and standards	52 40.0	60 46.2	18 13.8	89 68.5	30 23.1	11 8.5	21.39 0.000**
Infection control precautions should be used during freezing and storage operations	71 54.6	22 16.9	37 28.5	103 79.2	19 14.6	8 6.2	24.79 0.000**
Not concerning about the ovum cost of withdrawal.	98 75.4	29 22.3	3 2.3	125 96.2	5 3.8	0 0.0	23.21 0.000**
Not concerning about retrieval and storage.	41 31.5	33 25.4	56 43.1	98 75.4	17 13.1	15 11.5	52.17 0.000**
Not concerning about the wrong use of frozen ovum.	46 35.4	58 44.6	26 20.0	91 70.0	22 16.9	17 13.1	32.86 0.000**
Not concerning about poor storage of frozen ovum	25 19.2	53 40.8	52 40.0	92 70.8	20 15.4	18 13.8	69.80 0.000**
Not concerning about the long storage period	29 22.3	28 21.5	73 56.2	86 66.2	30 23.0	14 10.8	68.33 0.000**
Not fearing of not using frozen ovum in the future	68 52.3	30 23.1	32 24.6	109 83.9	12 9.2	9 6.9	30.11 0.000**
Ova cryopreservation isn't an emotional burden	51 39.2	19 14.6	60 46.2	94 72.3	16 12.3	20 15.4	33.00 0.000**
Ova cryopreservation is affordable/accessible	20 15.4	30 23.1	80 61.5	74 56.9	20 15.4	36 27.7	49.71 0.000**

*A Statistical significant $p \leq 0.05$

**A Highly Statistical significant $p \leq 0.001$

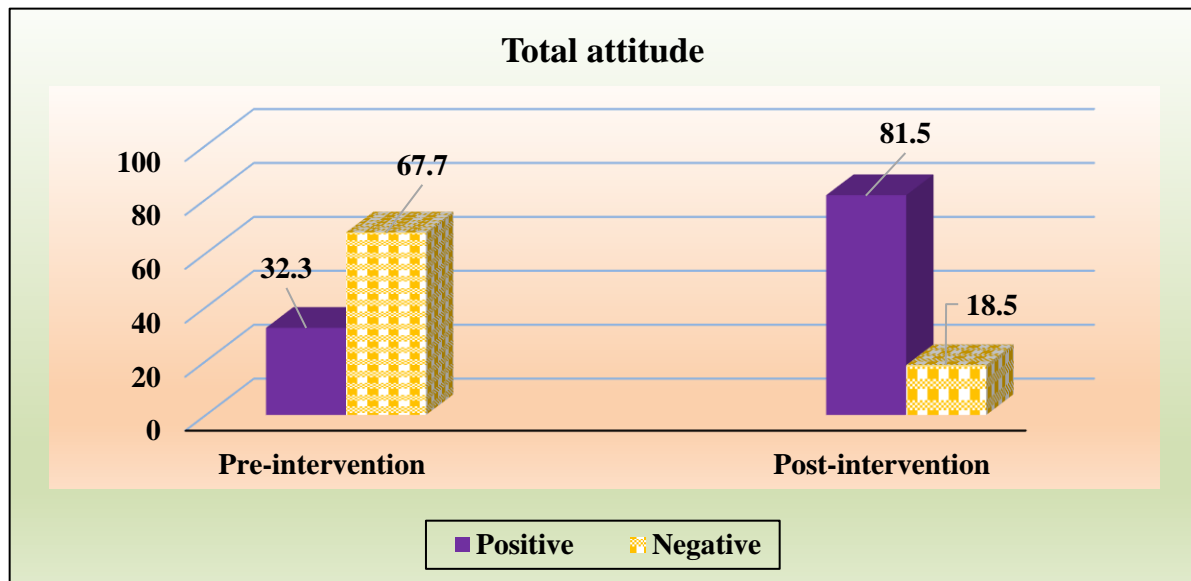


Figure (3): Percentage distribution of studied sample regarding their total attitude score about elective oocyte cryopreservation at Pre and Post-intervention phases (n=130).

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Table (4): Distribution of studied sample regarding their barriers regarding elective oocyte cryopreservation at Pre and Post-intervention phases (n=130).

