Effect of Health Belief Model-based Educational Intervention on COVID-19 Preventive Behaviors among Pregnant Women

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Abstract

Background: Educating pregnant women can improve compliance with COVID-19 prevention behaviors. **Aim** of the study was to investigate the effect of health belief model-based educational intervention on COVID-19 preventive behaviors among pregnant women. **Design:** A quasi-experimental research design (pretest/posttest, comparison group) was utilized. **Setting:** This study was carried out in the Obstetrics and Gynecology outpatient clinic at Benha University Hospital. **Sample:** A total of 174 pregnant women were enrolled in the study using a purposive technique. **Data collection tools** included a structured interviewing questionnaire with three sections covering demographic features of the studied woman, obstetric history, and pregnant women's knowledge about COVID-19. Health Belief Model scale and checklist for self-reported compliance with COVID-19 health preventive behaviors. **Results:** After one month of health belief model-based educational intervention, the mean scores of the overall health belief model and subscalesfor perceived susceptibility, perceived severity, perceived benefits, perceived self-efficacy, as well as cues to action about COVID-19 were significantly increased, while the mean score of perceived barriers was markedly lower in the study group (P< 0.001).The majority of the study group had high compliance with COVID-19 preventive behaviors, compared to more than a quarter of the control group. **Conclusion:** Health belief model-based educational intervention was effective in improving pregnant women's knowledge, health beliefs, as well as self-reported compliance with preventive behaviors regarding COVID-19. **Recommendation:** Provide continuous educational programs based on health belief model to enhance pregnant women's knowledge and compliance with COVID-19 pandemic preventive behaviors.

Keywords: COVID-19, educational intervention, health belief model, pregnant, preventive behaviors.

Introduction

Pregnancy exposes women to viral infections of the respiratory system as a result of the physiological alterations of the immune system, heart, and lungs [(1)]. Infectious disorders can have a significant impact on maternal and fetal outcomes. Stillbirth, miscarriage, and preterm delivery are all possible outcomes of prenatal respiratory infections [(2)].

According to the World Health Organization (WHO), the COVID-19 virus is spreading rapidly, and a global pandemic was announced on March 11, 2020 [(3)].COVID-19 is a single-stranded, non-fragmented RNA-encapsulated virus that causes symptoms varying from a mild cold to a life-threatening sickness. COVID-19 infection during pregnancy has yet to be proven to cause intrauterine infection[(4)].

Table 2. Nurse's general knowledge regarding COVID-19. (N= 110)COVID-19 infection is associated with an increased temperature, shortness of breath, cough, and symptomatic pneumonia, which can be confirmed by a positive RNA or lungs computed tomography [(5)].Pregnant women may be more susceptible to unfavorable outcomes during an outbreak due to the amplification of specific pregnancy issues[(6)]. Adverse pregnancy outcomes related to COVID-19 include pregnant women are at risk of preterm deliveries, cesarean section, intensive care unit admission, mechanical ventilation, and mortality[(7,8)].

With the global spread of the novel COVID-19 virus, pregnant women's preventative health behaviors have become critical. In particular, the transmission rate of infectious diseases can be lowered by raising knowledge and practicing preventive measures [(9)].

The efficacy of education depends on the appropriate use of health behavior theories and models. Such models have been shown to be helpful in promoting health by helping to elucidate risk factors and modify health behaviors [(10)]. The health belief model, which emphasizes behavior as a function of a woman's knowledge and beliefs, is one of the most appropriate models for improving incorrect beliefs and adopting healthy behaviors[(11,12)].

The Health Belief Model (HBM) is an extensively used psychosocial behavior change model that includes five main structures: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, as well as cues to action [(13)]. According to HBM, pregnant women should perceive the health threat posed by COVID-19 as a major health hazard to engage in preventive measures. This implies that women are considering themselves to be at risk (perceived susceptibility) and aware of the consequences and dangers (perceived severity). In addition, recognizing the efficacy of preventive behaviors (perceived benefits). Identifying and striving to eliminate impediments to preventative behaviors (perceived barriers), as well as incentives to participate in healthy lifestyle actions (cues to action) [14].

Currently, therapeutic management is primarily supportive with a major focus on preventing transmission of the COVID-19 virus [15].Therefore, educational interventions are extremely important for the COVID-19 prevention strategy. It is essential to evaluate women's health beliefs about the prevention and management of COVID-19, as well as the motivation to engage in preventive behaviors that include wearing protective equipment, keeping a safe social distance, as well as staying at home[16]. Besides, compliance with prevention and personal cleanliness rules, for example, hands washing on a regular basis and covering the mouth and nose while coughing or sneezing[17].

Nurses can assist pregnant women with COVID-19 or who dealt with infected individuals by providing direct care, educating, coaching, and counseling. Pregnant women should be taught to keep prenatal appointments and to limit interactions with others to minimize infection [18, 19]. Also, women experiencing COVID-19 symptoms must be advised to get tested as soon as possible with a nasal or throat swab, and to self-isolate to avoid cross-transmission[20].

Significance of the study

The disease produced by the novel COVID-19 virus is presently the most serious health problem facing the world [21]. In each contagious disease outbreak, pregnant women constitute a highly vulnerable group due to physiology and immune processes are altered and thus these women become more susceptible to infection [22]. Worldwide, by May 17, 2021, COVID-19 has registered 163,174,951 cases with 3,381,517 deaths [23]. From January 3, 2020, to June 5, 2021, there were 267,171 confirmed Covid-19 cases in Egypt, including 15,309 deaths [24]. According to a systematic review conducted by Juan and Gil[25],among pregnant women, COVID-19 disease was 95.6 percent mild, 3.6 percent severe, and 0.8 percent critical. Since vaccination is still progressing slowly and there is no specific treatment available. Therefore, practicing COVID-19 preventive behaviors is widely accepted to be the most beneficial and cost-effective. Accordingly, pregnant women's beliefs about the COVID-19 infection can have a significant impact on compliance with preventive behaviors for curtailing the control of the COVID-19 outbreak. Consequently, it is vital to equip and empower pregnant women with a thorough understanding of COVID-19, as well as accurate health beliefs related to the vulnerability and the seriousness of COVID-19, along with stressing the benefits of complying with preventive health behaviors. To our knowledge, there are no studies that have applied HBM educational interventions for COVID-19 to pregnant women. So, this study was carried out.

