

## Effect of Virtual Educational Program on Female Faculty Nursing Students' Perception toward Egg Freezing Technology and their Fears regarding it

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**Abstract:** As nursing students are the future health care providers, they should acquire knowledge regarding egg freezing technology (EFT) to serve themselves first and others. **Aim of the study:** Evaluate the effect of virtual educational program on female faculty nursing students' perception toward egg freezing technology and their fears regarding it. **Subjects and Method:** A quasi-experimental research design was used. **Setting:** The study was conducted at Faculty of Nursing, Tanta University. **Subjects:** A cluster random sample of 320 female nursing students were selected. **Four tools were used: Tool (I): A structured questionnaire which included: Part 1:** Socio demographic characteristics, **Part 2:** Knowledge regarding EFT. **Tool (II): Attitudes of the female nursing students regarding EFT. Tool (III): Opinion of the female nursing students about if they would personally consider undertaking EFT in the future and their reasons. Tool (IV): Fears of undergoing egg freezing among the female nursing students. Results:** The total knowledge score of the participants significantly improved among half of them and more than two-thirds of the participants had positive attitude toward EFT three months post-program with a highly statistically significant difference. The main reported fears of undergoing EFT among the participants were; the high cost involved and religious rejection. **Conclusion:** The virtual educational program achieved a significant improvement in female faculty nursing students' knowledge and had a positive effect on their attitudes toward EFT. **Recommendations:** Reapplication of the study for all faculties nursing students. Online distribution of an Arabic PDF about EFT among all specialties.

**Keywords:** Students' Perception, Egg Freezing Technology, Virtual Program.

### Introduction

Egg freezing technology (EFT) is one of the most recent innovative approaches in the assisted reproductive techniques.<sup>(1)</sup> It is also known as oocyte cryopreservation. EFT is defined as a technique used to preserve female's fertility through freezing and storing their healthy eggs for a subsequent chance of future pregnancy or infertility treatment.<sup>(2)</sup>

Despite the well-established evidence that fertility declines with female advanced age,

many females in the developing countries delay their childbearing.<sup>(3)</sup> As a result, those females may experience the threat of age-related infertility when they desire to get pregnant.<sup>(1,4)</sup> Hence, egg freezing has emerged as a technology mean to plan ahead for the anticipated loss of female fertility, thus keep open the possibility of using their own eggs for conception<sup>(5,6)</sup>.

Egg freezing technology is known to be offered for medical or non-medical reasons. Medical egg freezing is indicated for women who were

exposed to premature infertility due to diseases as; severe endometriosis which compromises the ovary, primary ovarian insufficiency from a genetic predisposition, possible damage to the ovaries during upcoming surgeries, or chemotherapy treatments for cancer that had a negative impact on future fertility.<sup>(7,8)</sup> Also, it can be offered to healthy women, with the intention to postpone their motherhood for non-medical reasons mostly for continuing education and career, lack of a husband, reproductive autonomy, anticipated age-related fertility decline, or for reasons beyond their control.<sup>(9-11)</sup>

It is believed that female's fertility decline over the course of her life time beginning with a slight decrease after the age of 32 years and become more evident after the age of 37 years.<sup>(12,13)</sup> So, according to the clinical practice, the most suitable age for EFT range between 20 to 30 years of age. The most significant contributing factors to the success of EFT includes; the age of woman at time of egg freezing, the number of eggs collected and frozen, along with the chosen clinic's and the physician's expertise level in egg freezing technique.<sup>(9,14,15)</sup> However, the highest success rates of EFT are for women under the age of 35 years old with freezing at least 10 oocytes and 40 at age 40 years old.<sup>(14,16)</sup>

Although ovarian reserve, follicle stimulating hormone (FSH), luteinizing hormone (LH), and serum anti-Mullerian hormone (AMH) are required prior to egg freezing, coagulation, blood and infectious disease screening for syphilis, hepatitis B & C are also recommended.<sup>(2,17,18)</sup> Additionally, hormonal stimulation of the ovaries before transabdominal or transvaginal healthy, viable eggs retrieval is very essential. The vitrification (flash-freezing) method is the recommended freezing approach rather than slow-freezing/ ultrarapid as it hinder the formation of ice crystals, and increasing the post-thawing egg survival rate as well as

improving the pregnancy outcomes.<sup>(2,19-21)</sup>

However, EFT are associated with risks including ovarian hyperstimulation syndrome which manifested by swelling or pain in the ovaries and abdomen, bloating, nausea, vomiting, and diarrhea. Bleeding, infection, or damage to the intestines, bladder, blood vessels and anesthesia problems are also other complications that can be reported.<sup>(2,19,22)</sup> In addition to, the post-frozen–thawed eggs risks especially at an advanced age such as; pregnancy-induced hypertension, preterm delivery with low birth weight infant, and multiple pregnancy. However, these risks vary widely, depending on the woman's health status, and increase with maternal age at delivery.<sup>(19,23)</sup>

Despite the benefits of EFT, many fears may affect the females' decision to undergo EFT as; lack of information, negative attitudes, cultural and religious beliefs regarding it. Therefore, the future nursing students need to be knowledgeable about EFT for a variety of reasons including; educating and counseling the public about fertility preservation option, being employed at EFT institutions and health care facilities, or a recipient of EFT for themselves, as they are responsible for evaluating knowledge and attitudes toward EFT to provide further clarification or adjustment of concepts or attitudes.<sup>(1,24-26)</sup>

With the advent and development of Internet technology during the 1990s, a powerful new tool called virtual education was provided to universities and research institutes at the top of the curricula to help students achieve their goals and create new dynamic learning and teaching environments.<sup>(27)</sup> It is a form of education where teacher and student are separated by time or space, or both, and the teacher provides course content through course management applications, multimedia resources, the Internet, and videoconferencing. Virtual learning can be

convenient, flexible, affordable and address issues as increasing the demand for higher education, the high cost of education, the need for students to access non-content, their time and space restrictions and issues related to mandatory and timely classroom attendance. <sup>(28,29)</sup>

### **Significance of the study**

In Egypt, the infertility ratio among the married couples has been estimated to be 10.4%. Moreover, the age of marriage has been progressively rising over the past few decades. <sup>(1,30,31)</sup> This will increase the incidence or risks of developing abnormal embryos and fetal loss as well as less opportunities for the eggs to become fertilized as the female fertility window is narrower and gradually continues to decline beyond the mid-thirties annually until the menopause compared to the male. <sup>(32)</sup> Thus nowadays, an emerging egg freezing technology can offer some protection for women against the loss of fertility with ageing and may be suggested or recommended as a cure or remedy for infertility problems. <sup>(1,26)</sup>

Since, the majority of women reported that the health care provider is the preferred and most reliable information source regarding their reproductive health choices. <sup>(24)</sup> Thus, the future obstetric or community nursing students health care providers should be updated with new practices and evidence-based medicine and technologies to enhance their knowledge and attitudes regarding EFT to serve themselves first and serve others. <sup>(19)</sup> So the current study was conducted to evaluate the effect of virtual educational program on female faculty nursing students' perception toward egg freezing technology and their fears regarding it as they are the future health care providers.