Barriers items	Pre-intervention			Post-intervention			X ² P-value
	Agree	To some extent	Disagree	Agree	To some extent	Disagree	
	No %	No %	No %	No %	No %	No %	
Fear of future husband refusal.	87 66.9	20 15.4	23 17.7	43 33.1	46 35.4	41 31.5	30.19 0.000**
Getting older due to the fear of death and leaving the children alone	96 73.8	27 20.8	7 5.4	39 30.0	40 30.8	51 39.2	59.96 0.000**
Fear of the possibility of egg mixing with those of another woman.	92 70.8	20 15.4	18 13.8	25 19.2	53 40.8	52 40.0	69.80 0.000**
Ova cryopreservation is very expensive and therefore cannot be feasible to anyone	103 79.2	19 14.6	8 6.2	71 54.6	22 16.9	37 28.5	24.79 0.000**
Constraints on my time	74 56.9	20 15.4	36 27.7	20 15.4	30 23.1	80 61.5	49.71 0.000**
Fear of Ova cryopreservation may decrease future fertility	86 66.2	30 23.1	14 10.8	29 22.3	28 21.5	73 56.2	68.33 0.000**
Possible health risks to a child conceived using frozen eggs	105 80.8	14 10.8	11 8.5	30 23.1	24 18.5	76 58.5	92.86 0.000**
Ova Cryopreservation may lead to loss of virginity for single women	120 92.3	10 7.7	00.0	61 46.9	28 21.5	41 31.5	68.75 0.000**
Ova cryopreservation make women more prone to moral criticism	111 85.4	19 14.6	00.0	36 27.7	30 23.1	64 49.2	104.73 0.000**
Traditional cultural and social barriers	102 78.5	10 7.7	18 13.8	43 33.1	28 21.5	59 45.4	54.36 0.000**
Challenges due to religious restrictions	100 76.9	20 15.4	107.7	31 23.8	42 32.3	57 43.8	74.89 0.000**
Lack of fertility service in the area	94 72.3	20 15.4	1612.3	44 33.8	33 25.4	53 40.8	41.14 0.000**
Limited knowledge about fertility preservation options	87 66.9	22 16.9	2116.2	29 22.3	45 34.6	56 43.1	52.80 0.000**
Family does not want to discuss fertility preservation	96 73.8	19 14.6	15 11.5	32 24.6	41 31.5	57 43.8	64.56 0.000**
Emotional distress.	91 70.0	19 14.6	20 15.4	56 43.1	43 33.1	31 23.8	19.99 0.000**
The success rate of fertility preservation is not as yet good enough to make it a viable option	98 75.4	14 10.8	18 13.8	60 46.2	28 21.5	42 32.3	23.40 0.000**

*A Statistical significant $p \leq 0.05$

**A Highly Statistical significant $p \leq 0.001$

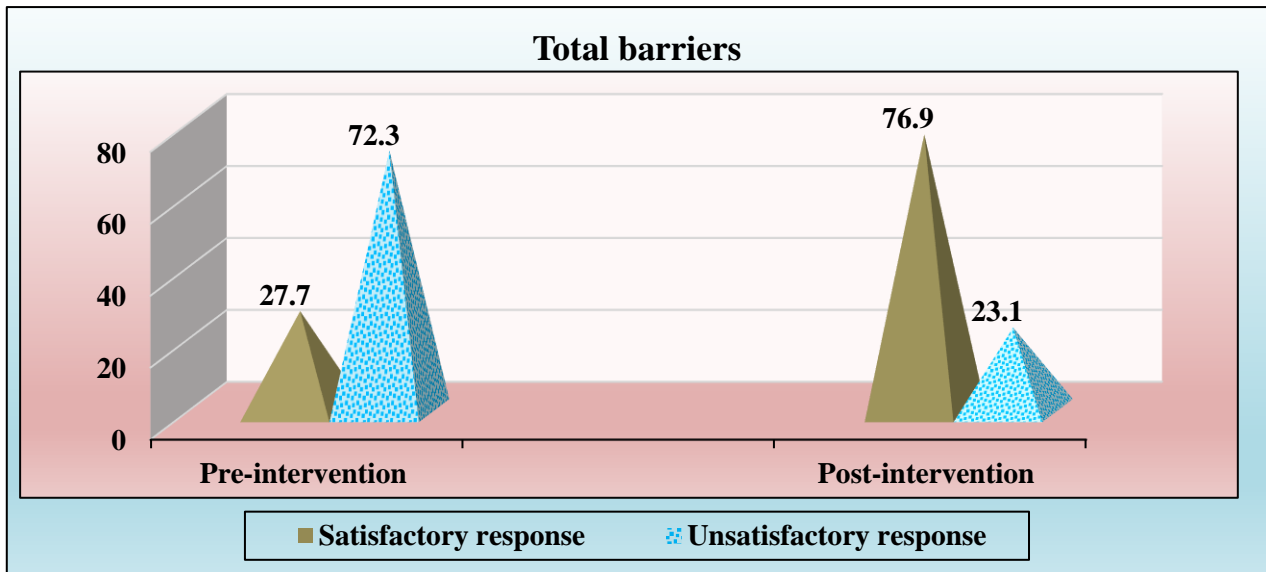


Figure (4): Percentage distribution of studied sample regarding their total barriers score regarding elective oocyte cryopreservation at Pre and Post-intervention phases (n=130).

Table (5): Mean scores of willingness (intention) of studied sample regarding elective oocyte cryopreservation at Pre and Post-intervention phases (n=130).