Aim of the study

The study aimed to investigate the effect of health belief model-based educational intervention on COVID-19 preventive behaviors among pregnant women.

Research hypotheses

The following research hypotheses were formulated to fulfill the aim of the current study:

Hypothesis 1: Pregnant women who exposed to the health belief model-based educational intervention will have improved knowledge about COVID-19 than those who do not expose.

Hypothesis 2: Pregnant women who exposed to the health belief model-based educational intervention will have positive changes of health beliefs regarding COVID-19 than those who do not expose.

Hypothesis 3: Pregnant women who exposed to the health belief model-based educational intervention will have higher levels of self-reported compliance with COVID-19 preventive behaviors than those who do not expose.

Subjects and Method

Research design

The present study used a quasi-experimental research design (pretest / posttest, comparison group).

Research setting

This study was carried out in the Obstetrics and Gynecology outpatient clinic at Benha University Hospital.

Sample

A total of 174 pregnant women were enrolled in the current study using a purposive technique, according to the inclusion criteria: pregnant women who attended the antenatal follow-up visits at the previously mentioned setting, had not been diagnosed with confirmed COVID-19, had no medical or obstetric complications, literate, and agreed to participate. While women with respiratory symptoms or a suspected COVID -19 diagnosis, who required hospitalization, and women who have received the same intervention before were excluded. The sample size was determined using the Yamane[26]statistical equation"$n = N / (1 + N (e)^2)$" where n is the required size, N is the total population size (1195 women), according to the statistical center of Benha University Hospital[27], and e is the level of precision was (0.07). In equal allocation ratio (1:1), the sample was divided into two groups: the study group (who exposed to the health belief model-based educational intervention) and the control group (who received conventional prenatal care).

Data collection tools

For collecting the data, three tools were utilized.

First tool: A structured interviewing questionnaire

The researchers designed the tool after reviewing the relevant literature[28,22]. It was divided into three sections:

Section (1) addressed the demographic features of the studied pregnant women; including age, level of education, occupation, residence, and the monthly income of the family.

Section (2) was dealt with obstetric history included gravidity, and gestational age.

Section (3) was concerned with assessing pregnant women's knowledge about COVID-19 using 10 items which contained19 multiple-choice questions covering definition, incubation period, signs and symptoms, high-risk group of infection, routes of transmission, diagnosis, complications,COVID-19 related adverse pregnancy outcomes, methods of management as well as preventive and precautionary measures during the pandemic.

Scoring system: Each item was scored by a dichotomous scale; correct answers got a score of two, while incorrect or I don't know answers got a score of one. The total score of knowledge was between 10 and 38, then distributed into two categories as inadequate knowledge when the total score less than 60% (1< 23 degrees) and considered adequate knowledge when the total score equal and more than 60% (23 ≤ 38 degrees).

Second tool: Health Belief Model scale

This scale was adapted by the researchers after reviewing prior studies(29,30,31), to assess pregnant women's health beliefs regarding COVID-19. The HBM scale involved six subscales comprising 25 items: perceived susceptibility (3 items), perceived severity (4 items), perceived benefits from compliance with preventive measures (6 items), perceived barriers to compliance with preventive measures (6 items), self-efficacy (4 items), as well as cues to action (2 items).

Scoring system: Each item was graded on a five-point Likert scale, with 1 indicating "strongly disagree" and 5 indicating "strongly agree". The scores for the items of each subscale were summed up and then the overall scale, the overall score ranged from 25-125. For the overall HBM scale and subscales, higher scores indicate more positive health beliefs toward COVID-19, except for perceived barriers of compliance with preventive measures, higher scores indicate more negative health beliefs.

Third tool: Checklist for self-reported compliance with COVID-19 health preventive behaviors

The tool was designed by researchers after reviewing related literature [32,33,34], to assess self-reported compliance with preventive behaviors against COVID-19. It consisted of 14 items.

Scoring system: Each COVID-19 preventive behavior was assessed by a three-point Likert scale, always, sometimes, and never scored 3, 2, and 1, respectively. The lowest possible score was 14 whereas the highest possible score was 42. The sum of the scores for all items is classified as follows: low compliance < 50% (1- 20 degrees), partial compliance 50 % < 75% (21-31 degrees) and high compliance 75 ≥100 (32- 42 degrees).

Validity and reliability

A panel of three experts in the fields of Obstetrics and Woman Health Nursing, as well as Community Health Nursing, evaluated and confirmed the tools' content and face validity. Based on the experts' comments, the required amendments were made as a rephrasing some sentences of the HBM scale

Reliability was performed using Cronbach's Alpha coefficient test; the first tool's internal consistency was 0.81.For the second tool, the overall HBM scale's internal consistency was 0.86, and HBM subscales were perceived susceptibility (0.83), perceived severity (0.80), perceived benefits (0.89), perceived barriers (0.79), perceived self-efficacy (0.85), and cues to action (0.82). The third tool had an internal consistency of 0.87.

