Effect of health education program on knowledge, stress, and satisfaction among infertile women undergoing in vitro fertilization injection

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Abstract

Background Stress and dissatisfaction are common issues among patients undergoing in vitro fertilization (IVF). The process of IVF can be emotionally and psychologically challenging, leading to stress, anxiety, and depression in patients. This can be exacerbated by factors such as the length of infertility, the uncertainty of the outcome, and the financial burden of treatment. Additionally, the physical demands of the treatment, the side effects of medication, and the fear of failure can contribute to dissatisfaction and emotional strain in IVF patients. This pre-post intervention study design aimed to evaluate the effect of a health education program on knowledge, stress, and satisfaction among 100 infertile women undergoing IVF attending the Woman's Health Hospital's infertility outpatient clinic and IVF unit at Assiut University. Knowledge and stress were measured by women's knowledge about IVF and the perceived stress scale, respectively. The satisfaction was measured using the Scale of Patient Satisfaction about IVF.

Results There is a marked improvement in the knowledge of infertile women, with a significant reduction in their stress levels after the health education program. Furthermore, the satisfaction scores of the women who participated in the program improved significantly.

Conclusion The health education program demonstrated a positive impact on knowledge, stress levels, and satisfaction among infertile women undergoing IVF. These findings highlight the positive impact of the program on the participants and emphasize the importance of continuous educational programs regarding IVF to improve knowledge, decrease stress levels, and increase their overall satisfaction with the treatment.

Keywords Health education, Infertile women, In vitro fertilization injection, Satisfaction, Stress

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Background

Infertility is a prevalent health issue affecting approximately one in every six spouses of reproductive age worldwide. Despite the significant prevalence of infertility, the WHO recognizes that most infertile women keep silent about their situation, raising their psychological vulnerability [1, 2]. At varying degrees, negative feelings might show as despondency, concern, discomfort, or tension. In addition to the unpleasant psychological impacts, infertility continues to generate stigma for infertile couples, including pressure from relatives and peers, disrupting the quality of life and social standing, and generating major marital strain [3].

Perceived infertility stress is described as symptoms produced by infertility that are similar to the majority of post-traumatic stress disorder symptoms. Stress associated with infertility is the result of the interplay of physical problems and medical procedures that can endure for years and recur after any diagnostic or therapeutic interventions. A person providing care for an infertile woman must be thoroughly aware of the causes of infertility, the treatments available, and the local social norms in order to assist these women in coping with the condition [4, 5].

When previous assisted reproductive technology treatments have failed, IVF is the most advanced therapeutic therapy for infertility. IVF encounters some opposition in the Arab world, particularly in Egypt, due to cultural, societal, religious, economic, and other constraints. Although success rates vary, IVF treatment, which helps infertile couples produce a child, represents one of the most effective kinds of assisted reproductive technology now accessible [6, 7].

Despite many embryo transfers in most infertility centers, only one-third of IVF cycles achieve clinical pregnancy, and most fail. In other individuals, implantation failure happens repeatedly [8, 9]. Recurrent IVF failure is typically characterized as the inability to achieve a pregnancy after undergoing 2–6 cycles of in vitro fertilization (IVF), during which more than 10 high-quality embryos were put into the uterus [10]. Zhou et al. found that couples undergoing IVF who experience high levels of stress are more likely to have pregnancy failure [11].

Stress can have a negative impact on IVF outcomes in a variety of ways. For starters, stress can cause hormonal abnormalities that interfere with ovulation and embryo implantation. Second, stress can alter the immune system, causing inflammation and interfering with embryo implantation. Third, stress can lead to harmful behaviors such as smoking, drinking, and eating poorly, all of which can have a detrimental impact on IVF outcomes. Finally, stress can create psychological distress, which can lead to sadness and anxiety, reducing the likelihood of a good IVF outcome [12–14].

The psychological impacts of IVF can include anxiety, depression, and feelings of isolation. Research has shown that of women undergoing IVF may experience of 51.1% were anxious and 54.0% were depressed [15]. Another study found that 55% of women with IVF or ICSI had more than moderate depressive symptoms, and 39% were severely anxious [16].

Women's behavior and compliance to health strategy guidelines are critical in IVF; several significant determinants of infertility therapy, as women age and biological factors, are unchangeable, whereas there is increasing evidence that variables, such as smoking, body mass index, nourishment, or physical exercise, which can be changed by health strategy, have a significant effect on IVF success [17, 18].

Nurses have significant responsibilities within the IVF procedure, encompassing assessment, arranging, carrying out, evaluation, guidance, and teaching. They are the key healthcare providers who interact with couples throughout the IVF process, organize the many phases of therapy, and guarantee that couples adhere to the therapy regimen. The nurses provide scientific advice and educational resources to help couples reduce stress and increase satisfaction throughout the treatment cycle [6, 19].