Willingness items	Max. score	Pre-intervention	Post-intervention	Paired t-test p-value
		Mean ± SD	Mean ± SD	
Being interested in checking the ovarian reserve.	5	2.10±.995	3.78±.787	15.66 .000**
Paying for a test to check my ovarian reserve.	5	1.46±.789	2.55±.584	12.97 .000**
The decision to freeze ova is a valid decision.	5	2.23±1.03	3.06±.712	7.41 .000**
The decision to freeze ova is a wise decision.	5	3.00±1.04	3.62±1.00	5.11 .000**
Being in favor of ovum freezing.	5	2.62±.69	3.42±.870	8.47 .000**
Not being ashamed of making the decision to freeze my ova.	5	2.35±.631	3.23±.629	10.86 .000**
Making the decision to freeze my ova wouldn't cause me a lot of trouble.	5	1.74±.710	2.86±.744	13.16 .000**
Total score	35	15.49±2.40	22.53±1.98	25.79 .000**

*A Statistical significant $p \leq 0.05$

**A Highly Statistical significant $p \leq 0.001$

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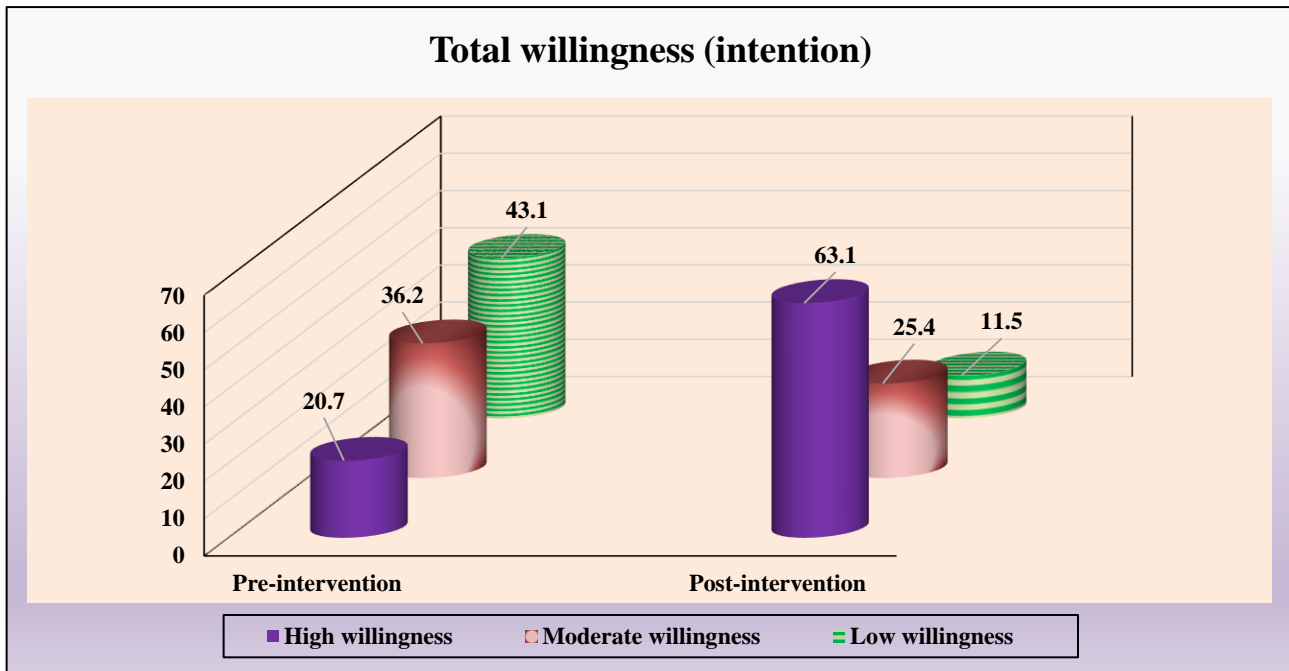


Figure (5): Percentage distribution of studied sample regarding their total willingness (intention) score regarding fertility preservation and oocyte cryopreservation at Pre and Post-intervention phases (n=130).

Table (6): Correlation between total knowledge score and (attitude, intention & barriers scores) of the studied sample at Pre and Post-intervention phases.

Variables	Total knowledge			
	Pre-intervention		Post-intervention	
	r	P-value	R	P-value
Total attitude	0.422	0.000**	0.457	0.000**
Total intention	0.513	0.000**	0.539	0.000**
Total barriers	- 0.547	0.000**	- 0.648	0.000**

**A Highly Statistical significant $p \leq 0.001$

Discussion:

An increasing number of females have been delaying marriage and reproduction in recent decades as a result of a multifaceted multitude of factors, such as the absence of a companion, the pursuit of career and educational advancement, and economic difficulties or financial stability. This phenomenon, which is referred to as the postponement transition, is becoming a

significant global concern in response to the persistent age-related decline in fertility that has been observed. Many females who are currently experiencing the burden of the biological clock have been afforded significant reproductive options as a result of recent advancements in OC techniques (Porcu et al., 2022).

The progressive decline in female fecundity with age has been recognized in numerous demographic and epidemiological studies, which is attributed to a reduction in ovarian quantity and quality. This decline has been observed beginning in the mid-thirteenth century. The trend of postponing motherhood, in conjunction with the deterioration of ovarian function, has resulted in an increase in the number of women who are involuntarily childless. Therefore, the solution and procedure for the preservation of a woman's ova (oocytes) is OC. This method has been employed to allow women to postpone conception until a later date, whether for medical or social reasons **(Hafezi et al., 2022)**.

The present research aimed to evaluate the influence of Nano-educational sessions on unmarried females' awareness, willingness, and barriers to elective oocyte cryopreservation. The research hypotheses were substantially supported by the results of this study, which demonstrates the significance of implementing Nano-educational sessions to increase the awareness and willingness of unmarried females to undergo elective oocyte cryopreservation, and its importance in reducing their barriers.