Ethical considerations

The ethical aspects were followed by researchers, including verbal informed consent was obtained after explaining all pertinent information about the study (aim and activities, expected outcomes, and benefits and risks associated), and voluntary participation was clarified. Confidentiality and anonymity were also guaranteed. Participants were told the right to discontinue at any time without any consequences. The precautionary measures were ensured by wearing protective face masks and maintaining a safe physical distance during data collection. After completion of the study, a designed educational booklet about COVID-19 preventive measures was given to the control group.

Pilot study

The simplicity, clarity, and applicability of the tools were evaluated in a pilot study involving 10% of the entire sample (17 women). The time required to collect the questionnaires was determined as well as any problems peculiar during data collection were identified. Since no modifications were made, pilot study participants were included within the total sample size.

Field work

An official letter from the dean of the Faculty of Nursing was taken and forwarded to the hospital director seeking permission to perform the study after clarifying the objective. The study was conducted in four stages namely assessment, planning, implementation, as well as evaluation. The stages lasted nine months from the start of October 2020 until end of June 2021. The researchers were accessible three days weekly (Saturday, Tuesday, and Thursday) at the aforementioned setting from 9 a.m. to 1 p.m. Researchers executed the precautionary measures from the pandemic throughout the stages of the study.

Assessment phase: The researchers interviewed the participants in the outpatient waiting place, introduced themselves, and explained to each participant the objective, process, and expected outcomes of the study and then verbal consent to participate was attained. The tools were filled by women in two groups (pretest). The time to complete the three tools took approximately 30-45 minutes per woman (the first was 5-10 minutes, the second was 15-20 minutes, the third was 10-15 minutes), and an average of 8-10 women were interviewed each week.

Planning phase: According to the analysis of pretest findings gained during the assessment phase on detecting the actual educational needs of women and relevant literature, the researchers designed an educational intervention based on HBM subscales to improve the deficiency of knowledge, health beliefs coupled with preventive behaviors of pregnant women regarding COVID-19. The educational methods and the number of sessions required were determined. Accordingly, an educational booklet about COVID-19 preventive measures has been designed and judged by experts.The booklet was written in a simple Arabic language with attractive and colorful pictures and included a definition, an incubation period, signs and symptoms, high-risk group of infection, routes of transmission, diagnosis, complications of COVID-19, adverse effect on maternal and neonatal outcomes, medical management and vaccination, the applicability of precautionary preventive behaviors. As well as measures to manage stress, and anxiety during this pandemic.

Implementation phase: In the study group, HBM-based intervention included four educational sessions held over two weeks (two sessions per week), each session lasting 35-45 minutes. The first session focused on pregnant women's perceptions of sensitive and vulnerability to COVID-19 infection (perceived susceptibility), followed by a comprehensive understanding of the seriousness and negative effects of COVID-19 infection during pregnancy(perceived severity), by providing information about definition and overview of COVID-19 morbidity and mortality, incubation period, signs and symptoms, high-risk group of infection, routes of transmission, diagnosis, complications, in addition to adversely affecting maternal and neonatal outcomes. After completing the first session, participants were handed an educational booklet.

The second session addressed the value and necessity of compliance with the applicability of preventive behaviors (perceived benefits) were highlighted by explaining and demonstrating preventive behaviors as the proper method of wearing, removing, and disposing of the mask. Hand washing frequency, and correct technique, as well as coughing and sneezing etiquette. Also emphasized measures related to personal hygiene, cleanliness of the surrounding environment, maintaining a distance of at least one meter from others, attending prenatal visits, eating a balanced diet, taking vitamins as prescribed, drinking plenty of water, engaging in recommended regular exercise, maintaining adequate sleep, and the isolation protocol was clarified if necessary.

During the third session, each woman identified the challenges and obstacles to adopting COVID-19 preventive measures, and researchers presented ways to overcome and resolve these issues through group discussion (perceived barriers).

The fourth session focused on empowering women to believe in abilities to prevent COVID-19 by applying correct preventive behaviors (perceived self-efficacy). Additionally, pregnant women's readiness to engage in COVID-19 preventive health behaviors when holding appropriate beliefs. one of the cues to action was an internal stimulus, as worry about pregnancy during the pandemic, while the others were external stimuli such as an educational booklet, media, and family (cues to action).

After each session, feedback on the previous session was given, as well as the objectives for the next one. Teaching methods used were group discussion, questions and answers, demonstration and redemonstration, PowerPoint presentations, brainstorming, and short educational videos.

Evaluation phase:

One month after the implementation of the educational intervention, post testing of the study and control groups was performed using the same pretest tools (the first tool 'section 3', the second and third tools). To eliminate bias, the evaluation began first with the control group and later with the study group.

The control group received conventional prenatal care without any intervention by researchers. Meanwhile, after evaluation, the women in the control group were given a designed educational booklet.

Statistical Analysis

The Statistical Package for Social Sciences (SPSS) version 26 was used to analyze the collected data. The Kolmogorov-Smirnov test was used to verify the normal distribution of the data, which was confirmed. As descriptive statistics, the frequency and percentage of qualitative data, as well as the mean and standard deviation of quantitative data, were utilized. The Chi-square test, Fisher exact test, and independent t-test were used to assess the differences between the two groups. The Pearson correlation coefficient was employed to examine the association between the quantitative continuous variables. The P-value was considered significant at

0.05, and the statistical significance was considered high at 0.001.

Limitations or obstacles of the study

Despite the fact that research on COVID-19 has been conducted from a variety of perspectives and on different population groups, there is currently a lack of research on educational interventions for pregnant women using the HBM model as a framework for comparing findings of the current study.

Results

Table (1) denotes that 52.9% and 50.6% of the study and control groups, were between the ages of 25 and 30 years, with mean ages of 26.54 ± 2.31and 27.74 ± 2.12 years, respectively. Regarding level of education, 49.4% and 46.0% of the study and control groups had a secondary education, respectively, While 72.4% of the study group and 60.9% of the control group were housewives. Rural areas are residence to 75.9% and 83.9 % of the study and control groups, respectively. The majority of the two groups had insufficient monthly income. No significant difference in demographic characteristics between the two groups ($p > 0.05$).