### **Aim of the study**

#### **The aim of this study was to**

Evaluate the effect of virtual educational

program on female faculty nursing students' perception toward egg freezing technology and their fears regarding it.

### **Operational definitions**

**Perception:** In this study, it means knowledge, attitudes and opinions of the female faculty nursing students regarding egg freezing technology.

**Fears:** In this study, it means concerns apprehensions, and worries of the female faculty nursing students toward egg freezing technology.

### **Research hypothesis**

Female faculty nursing students' perception regarding egg freezing technology are anticipated to be improved after the implementation of the virtual educational program.

### **Subjects and Method**

**Study Design:** A quasi-experimental research design was used in the present study.

**Setting:** This study was conducted at Faculty of Nursing, Tanta University.

### **Subjects**

- A cluster random sampling was used to obtain the sample size for the academic year 2022-2023 of undergraduate female nursing students at Faculty of Nursing, Tanta University. The number of the nursing students in the first, second, third and fourth academic years were as follows; 550, 1049, 1048, and 550 students respectively.
- The researchers selected a cluster random sample of around ten percent (10%) of the total student number which was 320 students.

**Tools of data collection:** Four tools were used by the researchers in ordered to obtain the necessary data as follow:

- **Tool (I): A structured questionnaire.** This tool was constructed by the researchers after reviewing the relevant recent literatures which included three parts:

**Part 1: Socio demographic characteristics of the female nursing students** as; age, current marital status, academic year, residence, mother educational level, father educational level, family income, and attendance of a training program and/or workshop regarding EFT.

**Part 2: knowledge regarding egg freezing technology among the female nursing students**

This part was developed by the researchers to assess students' knowledge about EFT which includes; female fertility (age, possible preservation, methods of females' fertility preservation), definition of EFT, suitable age for egg freezing, indications, advantages/ benefits, number of frozen eggs at different ages, preparations before starting egg freezing process, stages of egg freezing, methods of egg freezing, factors affecting the success of egg freezing, risks of egg freezing, associated symptoms, duration of storage of frozen egg, and legality of EFT under law.

**The scoring system**

The knowledge score of the studied nursing students regarding EFT was calculated as follow: Correct answers were taken score (1) and incorrect and/or don't know answers were taken score (zero).

**The total knowledge scores regarding EFT were calculated and ranged from (0-44) which furthers categorized as follows: -**

- **High level of knowledge  $\geq 75\%$  of the total score:  $\geq 33$ .**
- **Moderate level of knowledge  $60\% - < 75\%$  of the total score:  $26.5 - < 33$**
- **Low level of knowledge  $< 60\%$  of the total score:  $< 26.5$**

**Tool (II): Attitudes of the female nursing students regarding egg freezing technology:**

This tool was designed by the researchers after reviewing the related literatures <sup>(1,2,24)</sup>. It was intended to assess nursing students' attitudes

toward EFT. It consisted of 31 items, 14 items were negatively worded and other 16 items were positively worded. The studied nursing students' attitudes were measured using a three-point Likert scale which ranged between zero (disagree), one (uncertain), and two (agree). The score of the studied nursing students' attitudes were obtained by summing up the students' responses for all items taking into consideration the revise of negatively worded items.

**The scoring system**

The total attitudes scores ranged between ( 0-62). The studied nursing students' attitudes were categorized as follows:

- **Positive attitudes  $\geq 60\%$  of the total attitudes score:  $\geq 38$**
- **Negative attitudes  $< 60\%$  of the total attitudes score:  $< 38$**

**Tool (III): Opinion of the female nursing students about if they would personally consider undertaking EFT in the future and their reasons:**

This tool included two questions regarding if the participants would like to freeze their eggs in the future and reasons for undergoing egg freezing in the future among them.

**Tool (IV): Fears of undergoing egg freezing among the female nursing students.** It included one question directed to ask nursing students about possible fears of undergoing EFT among them.

**Method**

**- Administrative process**

An official permission to carry out the study was obtained from the Dean of the faculty of nursing, Tanta University and the ethical committee approval code number (315) was also obtained before the actual data collection.

**-Ethical consideration**

Respondents' anonymity and confidentiality were ensured. On the first page of the online questionnaire, respondents were clearly

informed about the background and objectives of the study and about their right to freely withdrawal at any time from the study. The submission of the answered questionnaire was considered as consent to participate in the study.

#### **-Developing of the tools**

The study tools were developed by the researchers based on the review of related literatures. The developed tools were submitted to 5 experts in the field of nursing and medicine for testing the face and content validity. The experts' questionnaires sheet used four points Likert scale ranging from strongly relevant score (4) to strongly not relevant score(1). Validity of the questionnaires based on experts' opinions were calculated and found to be = (96 %). The Cronbach's alpha coefficient of the questionnaire indicating acceptable internal consistency. For the sheet in total, it was 0.955 which indicates high reliability of the study tools.

#### **Pilot Study**

- A pilot study was conducted on 10% of the whole sample (32 nursing students) to ensure the clarity, applicability, and comprehension of the tools, identify obstacles that may be encountered during data collection and to determine the length of time needed to collect the data.
- According to the pilot study there were no modifications occurred after the pilot study so, those nursing students were included in the main study sample.

**Developing the virtual educational program:** The following steps were adopted to develop the virtual educational program.

1. **Field work:** The following phases; assessment, planning, implementation, and evaluation phase were used to achieve the aim of the study. These phases were completed over a 6-months period.

**-Assessment phase (Pre-test):** At the beginning of this phase; the researchers conduct the first online meeting using Microsoft teams program on the free time for each sample according to their academic year, introduced themselves, and explained the purpose of the study to the participants, Then, an online self-administered questionnaire link **which included the four tools** was distributed on students through Microsoft teams program and the nursing students WhatsApp groups to collect the baseline data about EFT as a pre-program assessment.

**-Planning and Implementation phase:** Based on the findings from the assessment phase, the researchers developed the virtual educational program sessions content material. The total students' numbers (55,105,105,55) were divided into 6 groups each group about 55 nursing students according to their academic year and available time to help the students' attends for the sessions. The content of the sessions were delivered to the students in the form of online symposium and group discussion on Microsoft teams that constructed for faculty theoretical lectures utilizing online audiovisual aids as; PowerPoint presentations, graphics, videos, and Arabic PDF for enhancing students' knowledge , attitudes and opinions regarding EFT. To implement the content of the virtual educational program, The virtual online program was given in 3 sessions. Each session took about 45 minutes. Implementing the virtual educational sessions continued over a period of 6 weeks.