Personal characteristics, the awareness, inclination, and barriers of unmarried females toward elective oocyte cryopreservation are primarily influenced by the data of the studied females, and monthly income, as well as age, residence, level of education, occupation, and religion. Therefore, it is imperative to ascertain these variables for the females under investigation. In terms of the present research revealed that the majority of the sample, specifically over half, was between the ages of 35 and 40, with a mean age of 35.02 ± 7.57 years, as indicated by the personal characteristics of the females under investigation. In respect of a domicile, over half of them resided in urban areas. Additionally,

over half of them pursued postgraduate studies. More than half of them were employed as staff members. Furthermore, the plurality of them identified as Muslims. Additionally, less than half of them had an insufficient monthly income. Additionally, less than seventy-five percent of them possessed no prior knowledge regarding ova cryopreservation.

This outcome was consistent with the findings of **(El-Adham and Shaban., 2023)**, who disclosed that (27% of the unmarried healthy females) were between the ages of 20 and 29, (68% were between the ages of 30 and 39), and (5%) were between the ages of 40 and 49. The range of the samples was 25 to 42 years, with a mean + standard deviation of $(31.60 + 3.78)$. Concerning residence (822*39*33333333%) were both urban residents and had university and postgraduate studies; (51%) were staff members, and (44%) had insufficient family income. Moreover, **(Mohamed et al., 2023)** who mentioned that the mean \pm SD of 25.53 ± 4.95 was reported for 60% of postgraduate females, with an age range of 25 to 30 years. Regarding residence and occupation, it was evident that 61.7% and 56.6% of the participants resided in urban areas and were not employed, respectively. Additionally, 51.4% of the study subjects had a moderate socio-economic status.

Conversely, the findings of the current investigation were in direct opposition to **(Mohamed et al., 2023)** who illustrated that the highest percentage of study subjects related their age (33.3%) were < 20 years old with a mean age+ SD of 25.65 ± 5.33 , while 50% of the sample were secondary & technical institute education and 23.3% were finance office. According to residence, two thirds (63.3 %) of unmarried females were from rural area

Concerning source of information, it was displayed that, the majority of studied females (more than half) (two-fifths) (more than one-quarter) obtain their information from

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internet and social media, health care provider and friends & relatives respectively. These findings underscored the substantial influence of the internet and social media on the awareness of women, whether in a positive or negative manner. Therefore, it is imperative that females are equipped with the appropriate knowledge through a variety of educational programs.

The present results of the research are in agreement with those of **(Mohamed et al., 2023)** who found that the primary sources were the internet and television (31.3 percent and 30.8%, respectively). In the same context, **(Hasab Allah et al., 2021)** who found that social media (46.4%) was the primary source, subsequently followed by physician and nurses (11.2%) and school and university (25.6%). The results of the current study are essentially consistent with those of **(Mohamed et al., 2023)**, who found that health care personnel were the primary source of information regarding frozen oocytes for unmarried females (40%), followed by internet and mass media (30%), then friends (15%), while the least source of information were from books and administrative staff (10% and 5%) respectively.

Moreover, **(Stevenson et al., 2021)** highlighted that the most used fertility information source was media (63.4%). This result is not unexpected, as it can be attributed to the fact that this demographic of adolescents is avidly engaged with social media and allocates a substantial quantity of time to it. Furthermore, they have easy access to social media, which offers them a wide range of information across a variety of fields.

The implementation of the program resulted in a substantial enhancement in the knowledge of the studied sample regarding elective oocyte cryopreservation, as indicated by the current research. A highly statistically significant difference was observed between the pre- and post-intervention phases

($p < 0.001$). This pertains to the female subject of the investigation. The examined sample exhibited a sufficient level of knowledge regarding elective oocyte cryopreservation (39.2%) and (84.6%) in both the pre-intervention and post-intervention phases, respectively. While, it was discovered that (60.8%) and (15.4%) of them possessed insufficient knowledge respectively, during the pre- and post-intervention phases. The well-organized Nano-educational sessions may have had a positive impact on this outcome. The women who were the subjects of the research were highly engaged and content during the learning sessions, as the subject matter was deemed to be crucial and sensitive to them. Additionally, an instructional booklet was disseminated to women in order to emphasize the knowledge they had acquired.

This result matched with **(El-Adham and Shaban., 2023)** who demonstrated that a highly statistically significant difference in the knowledge of fit, unmarried females regarding oocyte cryopreservation before and immediately after the program implementation addition to the period immediately following and one month following the program's execution, in all knowledge items ($p < 0.001$). Additionally, it was demonstrated that the total level of knowledge of the unmarried healthy females under study prior to, immediately following, and the curriculum is highly statistically significant one month later ($p < 0.001$). Moreover, it was illustrated that (95%) of the studied unmarried healthy females had low total level of knowledge regarding oocyte cryopreservation before the program, compared to (90%, and 55% respectively) a significant number of them demonstrated a high level of knowledge both immediately and one month following the program.