Table (2) demonstrates that 67.8% and 54.0% of the study and control groups were primigravidas respectively. While 69.0% and 72.5% of the study and control groups were in the second trimester of pregnancy respectively.

Figure (1) shows that before the educational intervention, 21.8 % in the study group and 26.4 % in the control group had adequate knowledge about COVID-19 (p-value=0.479). Meanwhile, after one month of the educational intervention, 89.7% of the pregnant women in the study group had an adequate level of knowledge, compared to 31.0 % of the control group (p-value =0.001).

Table (3) displays that the mean health belief scores about COVID-19 in the two groups before the educational intervention were similar in all subscales ($p > 0.05$). However, after one month of the educational intervention, mean scores for perceived susceptibility, perceived severity, perceived benefits, perceived self-efficacy, as well as cues to action were significantly higher in the study group than in the control group, while the mean score of perceived barriers was markedly lower in the study group($P< 0.001$).

Figure (2) reveals that the mean overall health belief model score about COVID-19 in the study and control groups was 71.37 and 70.26, respectively, with no significant difference between the two groups before the educational intervention (p-value = 0.304).

Whereas the mean overall health beliefs model score in the study group was noticeably higher than in the control group after one month of the educational intervention (p-value = 0.001).

Table (4) clarifies that before the educational intervention, there was no statistically significant differences between the study and control groups with respect to all items of self-reported compliance with COVID-19 preventive behaviors (P > 0.05). Whilst one month after educational intervention, highly statistically significant differences were found between both groups (P< 0.001).

Figure (3) shows that before the educational intervention, 20.7 % of pregnant women in the study group and 24.1 % in the control group had high compliance with COVID-19 preventive behaviors (p-value=0.643). While after one month of the educational intervention, 86.3% of pregnant women in the study group had high compliance with COVID-19 preventive behaviors, compared to 26.5 % in the control group (p-value=0.001).

Table (5) indicates a significant positive correlation between scores of total knowledge, the health belief model as well as self-reported compliance with COVID-19 preventive behaviors before and one month after educational intervention in the study and control groups (P< 0.001).

Table (6) portrays a significant positive correlation between overall score of health belief model and total self-reported compliance with COVID-19 preventive behaviors score before and one month after educational intervention in study and control groups (P< 0.001).

Table 1: Distribution of pregnant women in the study and control groups by demographic features (n=174)

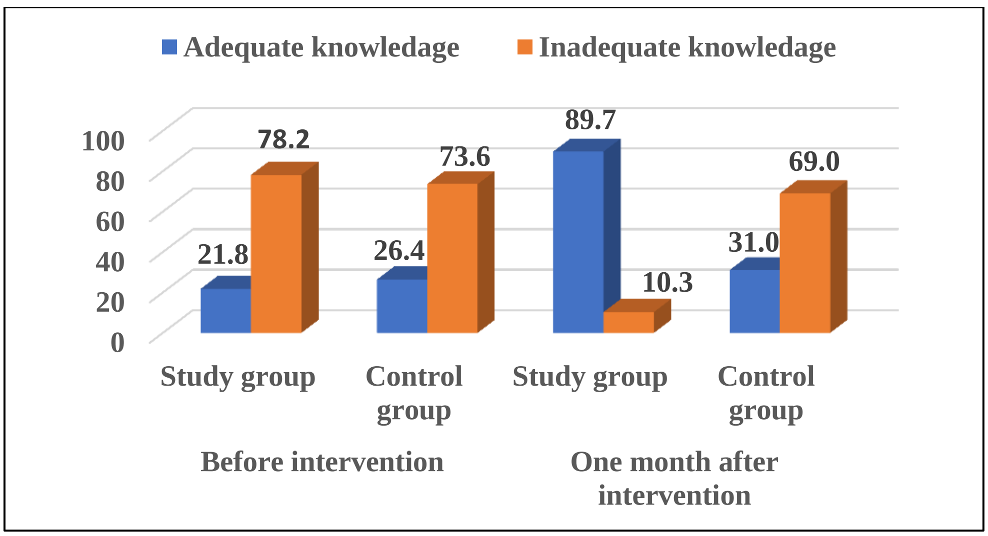
Groups / Variables	Study group n=87		Control group n=87		X^2/ FET	P-value
	No	%	No	%		
Age (years)						
20 < 25	10	11.5	13	14.9	1.487€	0.685ns
25 < 30	46	52.9	44	50.6		
30 < 35	24	27.6	26	29.9		
35 ≤ 40	7	8.0	4	4.6		
Mean ± SD	26.54 ± 2.31		27.74 ± 2.12		t=1.276	0.204ns
Level of education						
Primary education	12	13.9	7	8.0	2.784€	0.426ns
Secondary education	43	49.4	40	46.0		
University education	29	33.3	35	40.3		
Postgraduate studied	3	3.4	5	5.7		
Occupation						
Working	24	27.6	34	39.1	2.586	0.108ns
Housewife	63	72.4	53	60.9		
Residence						
Urban	21	24.1	14	16.1	1.753	0.186ns
Rural	66	75.9	73	83.9		
Monthly income						
Sufficient	11	12.6	17	19.5	1.532	0.216ns
Insufficient	76	87.4	70	80.5		

ns non statistical significance difference ($p > 0.05$) € Fisher Exact Testt=independent t-test

Table 2: Distribution of pregnant women in the study and control groups by obstetrics history (n=174)