**The first session:** This session aimed to establish a relationship with the studied nursing students and orient them about the importance of the educational program, its sessions and expectations of each session and provided them with information about fertility preservation for female, and methods of

woman's fertility preservation.

**The second session:** This session aimed to improve the studied nursing students' knowledge regarding; definition of EFT, suitable age for egg freezing, indications, advantages, number of eggs should be frozen at different age, preparations needed for egg freezing process, stages and methods of egg freezing.

**The third session:** This session aimed to provide feedback on previous session and discuss factors affecting the success of egg freezing , associated symptoms and risks of egg freezing, duration of storage of frozen egg, as well as legality of EFT under law. In addition open discussion for any questions and inquires about EFT.

**Evaluation phase:** This phase aimed to evaluate the effectiveness of the virtual educational program on the studied nursing student's **knowledge, attitudes and opinion** using **Tool (I) part 2, Tool II and Tool (III)**. The evaluation was conducted two times, before and three months after the implementation of the virtual program.

## 2. Statistical analysis:

The collected data was organized, tabulated, and statistically analyzed using Statistical Package for the Social Sciences (SPSS) software, version 25. Frequencies of correct knowledge answers and various attitudes were described. Correlation between variables was evaluated using Pearson's correlation coefficient. Significance was adopted at  $P < 0.05$  for interpretation of results of tests of significance.

## Results

**Table(1):Socio- demographic characteristics of the studied female faculty nursing students.** It shows that the studied female nursing students 'age ranged from 19-24 years

with mean  $21.0 \pm 1.284$  years. Regarding to academic year, the study subjects were as the following: first year (17.2%), second year (32.8%), third and fourth year (32.8%) and (17.2%) respectively. The majority (84.4%) of the subjects were single and two- thirds (64.4%) of them were living in rural areas. The entire subjects didn't attend any training program about egg freezing.

**Table (2): Mean and standard deviation of Knowledge of the studied female faculty nursing students toward EFT pre and 3-months post virtual educational program.** It shows that, there was a significant improvement in the total knowledge score of the studied female nursing students related to all items about EFT pre, and three months post program.  $P = (<0.001)$ , where the mean score of their knowledge increased from  $17.38 \pm 6.163$  pre-program to  $36.31 \pm 7.768$  three months post-program. This difference was a statistically significant  $t = (56.04)$ .

**Figure (1): Total knowledge score of the studied female faculty nursing students toward EFT pre, and three months post virtual educational program.** It illustrates that the total knowledge score of the studied female nursing students regarding EFT was high among only (6.3%) of them preprogram which significantly improved to be (50%) three months post-program.

**Figure (2): Total attitude score of the studied female faculty nursing students toward EFT pre, and three months post virtual educational program.** It clarifies that (20.3%) of the studied female nursing students had a positive attitude toward EFT before program application and increased to (68.4%) three months post-program with a highly statistically significant difference where ( $p < 0.0001^*$ ).

**Figure (3): Opinion of the studied female nursing faculty nursing students about if they would personally consider undertaking EFT in the future pre, and three months post virtual educational program.** It reveals that when the studied female nursing students were asked about if they would like to freeze their eggs in the future, their "yes definitely" answers increased from (5.6%) preprogram to (30.6%) three months post program .While, there" not at all" answers decreased from (48.8%) preprogram to (28.8%) three months post program.

**Figure (4): Reasons to choose EFT for future use among the studied female faculty nursing students.** It illustrates that the reasons to choose EFT for future use among the studied female nursing students are; medial reasons among (67.7%) of them, career reasons among (16,9%) of them and social reasons among (15,4%) of them .

**Figure (5): Fears of undergoing egg freezing among the studied female faculty nursing students.** It reveals that the high cost involved, religious rejection and fear of social stigma represents the main fears of undergoing EFT among (61.1%, 55.6% and 47.3% respectively) of the studied female nursing students. Followed by fears of; its effect on virginity, potential health implications of EF, and future husband rejection among (41.4%, 33.7% and 32.5% respectively) of the studied female nursing students.

**Table (3): Correlation between total knowledge scores, and total attitude scores among the studied female faculty nursing students toward EFT pre and 3-month post virtual educational program.** It demonstrates that there was a statistical significant correlation between the studied female nursing students' total knowledge score with their total attitude score regarding EFT pre and 3-month post virtual educational program ( $r= 0.203$   $p=0.000^{**}$  and  $r= 0.912$   $p=0.000^{**}$  respectively).

**Table (4): Correlations between total knowledge score, total attitude score toward EFT among the studied female faculty nursing students and their age, and academic year pre and 3-month post virtual educational program.** It reveals that there was a statistical significant correlation between the studied female nursing students' total knowledge score regarding EFT and their age, and academic year pre and 3-month post virtual educational program ( $p=0.000^{**}$ ). Also, there was a statistical significant correlation between the studied female nursing students' total attitude score regarding EFT and their age, and academic year pre and 3-month post virtual educational program( $p=0.000^{**}$ ).