Women undergoing IVF treatment may experience a variety of intense emotions, including stress [2]. Education programs are one of the most important instruments for improving the quality of health treatment, increasing satisfaction, and providing emotional support to reduce stress levels. Recognizing patients' educational requirements is one of the most important roles of nurses. Patient satisfaction may originate from appropriate health education, which allows patients to comprehend and engage in the making of medical decisions, which frequently leads to improved health results [20]. The knowledge gap in (IVF) patients is significant, impacting their psychological status, decision-making, and treatment process. Research shows that infertility and IVF treatments can have negative social and emotional effects, especially for females [21, 22]. Education and counseling are crucial in addressing this knowledge gap and providing accurate information about the treatment process, potential outcomes, and support services. Several studies found that education and counseling can effectively reduce anxiety, depression, and stress and improve coping skills, social support, and quality of life [23–25].

This study aimed to evaluate the effect of health education programs on knowledge, stress, and satisfaction among infertile women undergoing in vitro fertilization injection. We hypothesized that the health education program would have a good influence on the knowledge

and stress levels of infertile women and that it is likely to have an impact on satisfaction as well.

Methods

Study design and participants

This pre- and post-intervention study design aimed to evaluate the effect of a health education program on knowledge, stress, and satisfaction among 100 infertile women undergoing IVF injections attending the Woman's Health Hospital's infertility outpatient clinic and IVF unit at Assiut University. The sample size calculated based on the flow rate of the infertile women during the previous 6 months prior to the study conduction which was 122 infertile women, then Epi-Info (7.2.0.1) was used with a precision of 5%, a confidence level of 95%, and a p value of 0.05. The sample size was estimated to be 93 enlarged to 100 women to compensate for drop-out and refusal. A purposive sampling technique was followed in this research to select a specific group of individuals that the researchers are interested in studying; therefore, this type was selected because of the predetermined criteria (infertile women undergo IVF). Exclusion criteria involved women who refused to participate and have any history of psychiatric disorders.

Data collection

Three tools were used for this study:

All participants filled up a personal and infertility data sheet, which included age, level of education, occupation, resident, diagnosis, regularity of menstrual cycle, type, cause of infertility, previous trial for IVF, previous failure of IVF, and living children. Then, the following instruments were used:

Women's knowledge about IVF questionnaire

The questionnaire was designed by reviewing previous relevant studies [6, 21, 26–28] and was translated into Arabic and then back into English to confirm that the translated version communicated the correct meaning. The questionnaire included 19 questions such as the definition of IVF, causes of infertility, possible risks of treatment, the success rate of IVF, whether sexual intercourse should be avoided 3 days before the egg retrieval process, a period of rest, and relaxation immediately after the embryo transfer, recommended nutrition during IVF, deep breathing exercises to alleviate stress, and chemical substances to avoid during IVF. The overall score for knowledge was 47, with each correct answer worth one grade and each incorrect or incomplete response worth zero. In this study, the mean score was utilized to measure women's knowledge levels since knowledge over the mean score was considered adequate.

The perceived stress scale (PSS)

This scale was designed by [29, 30]. It consists of 10 items to assess women's feelings over the last month; each of the items was scored using a five-point scale ranging from 0 (never) to 4 (very often). The PSS scores ranged from 0 to 40, with higher scores indicating higher perceived stress: 0–13 considered low stress, 14–26 considered moderate stress, and 27–40 considered higher perceived stress. The Arabic-translated version was found to be valid and reliable ($r = 0.901$) [31].

Scale of patient satisfaction about IVF

This scale was developed by [32]. It consists of 15 items to measure patient satisfaction with IVF treatments; each of the items scored using a five-point scale ranging from 1 (very dissatisfied) to 5 (very satisfied), with a higher score denoting more satisfaction.

Validity and reliability of the study tools

Before using the questionnaire, a preliminary phase was undertaken to test its validity and reliability. The questionnaire was translated from English to Arabic by bilingual translators, then culturally adjusted by five experts in nursing and medical sciences. A pilot test was conducted with a small sample of 10% (10) infertile women undergoing IVF injection to assess its comprehensibility and acceptability. Back-translations were made to ensure accuracy.

The researchers conducted a reliability test by Cronbach's alpha was used to test the internal consistency of the tool in this present study, yielding a value of $\alpha = 0.86$ for the Women's knowledge about IVF questionnaire, $\alpha = 0.84$ for the perceived stress scale (PSS), and $\alpha = 0.83$ for the scale of patient satisfaction about IVF. These results indicate the good reliability of the study instruments.

Administrative design

The approval to perform this research was obtained by a formal letter addressed to the head manager of Woman's Health Hospitals related to Assiut University Hospitals for approval to carry out the research.