Groups / Variables	Study group n=87		Control group n=87		X^2/ FET	P-value
	No	%	No	%		
Gravidity						
Primigravidas	59	67.8	47	54.0	3.476	0.062 [ns]
Multigravida	28	32.2	40	46.0		
Gestational age						
First trimester	15	17.2	17	19.5	1.514	0.469 [ns]
Second trimester	60	69.0	63	72.5		
Third trimester	12	13.8	7	8.0		

[ns] non statistical significance difference (p > 0.05) [€] Fisher Exact Test



Before educational intervention (p-value = 0.479)One month after educational intervention (p-value =0.001)

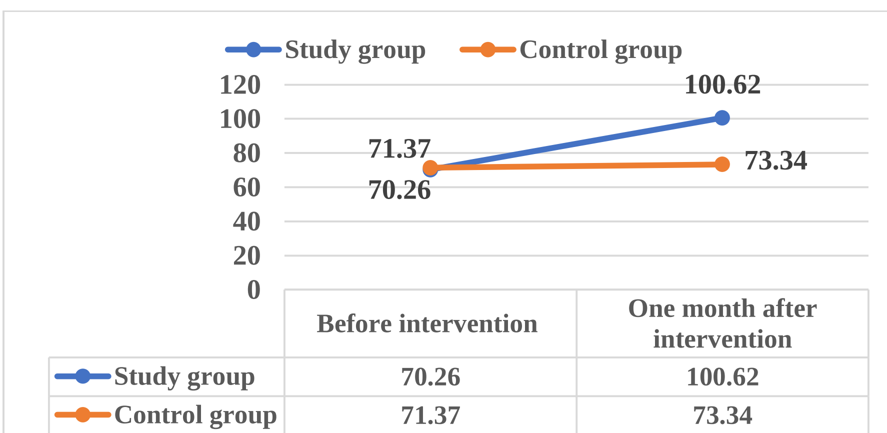
Figure 1: Distribution of pregnant women in the two groups by level of the total COVID-19 knowledge score before and after one month of educational intervention (n=174)

Table 3: Comparison of mean scores forCOVID-19health belief model subscales before and one month after educational intervention in the study and control groups(n=174)

Subscales	Possible range score	Phases	Study group n=87	Control group n=87	Independent t-test	P-value
			Mean ±SD	Mean ±SD		
Perceived susceptibility	3-15	Before intervention	7.26 ± 3.14	7.94 ± 2.85	1.495	0.137 ns
		One month after intervention	13.21±1.28	8.16 ± 3.10	14.405	0.000**
Perceived severity	4-20	Before intervention	9.98 ±1.65	10.32 ± 1.61	1.392	0.166 ns
		One month after intervention	17.18 ±1.88	10.76 ± 2.39	17.507	0.000**
Perceived benefits	6-30	Before intervention	17.29 ± 2.53	17.79 ± 2.44	1.341	0.182 ns
		One month after intervention	26.15 ± 2.58	18.15 ± 2.57	20.752	0.000**
Perceived barriers	6-30	Before intervention	27.93 ± 1.26	27.19 ± 3.92	1.667	0.097 ns
		One month after intervention	21.11 ± 1.28	27.92 ± 4.21	14.423	0.000**
Perceived self-efficacy	4-20	Before intervention	4.97 ± 0.82	5.13 ± 0.80	1.213	0.227 ns
		One month after intervention	15.25 ± 2.36	5.28 ± 0.74	37.635	0.000**
Cues to action	2-10	Before intervention	2.83 ± 0.84	2.98 ± 0.83	1.274	0.204 ns
		One month after intervention	7.64 ± 1.82	3.17 ± 0.87	20.721	0.000**

ns non statistical significance difference (p > 0.05) SD: Standard Deviation

**A high statistical significance difference (P ≤ 0.001).



Before educational intervention (p-value = 0.304) One month after educational intervention (p-value =0.001)

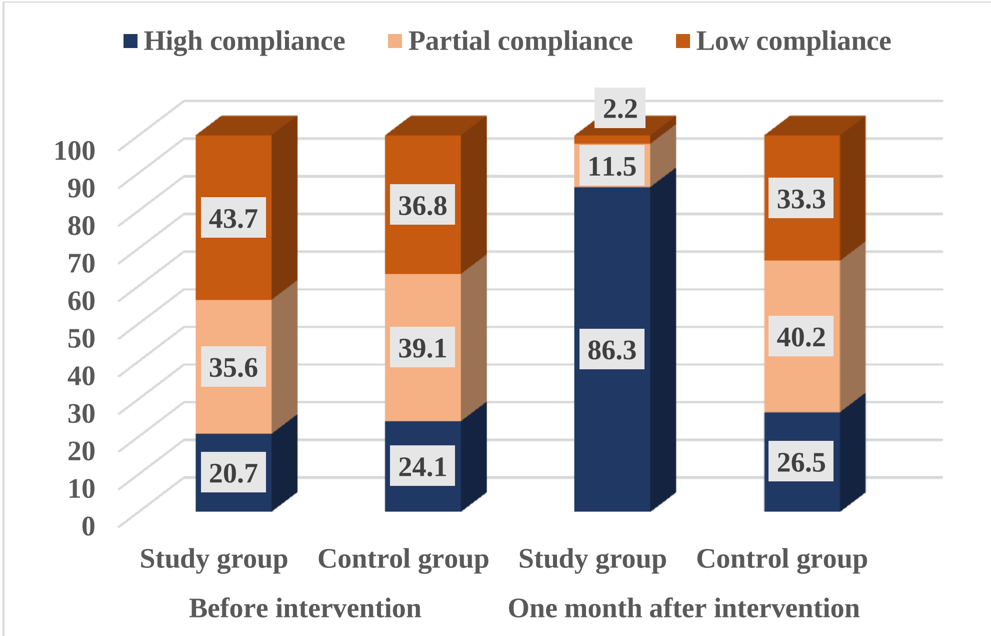
Figure 2: Mean overall score of health belief model about COVID-19 before and one month after educational intervention in the study and control groups (n=174)