**Table (1): Socio- demographic characteristics of the studied female faculty nursing students(n=320).**

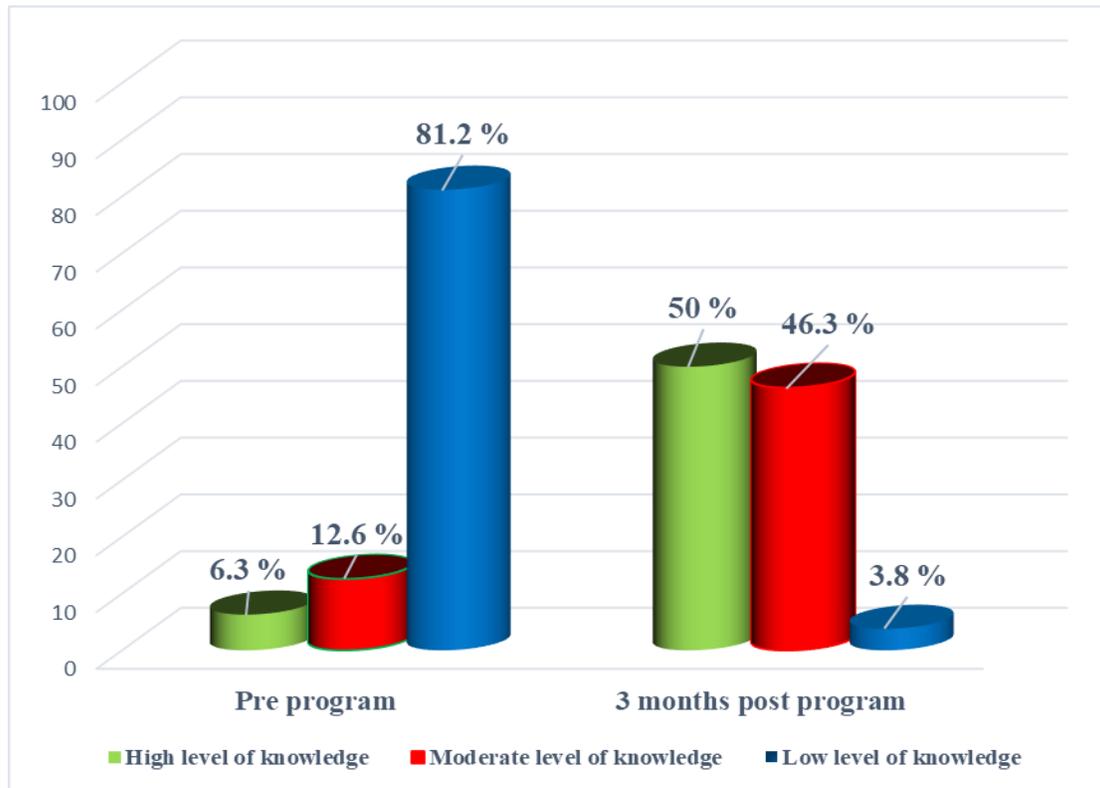
Socio-demographic characteristics	Studied female faculty nursing students(n=320)	
	No	%
<b>Age/years</b>		
≤20	101	31.5
>20-22	184	57.5
>22	35	11.0
<b>Range</b>	19	24
<b>Mean ± SD</b>	21.01 ± 1.284	
<b>Academic years</b>		
First year	55	17.2
Second year	105	32.8
Third year	105	32.8
Fourth year	55	17.2
<b>Marital Status</b>		
Single	270	84.4
Married	37	11.5
Divorced	13	4.1
<b>Mother s' Education</b>		
Illiterate	17	5.3
Read &write	31	9.7
Elementary education	33	10.3
Secondary& technical education	105	32.8
University	132	41.3
Postgraduate	2	0.6
<b>Father s' Education</b>		
Illiterate	15	4.7
Read &write	9	2.8
Elementary education	62	19.4
Secondary& technical education	114	35.6
University	101	31.6
Postgraduate	19	5.9
<b>Family Income</b>		
Just sufficient	227	70.9
Sufficient	58	18.1
Not sufficient	35	10.9
<b>Residence</b>		
Rural	206	64.4
Urban	114	35.6
<b>Attendance of a training program or workshop</b>		
No	320	100.0

**Table (2): Mean and standard deviation of knowledge of the studied female faculty nursing students toward EFT pre and 3- months post virtual educational program (n=320).**

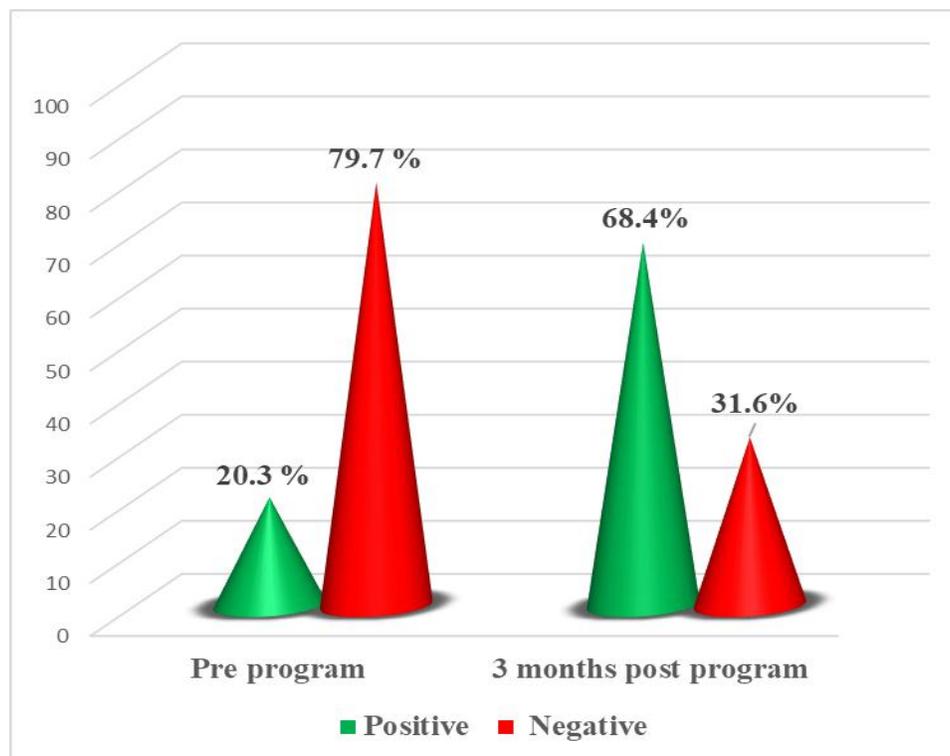
Items of knowledge about EFT	Studied female faculty nursing students (n=320)			
	Pre-program	3 months post program	T	p
	Mean &SD	Mean &SD		
1. Age when female fertility starts to decline	0.43 ± 0.496	0.92 ± 0.278	17.42	0.000**
2. Age when female fertility declines significantly	0.81 ± 0.391	0.97 ± 0.166	7.77	0.000**
3. Woman's fertility could be preserved despite her advanced age	0.56 ± 0.497	0.95 ± 0.225	14.11	0.000**
4. Methods to preserve woman's fertility	1.07 ± 0.839	3.00 ± 1.002	30.52	0.000**
5. Meaning of egg freezing	0.82 ± 0.383	0.86 ± 0.345	3.67	0.000**
6. Best age for egg freezing	0.07 ± 0.248	0.94 ± 0.242	46.59	0.000**
7. Indications of egg freezing	0.99 ± 0.513	3.50 ± 0.501	61.57	0.000**
8. Benefits of egg freezing	0.85 ± 0.512	1.88 ± 1.160	16.63	0.000**
9. Minimum number of eggs that should be frozen at the age of less than 30 years	0.05 ± 0.218	0.78 ± 0.416	29.22	0.000**
10. Minimum number of eggs that should be frozen at the age of 31-35 years	0.05 ± 0.218	1.00 ± 0.000	77.85	0.000**
11. Preparation before starting egg freezing process	1.22 ± 1.126	4.50 ± 0.501	50.05	0.000**
12. Stages of egg freezing process	0.49 ± 0.501	1.00 ± 0.000	18.08	0.000**
13. Methods of egg freezing	0.23 ± 0.420	1.00 ± 0.000	32.85	0.000**
14. Factors affecting the success of egg freezing	1.01 ± 1.002	2.50 ± 0.501	52.70	0.000**
15. Risks/damages of egg freezing	1.93 ± 0.365	3.99 ± 1.025	36.67	0.000**
16. Symptoms associated with egg freezing procedure	1.94 ± 0.237	3.00 ± 1.002	17.45	0.000**
17. Duration of storage of frozen egg	0.93 ± 0.253	0.97 ± .174	3.52	0.000**
18. Legality of egg freezing under law	2.00 ± .000	4.00 ± 1.002	35.721	0.000**
Total knowledge	17.38 ± 6.163	36.31 ± 7.768	56.04	0.000**