As well as, **(Mohamed et al., 2023)** reported in terms of all oocyte-cryopreservation items, a highly statistically significant

difference between the pre- and post-intervention phases. Prior to the intervention, only 2.8% of the students in the study had a satisfactory level of understanding of oocyte cryopreservation. As a result of the intervention, this percentage rose to 97.2%, a statistically significant increase ($p < 0.001$). This could potentially reflect a return to the straightforward and uncomplicated approach employed in the elucidation of the educational material utilized in the investigation. Education intervention has been demonstrated to be effective in addressing their requirements for knowledge enhancement and attitude improvement.

Likewise, (Hasab Allah et al., 2021) showed in the pretest, 20.0% of the students who were studied answered accurately regarding the definition of egg freezing. This percentage increased to 52.0% in the posttest. In the pretest, 24.8% of the participants responded completely correctly regarding the indications for oocyte cryopreservation, a figure that rose to 76.0% in the posttest. In response to the inquiry "Is there a substantial reduction in a woman's fertility as she ages?" The percentage of respondents who answered correctly in the pretest was 50.4%, which increased to 92.0% in the posttest.

The percentage of participants who correctly answered the question "oocyte cryopreservation can prolong a woman's fertility before the age of 35 years" increased from 36.8% in the pretest and in the posttest, to 72.0%. Related to "eggs numbers that should be stored to attain conception later on, 16.8% of them answered correctly in pretest, 61.6% of them answered —20-30 egg." in the subsequent examination. In the pretest, only 2.4% of the participants responded completely accurately regarding the barriers to oocyte cryopreservation. This figure increased to 15.2% in the posttest. In conclusion, the pretest revealed that 55.2% of students exhibited

insufficient knowledge regarding oocyte cryopreservation, which was significantly reduced to 17.6% in the posttest.

Similarly, the study "Awareness of fertility preservation among Chinese medical students" conducted by (Ng et al., 2020) underscored the absence of knowledge and awareness regarding fertility preservation. To expand one understands of medical knowledge and nursing students, there is a compelling global imperative to enhance the education and exposure of fertility preservation in the curriculum. There is also a need for increased public sector involvement and the improvement of facilities in terms of service provision and financial support for fertility preservation services. It is imperative to consider the diverse perspectives on childbearing that exist across various cultures. By fostering a greater understanding and awareness of this issue, we can foster more accepting attitudes toward fertility preservation among our unmarried females, thereby enhancing the quality of life and clinical outcomes for future females.

Moreover, (Malhotra et al., 2022) mentioned that 76% of respondents claimed to possess only a limited understanding of fertility preservation (FP). The duration required for oocyte cryopreservation was only known by a quarter of the respondents, and one-third were cognizant of the quantity of semen samples required for FP. Through seminars and continuing medical education programs, more than 90% of respondents aimed to increase their knowledge of fertility preservation. Consequently, there is an urgent need to establish well-organized educational programs to enhance awareness of FP. This will enable unmarried females to utilize their gametes to conceive children after they have married.

Also, (Mohamed et al., 2023) pointed out that the study subjects' knowledge toward egg frozen improved during the program implementation periods, the majority of the

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study subjects had unsatisfactory knowledge pretest scores. However, this improved to the extent that the majority of them had satisfactory knowledge at the follow-up and post-program implementation. The majority of the study subjects (86%) had an unsatisfactory total knowledge score prior to the program's implementation. However, this score improved to satisfactory for the majority (90.0%, 87%) immediately following the program's implementation and at the follow-up, a highly statistically significant difference ($P < .0001$).

The results that were previously mentioned were in agreement with the findings of (Al Ghaithi et al., 2023), who reported that approximately 94% of the participants expressed a need for additional information regarding fertility preservation. These results were in accordance with those of (Hong et al., 2019), which indicated that the female Korean population possessed a relatively Elective OC is not well-known or understood. Furthermore, (Stevenson et al., 2021) revealed that only 26.6% of respondents indicated that they were adequately informed about fertility. The necessity of providing support for educational programs is underscored by all of these findings, especially with regard to such sensitive matters that may be socially unacceptable as a result of a lack of awareness about them.

In contrast to the results of the current investigation, (Kim et al., 2022) demonstrated that there was a high level of awareness regarding the planned cryopreservation of oocytes. Despite the fact that a substantial number of participants regarded intentional cryopreservation of oocytes despite the fact that fertility issues are recognized as a woman's privilege, there are still voids in their comprehension. In comparison to the 'non-freezers' group, the 'prospect freezers' group exhibited a statistically significant increase in interest in fertility preservation education. The

discrepancy in results between the current study and this research may be attributed to the disparity in cultural levels and freedoms between the two societies.

By looking to studied females' attitudes, the current research's findings indicated that the implementation of the program significantly enhanced the attitude of the sample under investigation toward elective oocyte cryopreservation. The statistical significance of the difference between the pre- and post-intervention phases was highly significant ($p < 0.001$). The majority of the sample under investigation and less than one-third of the sample exhibited a favorable attitude toward elective oocyte cryopreservation during the pre-intervention and post-intervention phases, respectively. Nevertheless, it was noted that a majority of the participants (over two-thirds) and a minority of them (minority) held negative attitudes toward elective oocyte cryopreservation during the pre- and post-intervention phases, respectively. In accordance with the researchers' perspective, educational programs through the Nano-educational sessions are essential to positively impacts on unmarried females' attitudes and believes toward ova cryopreservation. A meaningful engagement of women in the educational programs is essential to increase effectiveness and uptake.