Table 4: Distribution of pregnant women's self-reported compliance with COVID-19preventive behaviors in the two groups before and one month after educational intervention (n=174)

Compliance with	Phases	Study group n=87			Control group n=87			X^2/FET	P-value
		Always No. (%)	Sometimes No. (%)	Never No. (%)	Always No. (%)	Sometimes No. (%)	Never No. (%)		
Wear a mask when going out	Before intervention	10 (11.5)	46 (52.9)	31 (35.6)	17 (19.5)	43 (49.4)	27 (31.1)	2.192	0.334 ^{ns}
	One month after intervention	78 (89.7)	8 (9.2)	1 (1.1)	23 (26.4)	40 (46.0)	24 (27.6)	72.444$^{€}$	0.000**
Wash hands with water and soap for at least 20 seconds or use alcohol sanitizers frequently	Before intervention	25 (28.7)	34 (39.1)	28 (32.2)	32 (36.8)	26 (29.9)	29 (33.3)	1.944	0.378 ^{ns}
	One month after intervention	83 (95.4)	4 (4.6)	0 (0.0)	36 (41.4)	31 (35.6)	20 (23.0)	59.392$^{€}$	0.000**
Keep distance of at least one meter from others	Before intervention	19 (21.8)	30 (34.5)	38 (43.7)	25 (28.7)	28 (32.2)	34 (39.1)	1.112	0.574 ^{ns}
	One month after intervention	63 (72.5)	15 (17.2)	9 (10.3)	30 (34.5)	24 (27.6)	33 (37.9)	27.521	0.000**
Avoid touching eyes, nose, and mouth with hands	Before intervention	5 (5.7)	18 (20.7)	64 (73.6)	10 (11.5)	15 (17.2)	62 (71.3)	2.174	0.367 ^{ns}
	One month after intervention	58 (66.7)	25 (28.7)	4 (4.6)	15 (17.2)	12 (13.8)	60 (69.0)	78.896	0.000**
Avoid hand shaking and kissing with	Before intervention	14 (16.1)	26 (29.9)	47 (54.0)	20 (23.0)	17 (19.5)	50 (57.5)	3.135	0.219 ^{ns}
	One month after intervention	60 (69.0)	21 (24.1)	6 (6.9)	22 (25.3)	19 (21.8)	46 (52.9)	48.479	0.000**
Place a tissue or bend elbow in front of the mouth and nose when sneezingor coughing	Before intervention	33 (37.9)	38 (43.7)	16 (18.4)	29 (33.3)	37 (42.5)	21 (24.1)	0.947	0.623 ^{ns}
	One month after intervention	77 (88.5)	8 (9.2)	2 (2.3)	35 (40.٢)	34 (39.1)	18 (20.7)	44.645$^{€}$	0.000**
Disinfect surfaces and touched objects such as cell phone	Before intervention	12 (13.8)	18 (20.7)	57 (65.5)	15 (17.2)	23 (26.5)	49 (56.3)	1.547	0.461 ^{ns}
	One month after intervention	54 (62.1)	26 (29.9)	7 (8.0)	18 (20.7)	25 (28.7)	44 (50.6)	44.863	0.000**
Attend antenatal visits at appointments	Before intervention	13 (14.9)	19 (21.8)	55 (63.3)	11 (12.6)	16 (18.4)	60 (69.0)	0.533	0.465 ^{ns}
	One month after intervention	45 (51.7)	32 (36.8)	10 (11.5)	14 (16.1)	15 (17.2)	58 (66.7)	56.319	0.000**
Eat balanced diet	Before intervention	25 (28.7)	23 (26.5)	39 (44.8)	32 (36.8)	21 (24.1)	34 (39.1)	1.293	0.524 ns
	One month after intervention	49 (56.3)	27 (31.1)	11 (12.6)	35 (40.2)	24 (27.6)	28 (32.2)	12.920	0.004**
Practice regular exercise.	Before intervention	5 (5.7)	12 (13.8)	70 (80.5)	3 (3.4)	18 (20.7)	66 (75.9)	1.831$^{€}$	0.402 ns
	One month after intervention	42 (48.3)	17 (19.5)	28 (32.2)	8 (9.2)	20 (23.0)	59 (67.8)	36.884	0.000**
Drink a plenty of water	Before intervention	37 (42.5)	16 (18.4)	34 (39.1)	30 (34.5)	15 (17.2)	42 (48.3)	1.569	0.448 ns
	One month after intervention	69 (79.3)	14 (16.1)	4 (4.6)	38 (43.7)	13 (14.9)	36 (41.4)	34.618$^{€}$	0.000**
Wash fruits and vegetables properly	Before intervention	34 (39.1)	24 (27.6)	29 (33.3)	37 (42.5)	19 (21.8)	31 (35.7)	0.775	0.679 ns
	One month after intervention	50 (57.5)	35 (40.2)	2 (2.3)	41 (47.2)	21 (24.1)	25 (28.7)	23.983$^{€}$	0.000**
Maintain adequate sleep	Before intervention	28 (32.2)	18 (20.7)	41 (47.1)	25 (28.7)	23 (26.5)	39 (44.8)	0.830	0.660 ns
	One month after intervention	66 (75.9)	13 (14.9)	8 (9.2)	27 (31.1)	22 (25.3)	38 (43.7)	38.234	0.000**
Avoid areas with covid-19 cases	Before intervention	44 (50.6)	17 (19.5)	26 (29.9)	48 (55.2)	14 (16.1)	25 (28.7)	0.484	0.785 ns
	One month after intervention	81 (93.1)	6 (6.9)	0 (0.0)	53 (61.0)	13 (14.9)	21 (24.1	29.430	0.000**