Overview of the infertile women health education program

Each course comprised 8–10 participants, and sessions were held two days every week for 1 h, for a total of sixth sessions (five instructional and one pre-assessment [first interview] sessions). The health education program and relaxation sessions covered in 6 h approximately. Each session included a lecture with tools,

such as videos and PowerPoint, group discussions, and relaxation technique training.

Phases of educational program
The researchers designed this study themselves after a 3-month evaluation of relevant materials. The program has three concepts. The first concept was implemented to educate infertile women on an overview of infertility, its causes, and the different treatment options available; detailed information on the in vitro fertilization process, including how it works, the risks involved, and the potential outcomes; and the injection process, including how to administer injections, the importance of timing, and how to manage side effects. The second concept was used to train infertile women to cope with stress. They learned about how stress can affect their mental and physical health during the IVF process, then instructed on techniques such as diaphragmatic breathing. In addition, the women were given a booklet to encourage practice at home. Another technique presented and discussed was meditation. Meanwhile, the third concept provided advice on healthy nutrition and lifestyle practices that support fertility and improve treatment outcomes. Finally, suggestions for good sleep hygiene were given.

The program was developed in the following stages:

1. Assessment phase: (1 month)

This phase was designed to examine knowledge, stress, and satisfaction levels among infertile women undergoing in vitro fertilization injection.

2. Consideration of the program's content (2 months)
The program strategy was covered in this phase (time, number of sessions, and teaching method). The teaching location and facilities were evaluated for suitability. The program's teaching sessions were held in the training hall. The schedule of the health education program is shown (Table 1).

3. Putting the program into action
In the pre-assessment session, the researchers assigned infertile women to individuals. They interviewed them individually to acquire demographic, clinical data and assess their knowledge, stress, and satisfaction levels regarding in vitro fertilization (first interview followed by five health education sessions). A report on the assignment outcomes was presented at the next session to determine how well they understood the prior session's themes. This stage is conducted during the ovulation and retrieve egg phases of the IVF process.

4. Evaluation of the program's impact
The infertile women were interviewed and assessed immediately after the implementation of sessions to evaluate the health education program's outcomes and to evaluate knowledge, stress, and satisfaction levels among infertile women undergoing IVF injection using the same pre-assessment tools. This stage

Table 1 Schedule of the health education program's content

Day	Session	Topic	Contents
First day Second day	1 2	Orientation of the study and it is nature and gain women participation agreement Pre-test Understanding infertility	Introduction to infertility, its causes, factors that affect fertility, the different types of infertility treatments, and introduction to in-vitro fertilization (IVF) and injection process
Third day	3	Revision of the previous session In vitro fertilization (IVF) process	Explanation of the IVF process, potential outcomes and risks associated with IVF, overview of medications used in IVF, importance of timing of medications and injections, and strategies to reduce discomfort and side effects associated with injections and medication
Fourth day	4	Revision of the previous session Injection process	Instructions on how to give injections, a demonstration of the injection procedure, the significance of properly storing and disposing of medications, approaches for managing potential adverse injection effects, the significance of adhering to the injection schedule, and the value of communicating with the healthcare provider are all covered
Fifth day	5	Revision of the previous session Coping strategies	Understanding the causes of stress and anxiety during IVF treatment, how to deal with stress and anxiety using relaxation techniques, meditation, and other coping strategies, the significance of self-care during the treatment process, strategies to improve communication and coping with partner and family members, and an overview of counseling and support services available to IVF patients
Sixth day	6	Revision of the previous session Nutrition and lifestyle Post-test	The impact of nutrition and lifestyle factors on fertility, recommended nutrition and lifestyle practices during IVF treatment, importance of exercise, and sleep hygiene

Program objective: To improve woman's knowledge regarding IVF, alleviate stress levels, and increases satisfaction

is conducted during the retrieve egg phase of the IVF process.

Statistical analysis

The IBM SPSS version 26.0 software was used to enter and analyze data. Continuous data were reported as the mean and SD, whereas categorical data were presented as the *N* and %. The groups under study were the chi-square and Mcnemar tests used to compare categorically. For comparison between the means of two related groups (pre and post), a paired *t* test was used. When there was a significant association between different demographic and clinical variables and the total score of knowledge, stress, and satisfaction, an independent sample *t* test was used for comparing two groups, and an ANOVA test was employed when there were more than two groups. Statistical significance was defined as a two-tailed *p* value of 0.05.

Results

Personal and infertility data: Table 2

Reveals that 59.0% of infertile women over 30 years old, with a mean age of 31.73 ± 5.29 years. 43.0% had secondary education, 79.0% lived in rural areas, and 85% were homemakers. 73.0% of women undergoing IVF had a regular menstrual cycle. 86.0% of women had primary infertility, 46.0% had 5—<10 years of infertility, and 43.0% of infertility causes were related to women. Also, 31.0% had a previous trial for IVF, with 96.8% of them having a history of failed IVF. The majority had no living children (Table 2).