The results of the current research were in agreement with those of (El-Adham and Shaban., 2023) who exhibited that the majority of variables exhibited a highly statistically significant difference in the attitudes of unmarried healthy females toward oocyte cryopreservation before and one month after the program's implementation ($p < 0.001$). It was shown that the total level of attitudes of the unmarried, healthy females under study differed significantly before and one month after the program ($p < 0.001$). Where, it was identified that (100%) of the studied unmarried

healthy females had negative attitudes regarding oocyte cryopreservation before the program, compared to (80%) of them had positive attitude one month after the program.

Furthermore, (Mohamed et al., 2023) demonstrated that the degree of agreement among study subjects regarding all attitude items increased significantly following the implementation of the educational intervention, and the total attitude score regarding oocyte-cryopreservation improved from 25.6% positive in the pretest to 90.3% positive in the posttest.

Additionally, the results that were previously mentioned were consistent with (Hasab Allah et al., 2021) who clarified that 60.0% of the studied sample held negative beliefs about egg storage in the pretest, while 33.6% of them did so in the posttest, indicating statistically significant improvements in their viewpoints. Further, the percentage of individuals who expressed a positive attitude toward egg storage increased from 25.6% in the pretest to 56.8% in the posttest, suggesting a statistically significant improvement in their attitudes. The pretest and posttest revealed that 55.2% and 72.0% of the sample in question concurred with the assertion that "egg preservation should be encouraged." 44.8% and 28.0% of the participants, respectively, believed that "egg preservation is not practiced in Egypt" in the pretest and posttest. Furthermore, in the pretest and posttest, 64.0% and 24.8% of them respectively believed that "egg preservation is extremely costly and unattainable." Additionally, 30.4% and 68.0% of them agreed with the statement "Oocyte freezing may be a viable alternative for you" in the pretest and posttest, respectfully.

In the same harmony, (Mohamed et al., 2023) found that a negative attitude toward embryos frozen was held by the majority of female participants (90%) prior to the program's implementation. Nevertheless, this

changed to the majority of participants having a positive attitude (91.7%, 88.3%) during the post-program implementation and follow-up phases, respectively, with a statistically significant difference ($P < 0.001$).

(Al Ghaithi et al., 2023) corroborated these findings, stating that approximately 62% of respondents believed that gender was a factor and 27% believed that women were more concerned. In terms of socioeconomic status, 65% of respondents agreed that women in both high and low socioeconomic states are concerned about their potential fertility. Nevertheless, 27% of the respondents expressed that the elevated socioeconomic status is the most concerning factor. Participants concluded that patients of all educational backgrounds are concerned about their prospective fertility. Furthermore, (Abbass et al., 2023) demonstrated that the teaching program's implementation yielded a highly statistically significant difference ($P < 0.001$).

In the overall students' attitude toward ova cryopreservation, indicating a noticeable positive change. The positive impact on the attitudes of females may have been influenced by the permissible discussion and effective communication that occurred during the learning sessions with the researchers. In addition, the instructional booklet was instrumental in assisting women in modifying their erroneous beliefs.

Also, (Tozzo et al., 2019) demonstrated that Italian women are significantly less aware and have a negative attitude toward the possibility of using social egg freezing and the age-related decline in fertility compared to their similarly situated counterparts in other Western countries. (Zhou et al., 2022) have increasingly concluded that it is necessary to enhance pertinent knowledge in order to assist females in acquiring a comprehensive comprehension of elective egg storage and egg b

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ank establishment. This knowledge will then be used to guide college students in the development of a scientific dialectical attitude toward this technology.

Conversely, (Akhondi et al., 2023) demonstrated that medical and social egg storage was viewed favorably by female students at Tehran universities. Variations in government policies and public education strategies that are intended to promote childbearing among young women who may delay their first child until their thirties due to failure to secure a partner or who are married but wish to prioritize their careers or education may be responsible for this discrepancy in outcomes.

As regards studied females' **barriers** regarding elective oocyte cryopreservation, the current study's findings suggested that the barriers encountered by the sample under investigation with regard to elective oocyte cryopreservation were substantially diminished subsequent to the program's implementation. The statistical significance of the difference between the pre- and post-intervention phases was highly significant ($p < 0.001$). The study demonstrated that the barriers to elective oocyte cryopreservation were satisfactorily addressed by over one-quarter and over three-quarters of the sample during the pre- and post-intervention phases, respectively. During the pre- and post-intervention phases, it was determined that fewer than three-quarters and less than one-quarter of the participants responded satisfactorily to the barriers to elective oocyte cryopreservation, respectfully.