^{ns} non statistical significance difference ($p > 0.05$) $^{€}$Fisher Exact Test

**A high statistical significance difference ($P \leq 0.001$).



Before educational intervention (p-value = 0.643) One month after educational intervention (p-value=0.001)

Figure 3: Distribution of the level of total self-reported compliance with COVID-19 preventive behaviorsby pregnant women in two groups before and after one month of educational intervention (n = 174)

Table 5: Correlation coefficient between scores of total knowledge, health belief model, and self-reported compliance with COVID-19 preventive behaviors in study and control groups before and one month after the educational intervention (n=174)

Variables	**Phases**	Total knowledge score			
		Study group		**Control group**	
		r	**p**	**r**	**P**
Overall health belief model score	Before intervention	0.562	0.002**	0.325	0.003**
	One month after intervention	0.698	0.000**	0.413	0.001**
Total score of self-reported compliance with COVID-19 preventive behaviors	Before intervention	0.654	0.000**	0.754	0.000**
	One month after intervention	0.726	0.000**	0.863	0.000**

**A high statistical significance difference ($P \leq 0.001$).

Table 6: Correlation coefficient between scores oftotal health belief model and self-reported compliance with COVID-19 preventive behaviors in study and control groups before and one month after the educational intervention (n=174)

Variables	**Phases**	Overall health belief model score			
		Study group		**Control group**	
		r	**p**	**r**	**p**
Total compliance with preventive behaviors score	Before intervention	0.814	0.001**	0.649	0.001**
	One month after intervention	0.832	0.001**	0.595	0.001**

**A high statistical significance difference ($P \leq 0.001$).

Discussion

The beliefs and behavioral responses of the general population, particularly pregnant women, are crucial in preventing and controlling COVID-19 outbreak. The HBM is one of the effective health education models, focusing primarily on preventing illnesses and adopting behaviors to avoid diseases. In addition, HBM is used to study the relationship between beliefs and health behaviors [13,35]. Adequate knowledge has been shown to be a prerequisite for establishing a preventive belief, forming a positive disease prevention and management behaviors [36,37]. Therefore, this study aimed to investigate the effect of health belief model-based educational intervention on COVID-19 preventive behaviors among pregnant women.

The results of the current study found no statistically significant differences in the demographic features of the pregnant women in the study and control groups. Around half of the study and control groups were between the ages of 25 and 30, with mean ages of 26.54 ± 2.31 and 27.74 ±2.12 years old, respectively. Also, less than half of the two groups completed secondary education and nearly two-thirds of the study and control groups were housewives. While more than three-quarters of the two groups resided in rural areas. The majority of both groups had insufficient monthly income. The results indicated that the two groups were homogeneously distributed. These are similar to Sabry et al., (2021) [38] revealed that more than half of women aged 25 to < 30 years old had a mean age of 26.97±2.76 years, and more than two-thirds of them resided in rural areas and were unemployed. According to Degu et al., (2021) [39] 56.9% of pregnant women were between the ages of 25 and 34, with a mean age of 27.19 ± 4.72 years. These results are in accordance with Omozuwa et al., (2020) [40] mentioned that 52.4% of pregnant women had completed secondary school. Abdelhafiz et al., (2020) [41] found that approximately half of the study participants had inadequate income.

The study findings showed that more than two-thirds of the pregnant women in the study group as well as more than half of the control group were primigravidas. More than two-thirds of both groups were pregnant in the second trimester. These are supported by Sabry et al., (2021) [38] found nearly half of women were primigravida with a gestational age between 20 to 30 weeks. Kumbeni et al., (2021) [42] the majority of women get pregnant in the second trimester.

The current study finding demonstrated that nearly a quarter of the two groups had adequate knowledge about COVID-19 before the educational intervention. This is consistent with Nicholas et al., (2020) [43] stated that 21.9% of the subjects had correct knowledge about COVID-19 infection. Other studies have found similar results, for instance, participants in studies conducted in Turkey Yıldırım and Güler, (2020) [44] and Bangladesh Ferdous et al., (2020) [45] reported low levels of COVID-19-related knowledge. Also, Nwafor et al., (2020) [46] and Zhong et al., (2020) [47] demonstrated that occupation, educational level, and place of residence are predictors for knowledge scores. As such, individuals with low educational level and unemployment have lower knowledge scores. Inadequate knowledge in the present study could be due to COVID-19 is a new and unknown disease, as well as the demographic characteristics of women in both groups, may explain the lack of knowledge. Pregnant women in rural areas with secondary education and housewives may have limited access to up-to-date information and gain more knowledge about COVID-19.

In contrast, Fikadu et al., (2021) [48] noticed that 54.84% of pregnant women attending hospitals in Guraghe Zone Southern Ethiopia had adequate knowledge about COVID-19 prevention measures.Serwaa et al., (2020) [49] foundthat knowledge of pregnant women in Ghana were 62.7%. In Uganda, 69% of pregnant women who had received prenatal care aware about COVID-19 (Olum and Bongomin, 2020) [50]. Also, Maharlouei et al., (2020) [28]found that 70% of the participants had an acceptable level of knowledge about COVID-19. The disparity could be attributed to differences in study cultures and efforts by healthcare systems to raise awareness about COVID-19.

However, after one month of the educational intervention, the majority of the study group had an adequate level of knowledge, compared to less than a third of the control group. This finding could be attributed to the effectiveness of the educational intervention in increasing women's knowledge about COVID-19 and interest in the topics presented. This finding supported by Sabry et al., (2021) [38]showed that three-quarters of women had a poor level of knowledge about the COVID-19 pre-educational program, compared to 93.0% of women who had a good level of knowledge post-educational program, with a high statistically significant difference ($p<0.001$).