Knowledge mean score in pre- and post-test

There was a marked improvement in the mean knowledge score in the post-test. It was found that the mean $\pm$ SD in the preprogram was 11.72 ± 5.70, while in the post-program, it was 33.74 ± 5.53, with a statistically significant difference ($P = <0.001$) (Fig. 1).

Stress and satisfaction levels in pre- and post-test

Clearly, 17.0% of women in the pre-program had moderate stress levels, compared to 49.0% post-program. Moreover, 81.0% of pre-program women had high-stress levels, which decreased to 29.0% post-program with a statistically significant ($P = <0.001$). It was found that 64.0% of women in the pre-program had low satisfaction levels, which increased to 39.0% post-program. In addition, 36.0% of women had a high satisfaction level pre-program and 61.0% post-program, with a statistically significant ($P = <0.001$) (Figs. 2 and 3).

Table 2 Personal and infertility data of women undergoing IVF at Assiut city

Personal data	No. (*n* = 100)	%
Age (years)		
20–30	41	41.0
>30	59	59.0
Mean ± SD	31.73 ± 5.29	
Level of education		
Illiterate	17	17.0
Read and write	13	13.0
Basic education	11	11.0
Secondary	43	43.0
University	16	16.0
Residence		
Urban	21	21.0
Rural	79	79.0
Occupation		
Housewife	85	85.0
Employee	15	15.0
Regularity of menstrual cycle		
Regular	73	73.0
Irregular	27	27.0
Type of infertility		
Primary	86	86.0
Secondary	14	14.0
Years of infertility		
<5	23	23.0
5—<10	46	46.0
≥10	31	31.0
Mean ± SD	7.77 ± 3.95	
Causes of infertility		
Female	43	43.0
Male	15	15.0
Both	31	31.0
Unexplained	11	11.0
Previous trial for IVF		
Yes	31	31.0
No	69	69.0
Previous failed IVF		
Yes	30	96.8
No	1	3.2
Living children		
None	93	93.0
One	7	7.0

Relation between total score of knowledge, stress, and satisfaction with women data (Table 3, 4, and 5)

Table 3 illustrates a statistically significant difference between the mean knowledge score and women's age in the pre-program. At the same time, there was a statistically significant between the mean knowledge score
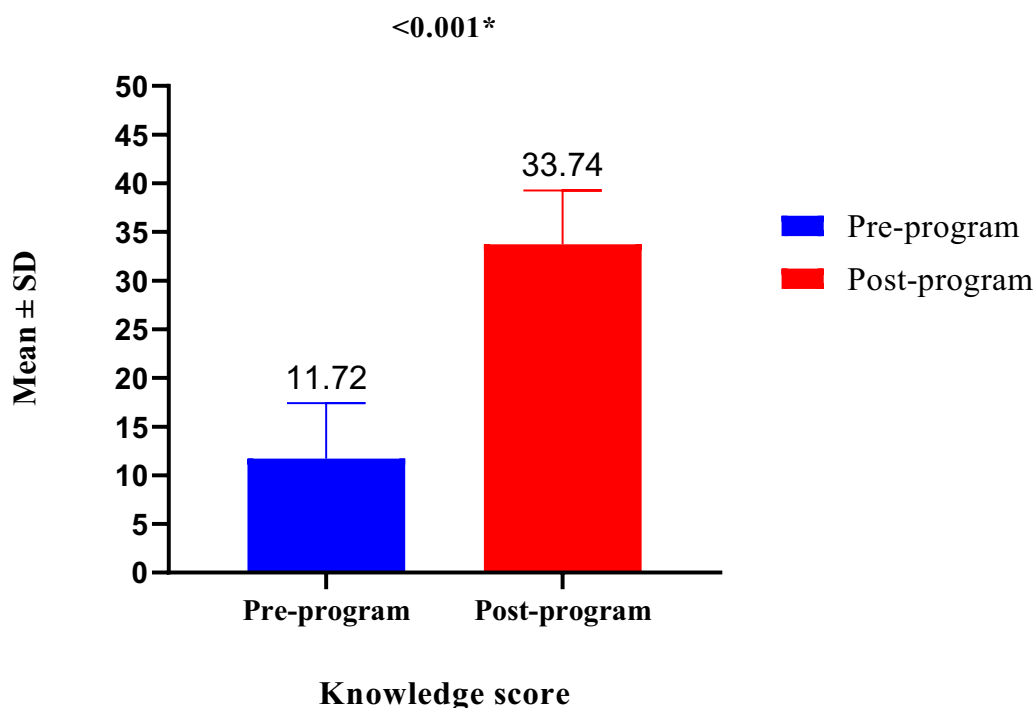
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<0.001*