The research findings were corroborated by (Malhotra et al., 2022) who aimed that the primary obstacle to not referring to FP was a lack of knowledge (43%; $n=58$). The lack of knowledge regarding referral pathways (16.5%, $n=22$) and the inability of females to afford FP procedures (22.5 percent, $n=30$) were also prevalent reasons. Insufficient time to

consult with a lawyer and marital status (unmarried). More than 90% of the participants ($n=260$) expressed a desire to enhance their understanding of FP. Seminars (31.3%), informative leaflets (23.9%), and continued education (33.8%) were the most widespread methods of enhancing one's understanding of the subject. Approximately 97.5% of the respondents ($n=276$) expressed a willingness to participate in an educational session regarding FP.

Furthermore, The findings of the present results were in accordance with the assertions of (Mohamed et al., 2023) that the primary obstacles and obstacles faced by the study subjects in relation to egg freezing were 35%, 17%, and 16% cost, religious beliefs and lack of knowledge are challenges to perform egg frozen. Additionally, (Abbass et al., 2023) noticed that after the implementation of the teaching program, the implementation of the teaching program resulted in a highly statistically significant difference ($P < 0.001$), which suggested a substantial improvement in the overall students' barriers regarding ova cryopreservation.

(Al Ghaithi et al., 2023) showed that the majority of participants experienced a significant improvement in their barriers to ova cryopreservation following the implementation of the instructional program ($P < 0.001$). Initiating fertility preservation discussions with patients is significantly hindered by the absence of fertility service infrastructure, according to 82% of respondents. Consistent with this, the findings of the current investigation were obtained. Nearly 59% of respondents indicated that their inadequate understanding of fertility preservation alternatives is a significant factor. Researchers have noted that there is a great similarity between the obstacles regarding freezing eggs to preserve fertility, even among different Arab and Western societies, which indicates the importance of spreading

awareness through educational programs of various kinds.

The current research findings indicate that the implementation of the program increased the willingness of the female participants to undergo elective oocyte cryopreservation. The analyzed sample's total mean score for willingness items demonstrated a highly statistically significant difference ($p \leq 0.001$) between the pre-intervention and post-intervention phases, which was higher than the score prior to implementation. Significant differences were also observed in all items of willingness (intention) ($p \leq 0.001$). In the pre-intervention and post-intervention phases, respectively, more than one-fifth and less than two-thirds of the sample demonstrated a high level of willingness (intention) to endure elective oocyte cryopreservation. It was discovered that the majority of individuals (over two-fifths) and a small minority of individuals (minority) exhibited a low level of willingness (intention) during the pre- and post-intervention phases, respectively.

This result was in agreement with the results of (El-Adham and Shaban., 2023) who demonstrated a highly statistically significant difference in the intention of unmarried healthy females to undertake oocyte cryopreservation prior to and one month following the program's implementation ($p < 0.001$). The table also illustrates that the total level of intention among the unmarried healthy females subjected to the study exhibited a highly statistically significant difference between one month prior to and post-program ($p < 0.001$). In the study, it was confirmed that (90%) of the unmarried healthy females had a low level of intention regarding oocyte cryopreservation prior to the program, while (80%) of them had a high level of intention one month after the program's ovum freezing.

Additionally, (Malhotra et al., 2022) $n=150$ indicated that just over half (53%) of

the respondents expressed a low intention to preserve fertility. Furthermore, (Stevenson et al., 2021) cleared that only 7.2% had considered use of fertility preservation. As well as, the study conducted by (Sousa-Leite et al., 2019) revealed that the perceived severity of infertility decreased, while fertility knowledge and perceived susceptibility to infertility increased. Additionally, women's intentions, desire, and number of children desired decreased. A limited number of women made progress in the decision-making process. A decision was reached by only 14% of the participants, and all of them chose not to participate in FP. The decision of women to undergo FP was predicted by their baseline intentions. These results support what researchers see as the great importance of holding ongoing educational and awareness programs related to such topics

However, the current research result was inconsistent with the statement made by (Gambadauro et al., 2023) whether fertility preservation is pursued for medical or age-related reasons, Swedish females would embrace and contemplate OC. In addition, the findings of the present investigation were in direct opposition to those of (Kim et al., 2022), who demonstrated a significant public interest in FP and a growing number of women who desire to protect themselves from age-related infertility.

The results of the current study demonstrated a statistically significant positive correlation between the total knowledge and (total attitude & intention) scores during the pre- and post-intervention phases ($P \leq 0.001$). This was in reference to the correlation between the total knowledge score and the (attitude, intention, and barriers) scores. Although there was a statistically significant negative correlation between the total knowledge and total barriers scores at the pre- and post-intervention phases ($P \leq 0.001$). The results

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were in accordance with those of (Mohamed et al., 2023), during the intervention phase. The attitude score of the study subjects improved by 8.97 ± 1.77 in the posttest score, as their total knowledge increased by 14.27 ± 1.75 .

In addition, the current research results were in agreement with those of (Hasab Allah et al., 2021), who found a moderate positive correlation between knowledge and attitudes regarding oocyte cryopreservation in the sample under study during the pretest. The p-value was 0.050, and the r_value was 0.270. Furthermore, the educational guidelines' implementation resulted in moderate positive correlations between knowledge and attitudes regarding oocyte cryopreservation in the sample under investigation, with a p-value of 0.469 and statistically significant differences at a p-value of 0.007. In the same vein, (Mohamed et al., 2023) discovered a statistically significant positive correlation between knowledge and attitude scores and educational level age during the post- and follow-up periods of guidelines implementation ($p < 0.001$).