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

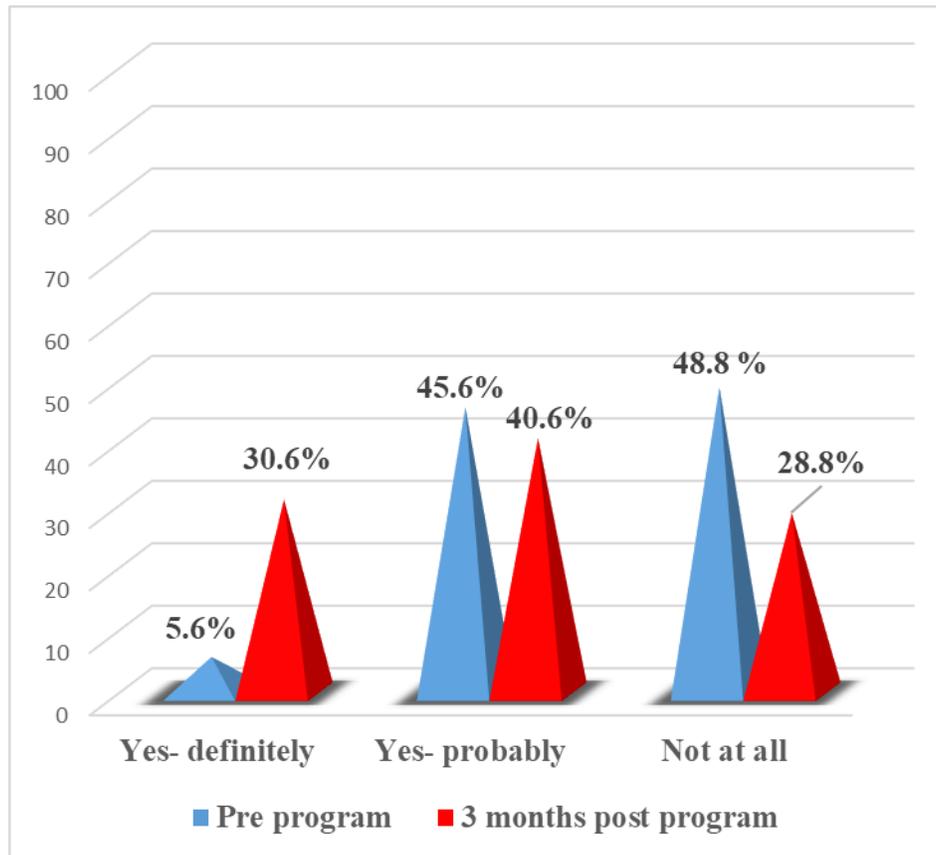
\* . Correlation is significant at the 0.05 level (2-tailed).



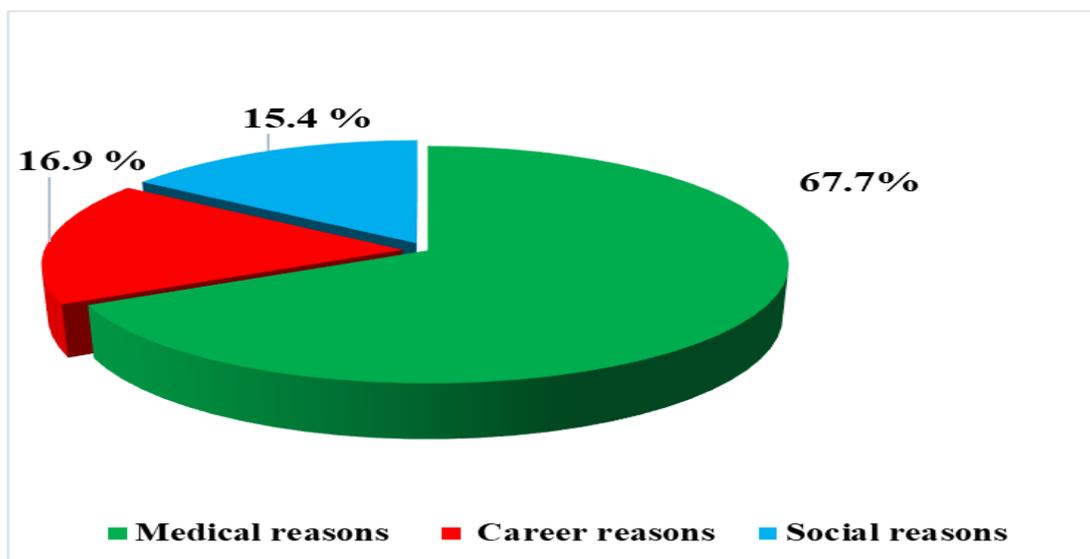
**Figure (1): Total knowledge score of the studied female faculty nursing students toward EFT pre, and three months post virtual educational program (n=320).**



**Figure (2): Total attitude score of the studied female faculty nursing students toward EFT pre, and three months post virtual educational program (n=320).**