Knowledge score

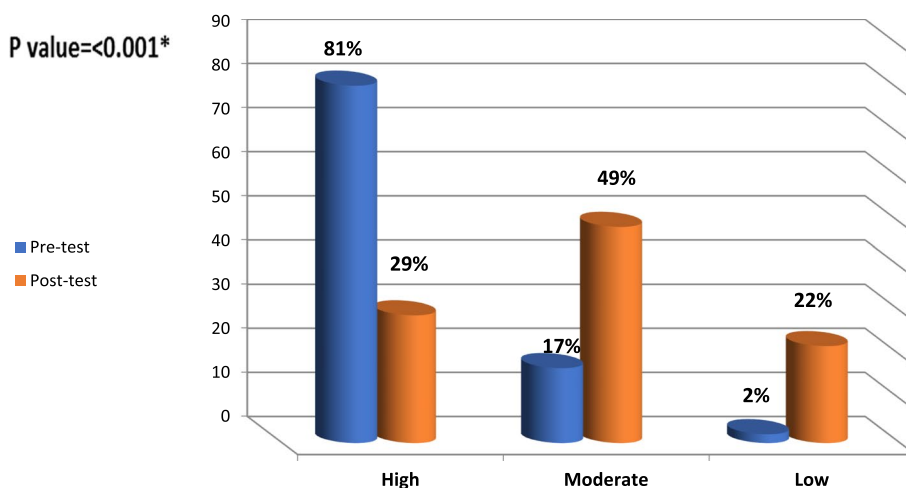**Fig. 1** Mean score of knowledge in pre/post-program among women undergoing IVF at Assiut city

Fig. 2 Stress level in pre/post-program among women undergoing IVF at Assiut city

pre- and post-program with women's residence and occupation ($P= <0.05$). On the other hand, there was no statistically significant association with the level of education.

Table 4 demonstrates a statistically significant association between the mean stress score and satisfaction with women's age in pre-program. Also, there was a statistically significant association between the mean satisfaction score and women's age post-program ($P= <0.05$).

Conversely, there was no association between the mean stress score and women's education in pre- and post-program. At the same time, there was an association between the mean satisfaction score and women's education pre-program ($P= <0.05$). There was no association between the mean satisfaction score and stress with residence and occupation pre- and post-program.

Table 5 indicates no statistically significant association between stress level, type, and years of infertility and
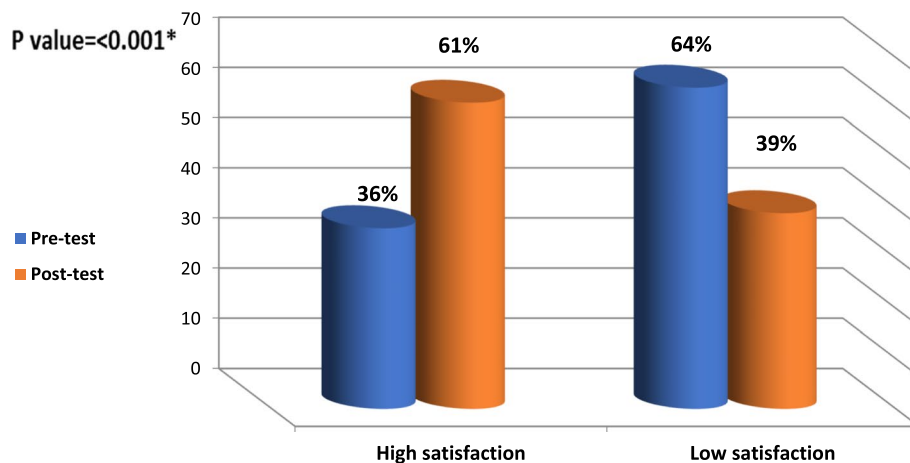
Fig. 3 Satisfaction level in pre/post-program among women undergoing IVF at Assiut city

Table 3 Relation between mean score of knowledge and personal data of women undergoing IVF in pre/post-program at Assiut city

Personal data	Mean score of knowledge	
	Pre-program	Post-program
	Mean ± SD	Mean ± SD
Age (years)		
20–30	10.56 ± 5.17	33.98 ± 5.70
>30	12.53 ± 5.94	33.58 ± 5.45
t value	7.933	0.125
P value	< 0.001*	0.724
Level of education		
Illiterate	10.59 ± 5.22	34.12 ± 5.69
Read and write	13.38 ± 6.50	33.62 ± 4.75
Basic education	10.36 ± 3.47	32.09 ± 4.41
Secondary	11.07 ± 5.65	32.81 ± 5.86
University	14.25 ± 6.38	37.06 ± 4.86
F value	1.565	2.103
P value	0.190	0.086
Residence		
Urban	16.48 ± 6.96	37.10 ± 5.36
Rural	10.46 ± 4.59	32.85 ± 5.25
t value	22.571	10.758
P value	< 0.001*	0.001*
Occupation		
Housewife	10.93 ± 4.99	33.27 ± 5.23
Employee	16.20 ± 7.42	36.40 ± 6.58
t value	12.145	4.219
P value	0.001*	0.043*