Furthermore, (Abbass et al., 2023) demonstrates that a statistically significant positive correlation existed between students' attitudes and the barriers to ova cryopreservation at both the pre- and post-implementation stages of the educational program ($p < 0.001$). From the researchers' perspective, all the above-mentioned results indicate the importance of raising the level of information and the extent of its significant impact on attitude, desires or willingness and even barriers that may hinder females in making decisions.

Opposite to our research results, (El-Adham and Shaban., 2023) indicated that the knowledge, attitude, and intentions of the unmarried, healthy females under investigation regarding oocyte cryopreservation did not

exhibit a statistically significant correlation in the period prior to and following the implementation of the educational program ($p > 0.05$).

Conclusion:

In accordance with the results of this research, it was determined that the Nano-educational sessions improved unmarried females' knowledge and positively changed attitude that subsequently improved willingness and reduced barriers regarding elective oocyte cryopreservation. Furthermore, a statistically significant positive correlation was observed between the total knowledge score and the scores of total attitude and intention during both the pre- and post-intervention phases ($P \leq 0.001$). The analysis revealed a statistically significant negative correlation between the total knowledge and total barriers scores during both the pre- and post-intervention phases ($P \leq 0.001$). Consequently, the research hypotheses were substantiated and the impact of Nano-educational sessions was replicated.

Recommendations:

The subsequent suggestions were proposed in accordance with the results of the current investigation:

- Nano-educational sessions ought to be encouraged in order to empower unmarried females to practice their autonomy in making decision concerning oocyte cryopreservation.
- Implementing a systematic educational program on a consistent schedule for diverse non-medical faculties' to improve females' understanding, perspectives, and motivations related to oocyte cryopreservation.
- Health care systems, educational institutions, and various public media platforms must make additional efforts to reduce the stigma surrounding fertility

awareness among young people, regardless of gender.

- Creating and developing educational programs for both sexes who are facing potential infertility, whether as a result of age or underlying medical conditions, to improve their awareness of egg freezing and fertility preservation.
- There is a need for introducing service, economic support and facilities for fertility preservation.
- Cooperation between the Ministry of Health and Egyptian Dar Al Iftaa to enhance citizens' awareness regarding the use of modern technology in oocyte cryopreservation and the use of all health institutions to implement these education sessions
- **Further research** Involving family members and companions in premarital counseling and at various health centers to eradicate barriers associated with oocyte cryopreservation and increase their awareness.

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تأثير جلسات النانو التعليمية على الوعي والإستعداد والمعوقات تجاه حفظ البويضات الاختياري لدى الإناث غير المتزوجات

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للحفاظ على الخصوبة وعلاج العقم المستقبلي الناشئ عن عوامل طبية واجتماعية، في تكنولوجيا الإنجاب المساعد، يعد تجميد البويضات الاختياري مكوناً أساسياً. لذا هدف البحث إلى التحقيق في تأثير جلسات النانو التعليمية على الوعي والإستعداد والمعوقات تجاه حفظ البويضات الاختياري لدى الإناث غير المتزوجات. وتم استخدام التصميم شبه التجريبي (مجموعة واحدة، اختبار قبل وبعد) لتحقيق هدف البحث. حيث اجريت هذه الدراسة في ست كليات من أصل اثنا عشر كلية غير طبية بجامعة بنها بمحافظة القليوبية، مصر. على عينة مقصودة من ١٣٠ أنثى غير متزوجة تعمل في أماكن البحث المذكورة أعلاه. تم جمع البيانات باستخدام أربع أدوات أساسية: استبيان ذاتي منظم، ومقياس ليكرت معدّل لتقييم مواقف الإناث غير المتزوجات، واستبيان تقييم المعوقات لدى الإناث غير المتزوجات، واستبيان استعداد (نية) الإناث غير المتزوجات. وأظهر البرنامج زيادة كبيرة في وعي واستعداد الإناث غير المتزوجات، فضلاً عن انخفاض في العوائق المرتبطة بالتجميد الاختياري للبويضات. لوحظ فرق ذو دلالة إحصائية عالية بين مرحلتي ما قبل التدخل وما بعده. لوحظت ارتباطات إيجابية ذات دلالة إحصائية بين درجات المعرفة الكلية و(الإتجاهات الإستعداد الكلية) خلال مرحلتي ما قبل التدخل وما بعده. في حين أظهرت درجات المعرفة الكلية وإجمالي المعوقات ارتباطاً سلبياً ذا دلالة إحصائية خلال مرحلتي ما قبل التدخل وما بعده. كما عززت الجلسات التعليمية النانوية معرفة الإناث غير المتزوجات وغيرت الإتجاه بشكل إيجابي مما أدى لاحقاً إلى تحسين الاستعداد وتقليل المعوقات فيما يتعلق بالتجميد الاختياري للبويضات. وأوصت الدراسة بأنه ينبغي تشجيع الجلسات التعليمية النانوية من أجل تمكين الإناث غير المتزوجات من ممارسة استقلاليتهن في اتخاذ القرار بشأن تجميد البويضات.