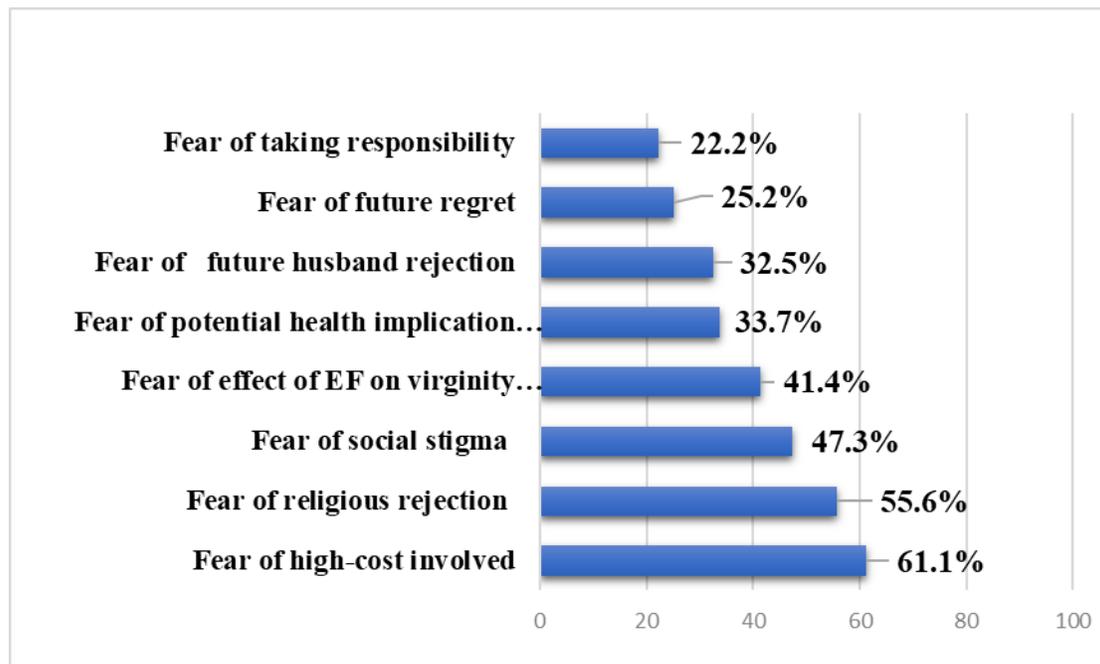


**Figure (3):** Opinion of the studied female faculty nursing students about if they would personally consider undertaking EFT in the future pre, and three months post virtual educational program (n=320).



More than one answer

**Figure (4):** Reasons to choose EFT for future use among the studied female faculty nursing students



More than one answer

**Figure (5): Fears of undergoing egg freezing among the studied female faculty nursing students**

**Table (3) :Correlation between total knowledge scores, and total attitude scores among the studied female faculty nursing students toward EFT pre and 3-month post virtual educational program (n=320).**

Variables	Total knowledge score pre program	Total attitude score pre program	Total attitude score 3 months post program
	r p	r p	r p
Total knowledge score 3 months post program	0.646 0.000**	0.123 0.000*	0.912 0.000**
Total attitude score pre program	0.203 0.000**	-	0.250 0.000**
Total attitude score 3 months post program	0.590 0.000**	0.250 0.000**	-

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

\* . **Correlation Coefficient** is significant at the 0.05 level (2-tailed)

**Table (4): Correlations between total knowledge score ,total attitude score toward EFT among the studied female faculty nursing students and their age, and academic year pre and 3-month post virtual educational program (n=320).**

Variables	Age	Academic year	Total knowledge score pre-program	Total knowledge score 3 months post program	Total attitudes score pre-program	Total attitudes score 3 months post program
	r p	r p	r p	r p	r p	r p
Age/years	-	0.592 0.000**	0.293 0.000**	0.436 0.000**	0.002 0.968	0.469 0.000**
Academic year	0.592 0.000**	-	0.557 0.000**	0.870 0.000**	0.114 0.042*	0.897 0.000**

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

\*. Correlation is significant at the 0.05 level (2-tailed).

### Discussion

Egg freezing technology now allows women to freeze and store oocytes with a realistic chance of future pregnancy, with in vitro fertilization (IVF) pregnancy rates now similar to those achieved with fresh oocytes. A better understanding of EFT is crucial to optimize the appropriate use of fertility preservation by it. <sup>(3, 33)</sup> This study aimed to determine the effect of a virtual educational program on knowledge, attitudes and opinions among faculty nursing students regarding EFT. The results revealed improvement in female faculty nursing students' knowledge, attitudes and opinions regarding EFT. This result support study hypothesis "Female faculty nursing students' perception regarding egg freezing technology are anticipated to be improved after the implementation of the virtual educational program". The results of the present study revealed that; the age of the studied female faculty nursing students

ranged from 19-24 years with mean  $21.01 \pm 1.284$  years. As regards their academic year, they were as follow: an equal percent of less than one- fifth in the first and fourth year, and an equal percent of one- third in the second and third year. The majority of the studied nursing students were single, two-thirds of them were living in rural areas and all of them didn't attend any training program about EFT.

**In relation to the total score of knowledge regarding EFT in the present study**, only 6.3% of the studied nursing students had high total score of knowledge before the application of the virtual educational program which significantly improved to half of them three months post program. These findings agrees with **Rafiei N et al., (2019)** <sup>(34)</sup> s' quasi-experimental study at Tehran, Iran, which assessed the impact of educational package on nursing students' knowledge towards fertility preservation,

and found a significant difference in mean score of nursing students' knowledge before and after the educational package intervention. Also, agrees with **Rashed A et al., (2018)**<sup>(35)</sup> who assessed the effect of cryopreservation counseling on knowledge and attitude of young female cancer patients and reported that, the majority of studied females had poor knowledge level before counseling and after counseling more than three quarters of them had good knowledge level. Moreover, these findings are similar with **Will E et al., (2017)**<sup>(33)</sup> who assessed medical students' and house staff's knowledge and personal and professional perceptions of age-related fertility and fertility preservation before and after an educational intervention. They mentioned that the short informational session significantly improved knowledge-based scores on pre- and post-event assessment surveys. In addition, agrees with **Hasab Allah M et al., (2021)**<sup>(1)</sup> who examined the effect of educational guideline on nursing students' knowledge, beliefs and attitudes toward oocyte cryopreservation, at Minia, Egypt. They revealed that there was a poor knowledge about oocyte cryopreservation in pretest reduced to less than one fifth of them in posttest with highly statistically significant improvements in their knowledge level. Furthermore, in a pre-/post-intervention study by **Wojcieszek A and Thompson R (2013)**<sup>(36)</sup>, knowledge of fertility and IVF effectiveness was assessed in undergraduate students immediately before and after viewing a brief online brochure, with significant improvements in knowledge noted among the intervention group. **Parker L et al., (2019)**<sup>(37)</sup>, added that the knowledge gaps among oncology nurses regarding fertility preservation (FP) suggest

that they would benefit from comprehensive training about fertility issues that impact oncology patients to adequately and confidently counsel these patients on this topic. Additionally, the present study finding agree with several recent studies among students population by **Abbass E et al., (2023)**<sup>(2)</sup> and **Fahmy S & Mohamed M (2021)**<sup>(24)</sup>. Also, among the general population by **Mansour S & Hassan S (2021)**<sup>(38)</sup>. It also agree with the findings of a descriptive study among medical students at Northwestern University in Chicago (US) in which 99% of respondents had heard about elective egg freezing **Ikhena-Abel D et al. (2017)**<sup>(39)</sup>. Meanwhile, other descriptive studies disagree with the finding of the current study including; a study of **Tozzo P et al. (2019)**<sup>(40)</sup>, which revealed that the baseline knowledge of oocyte freezing in Italy university female students was low which was similar to that reported by Singaporean medical students in a study by **Tan S et al. (2014)**<sup>(41)</sup>. **Tozzo P et al. (2019)**<sup>(40)</sup> concluded that it is certainly necessary to raise a greater awareness about fertility issues, both in the female population and in the medical and scientific community, so as to encourage health professionals to better inform their patients. From the researcher's point of view, this improvement in total knowledge in the current study might be due to the effect of the virtual educational program. As well as it might be attributed to the ability and interest of the female faculty nursing students to gain and update their knowledge about EF for themselves and for the general public. Regarding **the studied nursing students' attitudes regarding EFT**, one-third of them had a positive attitude toward EFT before