* Statistically significant difference (*p*<0.05)

Table 4 Relation between mean score of stress and satisfaction with women personal data at Assiut city

Personal data	Mean score of stress		Mean score of satisfaction	
	Pre	Post	Pre	Post
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Age: years				
20–30	25.47 ± 3.35	20.68 ± 5.00	59.50 ± 6.22	62.83 ± 7.29
>30	27.41 ± 4.30	21.34 ± 5.59	55.52 ± 5.58	59.54 ± 8.33
t value	5.255	0.363	10.572	4.164
P value	0.024*	0.548	0.002*	0.044*
Level of education				
Illiterate	26.44 ± 4.63	23.24 ± 5.12	53.93 ± 5.63	59.12 ± 8.75
Read and write	28.00 ± 5.69	22.08 ± 4.21	54.14 ± 5.90	60.00 ± 9.50
Basic education	25.13 ± 5.25	21.82 ± 5.58	61.75 ± 7.55	57.55 ± 6.83
Secondary	26.91 ± 3.59	19.28 ± 5.59	57.87 ± 5.32	61.70 ± 7.59
University	27.18 ± 2.89	22.25 ± 4.54	58.00 ± 6.21	63.63 ± 7.67
F value	0.556	2.402	4.092	1.307
P value	0.695	0.055	0.004*	0.273
Residence				
Urban	27.43 ± 2.74	19.95 ± 5.71	57.50 ± 7.25	62.71 ± 8.42
Rural	26.64 ± 4.27	21.37 ± 5.24	56.77 ± 5.91	60.41 ± 7.93
t value	0.445	1.167	0.173	1.371
P value	0.506	0.283	0.678	0.244
Occupation				
Housewife	26.71 ± 4.10	21.27 ± 5.26	56.64 ± 6.08	60.76 ± 8.00
Employee	27.75 ± 4.43	19.93 ± 5.82	62.50 ± 1.91	61.60 ± 8.58
t value	0.247	0.798	3.669	0.136
P value	0.620	0.374	0.058	0.713

* Statistically significant difference (*p*<0.05)

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Table 5 Relation between mean score of stress and satisfaction with women infertility data at Assiut city

Items	Mean score of stress		Mean score of satisfaction	
	Pre	post	Pre	post
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Type of infertility				
Primary	26.73 ± 4.16	21.10 ± 5.28	56.83 ± 6.19	59.84 ± 7.68
Secondary	27.20 ± 2.59	20.86 ± 5.88	57.60 ± 3.78	67.36 ± 7.42
t value	0.063	0.026	0.075	11.843
P value	0.802	0.873	0.785	0.001*
Years of infertility				
< 5	24.67 ± 3.34	21.70 ± 5.19	60.58 ± 6.95	65.70 ± 8.14
5—< 10	27.24 ± 3.90	21.30 ± 5.40	57.12 ± 5.31	61.67 ± 6.32
≥ 10	26.76 ± 4.42	20.26 ± 5.43	55.37 ± 6.35	56.16 ± 7.96
F value	1.952	0.556	3.622	11.776
P value	0.148	0.576	0.030*	< 0.001*
Previous trial for IVF				
Yes	25.96 ± 4.65	20.87 ± 5.74	53.96 ± 6.92	56.55 ± 9.79
No	27.04 ± 3.86	21.16 ± 5.19	57.95 ± 5.40	62.84 ± 6.29
t value	1.374	0.062	9.153	14.914
P value	0.244	0.804	0.003*	< 0.001*

* Statistically significant difference ($p<0.05$)

previous trials for IVF in pre- and post-program. On the other hand, there was a statistically significant association between satisfaction level with years of infertility and previous IVF trials in pre- and post-program ($P= <0.05$).

Discussion

Patient-centered care, good communication, and effective health strategy are critical elements for the optimal management of infertility in women. These approaches may also increase their compliance with IVF guidelines and decrease the physical, psychological, and psychological burdens related to IVF therapy [33]. The current research recorded that nearly three-fifths of women were aged > 30 years. This observation agreed with Okafor et al. [34], who found that one-quarter of the study sample was aged 30–34 years, while in contrast with [21] who pointed out that nearly two-thirds of the study group were aged 15–24 years.

The present findings reported that more than two-fifths of women had secondary education, and most were housewives. This contradicts Okafor et al. [34], who noted that slightly more than two-thirds had a university education and two-fifths of the study group were employees. Also dissimilar to Omobude et al. [35], who stated that nearly three-quarters of women had a tertiary level of education. Regarding residence, the study results made it clear that more than three-quarters of women were

from rural areas; this result differed from Yüksekol et al. [36], who showed that only 9.8% of the study group was from villages.

The current study displayed that approximately three-quarters of infertile women had a history of a regular menstrual cycle; this was similar to the result of Sõritsa et al. [17], who cleared that most of the infertile women had a regular menstrual cycle. Also, this finding is in line with Abdelgelel et al. [37], who conveyed that approximately two-thirds of the study and control groups had regular menstrual cycles. According to the presented study findings, only 7.0% of women had live children. This disagreed with Arhin et al. [21], who recorded that less than one-quarter of the study sample had a child before. Furthermore, this result is inconsistent with Chikeme et al. [28], who mentioned that half of the study sample had children before.

Regarding types of infertility, the current results found that most women had primary infertility. This observation agrees with those of [35, 38] who recorded that most women had primary infertility. The proposed study results demonstrate that approximately half of the women had 5-< 10 years of infertility with $M \pm SD$ 7.77 ± 3.95; this is similar to Karlidere et al. [39] who reported M ± SD of infertility duration was 8.55 ± 4.79 years, and also agree with Sõritsa et al. [17] who indicated that the duration of infertility in the study group was 4.6 years. Also, the current study agrees with [35] who found that more than half of the sample had < 7 years of infertility. As regards causes of infertility, more than two-fifths of causes are related to women. This result is consistent with Panahi et al. [40] who noted that more than one-third of infertility causes are related to women, while disagreeing with Roudsari and Bidgoli [41] who reported that slightly more than one-third of the intervention group and half of the control group caused infertility related to men.

According to the mean score of total knowledge in the pre-health program among women, the results recorded those infertile women had a low mean score of knowledge of 11.72 ± 5.70. This result aligns with [20, 27] who stated that there is a relatively low level of knowledge about ART among women, with many having limited awareness of the different types of ART procedures available. They highlight the value of a well-designed health education booklet to empower and educate infertile couples about the IVF process, enabling them to make informed decisions and actively participate in their fertility treatment.

In contrast to the previous study conducted by Oche et al. [42], they noticed that most women were aware of IVF; however, there were several misperceptions about the procedure. For example, some women believed that IVF was unnatural or involved using donor eggs or

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sperm. Also, they found that the cost of IVF was a significant barrier to its use. Overall, they suggested that there is a need for more education about IVF to dispel myths and misconceptions about the procedure. This education could be provided by doctors, nurses, and other healthcare professionals, as well as by the media and other public awareness campaigns.

Likewise, the current study cleared that there was an improvement in women's mean knowledge score in the post-health program to be 33.74 ± 5.53 with a statistically significant difference between pre- and post-health education program. This observation is consistent with Timmers et al. [18]. They found that the study group had significantly higher satisfaction levels with the information they received than the control group and a higher level of knowledge about the steps and procedures of IVF treatment. Additionally, the study group reported feeling more prepared for IVF treatment and more confident in their ability to manage the emotional and physical challenges of the treatment.

In addition to these results, similar to [37, 43, 44], who revealed that an educational program is more effective in improving knowledge among the study group than the control group. This indicates that the teaching programs significantly enhance knowledge levels, equipping women with a better understanding of IVF and potentially empowering them to make informed decisions regarding their fertility treatment. Also, the educational program positively affects the success rate of IVF by enhancing patient understanding, adherence to treatment protocols, and overall involvement in their care.

The results of the present study demonstrate that the health education program significantly reduced the stress levels of the participating women. Pre-program, over three-quarters of infertile women, experienced high stress levels. However, after completing the program, the proportion of women reporting high stress levels declined considerably to less than one-third. The difference was found to be statistically significant ($P = < 0.001$). The observed decrease in stress levels could be attributed to several factors related to the program. The program may have imparted skills or coping mechanisms that helped participants manage their stress effectively. The program also created an environment of support and understanding that alleviated participants' stress. Also, the decline in stress levels post-program could be due to alleviating uncertainty about what they will do in the future. Lawal et al. [45] found that infertile women experience higher perceived stress than fertile women. Additionally, it highlights the importance of addressing stress and psychological well-being in infertility management. In the same context, Hawkins et al. [46] concluded that

improving women's education regarding IVF will alleviate their stress and potentially improve IVF outcomes.

Also, Sökmen and Türkleş, [47] in their study, referred to several factors that contribute to stress among women obtaining IVF therapy, including the financial burden associated with treatment, the physical demands of the procedures, the uncertainty of success, and the emotional toll of infertility. Additionally, they identify factors such as the duration of treatment, previous failed attempts, and lack of support from family and friends as significant stressors. They also emphasize the importance of addressing these stress-inducing factors and implementing appropriate support mechanisms to mitigate the psychological impact of IVF treatment on women. In addition, Heredia et al. [48] demonstrate that the psychological intervention effectively reduced stress and enhanced coping strategies among infertile women. They suggest that addressing psychological factors and providing stress management tools before IVF can positively impact women's emotional states during the treatment process; in their study, they highlight the importance of integrating psychological support into pre-IVF care to improve the overall well-being of women undergoing fertility treatment.