the application of the virtual educational program and increased to more than two-thirds of them three months post-program. The current result agrees with **Hasab Allah M et al., (2021)**<sup>(1)</sup> results which revealed that only one quarter of nursing students' had positive attitude about oocyte cryopreservation in pretest and increased to more than half of them in posttest with statistically significant improvements in their attitudes. Also, agrees with **Mansour S & Hassan S (2021)**<sup>(38)</sup> who found that the total attitude score of the oncology nurses regarding fertility preservation were improved significantly with highly significant difference post-educational package. Moreover, **Fahmy S & Mohamed M (2021)**<sup>(24)</sup>, mentioned that two thirds of the studied bridging program, nursing students has a positive attitude regarding EF. This finding is consistent with results from USA, and Brazil which predominantly reported favorable attitudes towards EFT.<sup>(39,42)</sup> {**Ikhena-Abel D et al. (2017)**<sup>(39)</sup> and **Santo E et al., (2017)**<sup>(42)</sup>} Meanwhile, finding of the current study disagree with several descriptive studies including; the study of **Ng E et al.,(2020)**<sup>(43)</sup> which highlights the negative attitudes of FP among Chinese medical students, and the study of the nursing/midwifery students in Izmir, Turkey which found that the students' attitudes toward EFT was negative. **Daşikan Z & Taner A (2020)**<sup>(44)</sup> Also, in Italy and Belgium participants typically had more negative views towards EFT {**Tozzo P et al. (2019)**<sup>(40)</sup> and **Stoop D et al., (2011)**<sup>(45)</sup>}. Moreover, in a Singaporean sample, majority of women indicated a more negative towards EFT (**Tan S et al. (2014)**<sup>(41)</sup>), and a sample comprised of participants across both the United Kingdom (UK) and

Denmark (**Milman L et al., (2017)**<sup>(46)</sup>). From the researchers' point of view, support for EFT remains relatively low on the whole.

Regarding the **opinion of the studied female faculty nursing students about if they would personally consider undertaking EFT in the future**; half of them mentioned that they would consider it preprogram ,and that percent increased to more than two thirds of them three months post program. This finding is consistent with the published article in Al-Ahram Weekly on the occasion of International Women's Day, in 2023and looked into the rising number of Egyptian women opting to freeze their eggs. It revealed that despite prior controversies among supporters and opponents of the practice, EFT has been growing in popularity among Egyptian women.<sup>(47)</sup>This finding is also consistent with the results from USA, and Brazil which predominantly reported that 71%, and 85.4% of participants positively supporting the EFT, respectively. **Ikhena-Abel D et al. (2017)**<sup>(39)</sup> and **Santo E et al., (2017)**<sup>(42)</sup> } Moreover, a number of studies reported that a high proportion of women would personally consider undertaking EFT in the future. **Platts S et al. (2021)**<sup>(3)</sup>; **Santo E et al., (2017)**<sup>(42)</sup>; **Sandhu S et al. (2023)**<sup>(48)</sup>; **Hickman L et al. (2018)**<sup>(49)</sup>; **O'Brien Y et al., (2017)**<sup>(17)</sup>. Conversely, in the survey of Singaporean study, 70% of medical student participants initially reported that they would consider using EF, which decreased to 48.9% after an educational intervention regarding EF. **Tan S et al. (2014)**<sup>(41)</sup>. Another study of American medical students echoed a decrease in likelihood to freeze following educational intervention in participants who were originally neutral

regarding their intention to use EFT. **Milman L et al., (2017)<sup>(46)</sup>**. Also, **Mahesan A et.al (2019)<sup>(50)</sup>**, revealed that most undergraduate and medical students would not consider EFT at the present time. In Belgium participants their support for the procedure was very low **Stoop D et al., (2011)<sup>(45)</sup>** and much lower rates of intention to use EFT were found in other studies. **Will E et al., (2017)<sup>(33)</sup>**; **Tozzo P et al. (2019)<sup>(40)</sup>**; **Hurley E et al. (2018)<sup>(51)</sup>** }. From the researchers' point of view, there is divided opinion about the EFT in Egypt and across the world.

Concerning **the reasons of potential users for EFT among the studied female faculty nursing students**; medial reason was among more than two thirds of them , career progression reason was among 16.9% of them and social reasons was among 15.4% of them. The findings of this study concur with **O'Brien Y et al., (2017)<sup>(17)</sup>** who reported that only (18.5%) of women from the general population would undertake EFT for career reasons. Also ,concur with other studies assessing acceptance of EFT for social reasons in other countries : we found in a study by **Tozzo P et al. (2019)<sup>(40)</sup>** in Italy that only (19.5%) of women would accept freezing their eggs for social reasons and this percentage is similar to that reported in a study by **Milman L et al., (2017)<sup>(46)</sup>**, in the study comparing attitudes of Danish and British women .Moreover, the present findings is similar with a study done by **Tan S et al. (2014)<sup>(41)</sup>** in Singapore which found that only one fifth of medical students would accept EFT for social reasons and slightly lower than that in a previous Belgian study by **Stoop D et al., (2011)<sup>(45)</sup>**. While , the findings of the present study disagree with **Mahesan A et.al**

**(2019)<sup>(50)</sup>** in their study in Eastern Virginia who found that less than half of students would consider EFT for medical reasons, two thirds of students would consider EFT for career reasons, and only one third would consider it for social reasons. Also, **Ng E et al., (2020)<sup>(43)</sup>** mentioned that medical students showed overwhelming support towards EFT for medical reasons among most of them but had mixed responses about EFT for career reasons among nearly two thirds of them. Moreover, **Wennberg A-L et al., (2016)<sup>(52)</sup>** found that less than half of women were positive towards EFT for medical reasons. The findings of a study in USA published by **Ikhen-Abel D et al. (2017)<sup>(39)</sup>** revealed that career progression has been shown to have little effect on decision-making regarding EFT. **Platts S et al. (2021)<sup>(3)</sup>** in their systematic review, revealed that career advancement was not found to be a direct motivating factor in studies of known or potential EFT users. **Will E et al., (2017)<sup>(33)</sup>**, **Jones B et al., (2020)<sup>(53)</sup>**, **Baldwin K et al., (2019)<sup>(54)</sup>**. From the researchers' point of view, these findings highlight the dynamic nature of reproductive aspirations and choices among student populations and general public.