Several prior studies conveyed that, infertile women who received collaborative counseling experienced a significant reduction in perceived infertility-related stress and significantly improved coping strategies compared to those who did not receive counseling. They suggest collaborative counseling can effectively mitigate the stress experienced by infertile women undergoing IVF treatment. Those studies highlight the importance of incorporating counseling services as part of comprehensive infertility care to address the psychological impact of infertility and enhance well-being during the IVF journey [49, 50]. Therefore, it seems that the stress reduction in the current study appears to be justifiable given the improved knowledge and increased satisfaction of infertile women about the in vitro fertilization injection process and learning some coping strategies and communicative skills covered in the health education program sessions.

The study by Sallem et al. [38] revealed that psychological stress significantly impacted the outcomes of assisted reproduction. Women who reported higher stress levels experienced lower pregnancy rates and live birth rates than those with lower stress levels. Additionally, the miscarriage rate was higher among women who reported higher stress levels. The researchers suggested that stress management interventions and psychological support should be considered part of the ART process. By addressing and reducing stress levels, it may be possible

to improve the success rates of these reproductive techniques in infertile women.

Consequently, Gürbüz et al. [51] discussed that infertile couples without sufficient counseling from healthcare providers might have many biopsychosocial health problems during the IVF treatment procedure. Many studies, such as [52–54] confirm that women who do not receive health strategies have high levels of stress; this is in alignment with the result of the present study, which observed that most of the women before the health education program had a high level of stress.

The current study shows women's satisfaction levels before and after participating in a health education program. The findings indicate that approximately one-third of women had high satisfaction in the pre-health education phase. This suggests that most women were not highly satisfied with the in vitro fertilization injection therapy before receiving health education. In contrast, less than two-thirds of women in the post-health education phase reported high satisfaction. This indicates a significant improvement in satisfaction levels after participating in the health education program, with a statistically significant difference between the pre and post-health education program satisfaction levels ($p = < 0.001$).

These results were consistent with another study, which stated that in comparison with two groups (intervention and control), providing intervention with timely information increases their level of satisfaction [18]. Also, this observation agreed with El-sharkawy et al. [43] who found that the infertile women were high satisfaction levels after the intervention in the study group compared to the control group. Also, other studies, [41, 55] reported that counseling could improve the marital satisfaction of women with infertility undergoing IVF. This might be explained by the fact that women were more disciplined in adherence to health strategy recommendations and in participation in IVF therapy, which increased their satisfaction.

According to the relationship between personal data and total knowledge score, there was a statistically significant association between knowledge in the pre-test among women related to their age and occupation ($P = < 0.001$ and 0.001), respectively. This result contrasts with other studies [21, 42], which showed that the respondents' age and occupation had no statistically significant association with their knowledge regarding IVF. Also, the current study found no statistically significant association between knowledge in pre and post-program among women related to their level of education. his result disagrees with [20, 21], who reported a statistically significant relationship between knowledge and education among the study group (P value = 0.001 and 0.032).

On the other hand, previously evident that there was no association between the knowledge of infertile women with demographic variables [44]. The current study showed a significant difference between stress levels in preprogram and women's age (P value = 0.024). These results disagreed with [38] who found no relationship between psychological stress and socio-demographic characteristics of women.

The number of women at Woman's Health Hospital's infertility outpatient clinic and IVF unit at Assiut University was few, and difficulty accessing private clinics was considered one of the limitations. As a result, the findings of the current study cannot be generalized. While these findings are promising, it is important to note that the study was conducted at a single center and had a limited follow-up period. Future research involving multiple centers and longer follow-up periods is needed to validate further the generalizability and long-term effects of the health education program. Nevertheless, the current study provides valuable evidence supporting the integration of continuous educational programs into IVF treatment protocols to improve the overall well-being and satisfaction of infertile women.

Conclusion

The health education program demonstrated a positive impact on knowledge, stress levels, and satisfaction among infertile women undergoing IVF. These findings highlight the positive impact of the program on the participants and emphasize the importance of continuous educational programs regarding IVF to improve knowledge, decrease stress levels, and increase their overall satisfaction with the treatment. Also, we recommend educational materials such as posters and guideline booklets be available in infertility clinics to improve awareness of women undergoing IVF, and more studies should be conducted to investigate stress and satisfaction levels for the suggestion of stress coping strategies.

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Availability of data and materials

All data generated or analyzed during this study are available from corre‑sponded on request.

Declarations

Ethics approval and consent to participate

This study was approved by the institutional review board of Assiut Uni‑versity's Faculty of Nursing (approval no. 4820033). There was no risk to the study subject when the research was applied. The subjects' written informed consent to participate was obtained following an explanation of the study's objectives. They were offered the chance to refuse and were informed that they may withdraw from the study at any time. They also received guarantees that data would remain private and only be used for this study. Moreover, this study followed the latest version of the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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