In relation to, the **Fears of undergoing EFT** among the studied female faculty nursing students; the high cost involved, religious rejection and social stigma represents the main fears among (61.1%, 55.6% and 47.3% respectively) of the studied nursing students. Followed by fears of; effect of EFT on virginity before marriage, potential health implications, and future husband rejection among (41.4%, 33.7% and 32.5% respectively) of the studied nursing students. And, followed by fear of future regrets and fear of taking

responsibility among (25.2%-, and 22.2% respectively) of the studied nursing students. These finding agrees with several studies which indicated that the cost of EFT is the limiting factor in women's ability to undergo the procedure. {**Bavan B et al., (2011)**<sup>(55)</sup> ; **Goldman R et al., (2017)**<sup>(56)</sup>; **Kudesia R et al.,( 2015)**<sup>(57)</sup> }. **Platts S et al. (2021)**<sup>(3)</sup> in their systematic review, revealed that several studies identifying cost as the most important barrier to EFT and was in agreement that the main barriers for EFT were the high cost of the procedure. {**Will E et al., (2017)**<sup>(233)</sup> ; **Hasab Allah M et al., (2021)**<sup>(1)</sup> ; **Santo E et al., (2017)**<sup>(42)</sup> ; **Hickman L et al. (2018)**<sup>(49)</sup> ; **Hurley E et al. (2018)**<sup>(51)</sup> ; **Carroll K& Kroløkke C (2018)**<sup>(58)</sup> } Other findings indicated that women would be more inclined to undergo EFT procedures if the cost was reduced or subsidized {**Tozzo P et al. (2019 )**<sup>(40)</sup> and **Tan S et al. (2014)**<sup>(41)</sup> } Regarding religious rejection, there was no other studies that mentioned it but Egypt's Dar El-Iftaa, the country's Islamic institution responsible for issuing religious edicts, released a statement in 2019 saying that EFT is permissible if four conditions are met: the frozen eggs are only to be used within the context of marriage using the husband's sperm; the eggs are to be well-secured so as not to get mixed up with another women's eggs; the eggs should not be fertilized in another woman's womb; and the procedure should not negatively affect, or cause any birth defects, to the embryo.<sup>(59)</sup> **Hasab Allah M et al., (2021)**<sup>(1)</sup> and **Hodes-Wertz B et al., (2013)**<sup>(60)</sup> agree that there to be social stigma surrounding EFT. **Will E et al., (2017)**<sup>(33)</sup> agree with the present study finding in regard to the perceived potential

health implications as a barrier to undertaking EFT.

While, interestingly, the present study finding disagree with one German study which rated financial costs as one of the least important reasons in considering EFT {**Schick M et al.,(2017)**<sup>(61)</sup>}Also, the present study finding disagree with **Daniluk J & Koert E (2016)**<sup>(62)</sup> , finding which revealed that perceived risk was among women's highest-rated considerations regarding EFT. Meanwhile, **Baldwin K et al.,(2019)**<sup>(54)</sup> and **de Groot M et al., (2016)**<sup>(63)</sup> agreed in their studies that women were not too concerned about possible risks of the intervention, and such concerns were overruled by the desire for pregnancy. Moreover, in **Fahmy S & Mohamed M (2021)**<sup>(24)</sup> study, about four quarters of studied bridging program nursing students consider fear of future husband refusing as a barrier to perform EFT. In addition, Fear of future regret" was identified as a motivating factor to undertake EFT by women in a number of studies.{ **Sandhu S et al. (2023)**<sup>(48)</sup> ; **de Groot M et al., (2016)**<sup>(63)</sup> ; **Baldwin K& Culley L( 2020)**<sup>(64)</sup> }From the researcher's point of view, this agreement between countless number of studies across the world that fear of high cost is the main barrier to EFT uses, might be due to the recent jump in the dollar exchange rate. Another obstacle to the demand for EFT could be specific to the student population in the present study that the subject of high cost is always a sensitive topic among them because they worry about future earning potential.

Concerning the **correlation between the studied female faculty nursing students' total knowledge score and their total attitude score regarding EFT**, there was a

statistical significant correlation between them pre and three month after the application of the virtual educational program. These findings are consistent with **Rashed A et al., (2018)** <sup>(35)</sup> and **Hasab Allah M et al., (2021)** <sup>(1)</sup>. While, **Mansour S & Hassan S (2021)** <sup>(38)</sup> revealed that there was significant association between the post-intervention total knowledge and attitude level among the nurses only.

Concerning the **correlation between the studied female faculty nursing students' total knowledge score regarding EFT and their age, and academic year**, there was a statistical significant correlation between them pre and three month after the application of the virtual educational program. These findings agree with **Hasab Allah M et al., (2021)** <sup>(1)</sup> findings which found a highly statistical significant relation between students' total knowledge about oocyte cryopreservation and their age, in both pretest and posttest. Also, **Abbass E et al., (2023)** <sup>(2)</sup>, indicated that there was a statistically significant relationship between the overall amount of knowledge that students had acquired about ova cryopreservation before and after the implementation of the educational program and their age.

Relating to the **correlation between the studied nursing students' total attitude score regarding EFT and their age, and academic year**, there was a statistical significant correlation between them pre and three month after the application of the virtual educational program. These findings agree with **Hasab Allah M et al., (2021)** <sup>(1)</sup> findings who found a statistically significant relation between students' total attitudes toward oocyte cryopreservation and their age, in pretest, posttest. **Stoop D et al.,**

**(2011)** <sup>(45)</sup> and **Daniluk J & Koert E (2016)** <sup>(62)</sup> studies found that societal attitudes towards EFT appear to be influenced by age. While, **Baldwin K et al., (2015)** <sup>(65)</sup> mentioned that the lack of acceptance of EFT from the older age bracket could be due to generational differences, as older women tend to be more inclined to endorse strong beliefs towards traditional motherhood and biological conception. In the systematic review of **Platts S et al. (2021)** <sup>(3)</sup> studies exploring the impact of participant age on likelihood to consider EFT were inconclusive. **{Ikhena-Abel D et al. (2017)** <sup>(39)</sup>, **Milman L et al., (2017)** <sup>(46)</sup>, **O'Brien Y et al., (2017)** <sup>(17)}</sup>.

### Conclusion

The virtual educational program achieved a significant improvement in female faculty nursing students' knowledge and had a positive effect on their attitudes toward EFT. Also, the main reported fears of undergoing EFT among the female faculty nursing students were the high cost involved, religious rejection and fear of social stigma. So, the aim of this study has been achieved and the study hypothesis has been supported.

### Recommendations

Reapplication of the study for all faculties nursing students. Online distribution of a simplified and comprehensive Arabic PDF about EFT should be available across all levels of training and specialities. Integrating this new approach to fertility preservation in the nursing curriculum and hospital policy. Finally increasing workshops, conferences related to infertility issues and EFT.

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