Concerning pregnant women's health beliefs regarding COVID-19, the study results indicated that the mean scores of the overall health belief model and subscales were similar before the educational intervention in both groups, with no statistically significant differences observed. Nonetheless, after one month of the educational intervention, the mean scores of the overall health belief model and subscales, namely, perceived susceptibility, perceived severity, perceived benefits, perceived self-efficacy, as well as cues to action, were significantly higher in the study group than in the control group, whereas the mean score of perceived barriers was significantly lower. These findings might be due to improving pregnant women's knowledge regarding COVID-19 by an effective educational intervention which in turn enhanced positive health beliefs regarding COVID-19 prevention.

These findings are comparable to Mehanna et al., (2021) [(51)] who emphasized those efforts should be directed to educate individuals about the necessity of adhering to preventive measures. knowing the importance of each protective action in preventing infection with the novel COVID-19 virus, as well as the disease's potentially devastating consequences would undoubtedly encourage individuals to adhere to the preventive measures. According to Lee et al., (2020) [(52)] the perceived benefits and severity of preventive health behaviors related to COVID-19 are important indicators. Also, the findings of Alagili and Bamashmous (2021) [(53)]pointed out that the best model structures for predicting adherence to COVID-19 preventive practices during the outbreak were perceived benefits, perceived barriers, and cues to action.

Regarding self-reported compliance with COVID-19 preventive behaviors, the current study found that before the HBM-based educational intervention, nearly a quarter of the pregnant women in both groups were highly compliant with COVID-19 preventive behaviors, with no statistically significant differences in all items of preventive behaviors between the two groups. These findings are in the same line with Metwally and Desoky, (2020) [(54)]found that only 12.4% of pregnant women had a satisfactory practice level for COVID-19 infection prevention measures, and 87.6% of women had an unsatisfactory level of total practice. These findings are also slightly consistent with those of another study by Nwafor et al., (2020) [(46)]noticed that 69.7% of pregnant women have poor practices of preventive measures against COVID-19 virus. The low compliance with COVID-19 preventive behaviors could be due to a variety of reasons including inadequate knowledge, negative beliefs, the high expense of protective equipment such as face masks, and hand sanitizers.

On the contrary, Kumbeni et al., (2021) [(42)] found that 46.6% of the pregnant women were engaged in COVID-19 preventive practices. Also, Ayele et al., (2020) [(32)]; Kamal et al., (2020) [(55)] and Omozuwa et al., (2020) [(40)]indicated that 47.6%, 30.3%, and 77.1% of pregnant women, respectively, had good practices of COVID-19 prevention. In addition, Besho et al., (2021) [(56)]proved that 43.6 percent of participants applied good COVID-19 infection prevention strategies. The women's responses to infection prevention methods for COVID-19included using a face mask (88.2%), washing hands frequently (90.6%), covering the mouth with a bent elbow when coughing or sneezing (91.8%), avoiding shaking hands with others (87.7%), and maintaining a physical distance (73.7 %). Also, Anikwe et al. (2020) [(57)] showed most pregnant women wear masks, wash hand, avoid touching the face, and quarantine the infected people as good COVID-19 infection prevention practices.

Conversely, after one month of HBM-based educational intervention, the majority of the study group demonstrated high compliance with COVID-19 preventative behaviors, compared to more than a quarter of the control group, and a highly statistically significant difference was found between the two groups. This can be attributed to that the HBM-based educational intervention made pregnant women in the study group believe and feel more vulnerable, understand the consequences and severity of COVID-19 infection, recognize the negative pregnancy outcomes linked to COVID-19 infection as well as have increased motivation and tendency to engage in preventive behaviors, along with reinforced confidence in overcoming barriers. This was reflected in the pregnant women's engagement and compliance with the recommended preventive behaviors for COVID-19.

These findings are compatible with the results of Duan et al., (2020) [(58)]point out that the perception of risk is largely related to the acceptance of the recommendations for preventive measures for COVID-19. Kim and Kim,(2020) [(59)]demonstrated that a greater perceived understanding of COVID-19 is related to more social distancing behaviors. Those with a thorough comprehension of COVID-19 followed the authorities' guidelines for infection prevention and engaged in good practices (93.8%). Also, Al-Hanawi et al., (2020) [60] stated that good knowledge of participants about COVID-19 infection is translated into effective and safe practices during the pandemic.

The results of present study revealed a significant positive correlation between overall knowledge, health belief model, and self-reported compliance with COVID-19 preventive behaviors scores in both groups before and one month after the HBM-based educational intervention. This could be due to pregnant women with adequate knowledge had more positive perceptions and health beliefs about the prevention of COVID-19 and practiced more preventive behaviors. Compatible with these findings, Zhang et al., (2020) [61] indicateda positive association between COVID-19 knowledge and practices among participants. Shiina et al., (2020) [62] found that participants with poorer levels of knowledge were less likely to perform COVID-19 preventive behavior. Zhong et al., (2020) [47] demonstrated that COVID-19 knowledge is substantially associated with greater preventive measures. In addition, W/Mariam et al., (2020) [63] revealed that pregnant women with good understanding regardingCOVID-19 were 2.3 times more likely than counterparts to have good preventive practices. In contrast, Barakat and Kasemy, (2020) [31] reported a correlation between participants' knowledge and engaging in preventive behaviors.

Furthermore, there was a significant positive correlation between the scores of overall the health belief model and self-reported COVID-19 preventive behaviors compliance in both groups before and one month after the educational intervention. This may be attributed to the HBM-based educational intervention had a positive effect on health beliefs that could significantly influence the protective behaviors of pregnant women. This signifies that increased self-reported compliance with COVID-19 preventive behaviors was associated with an improvement in pregnant women's health beliefs.

This is in congruence with the study by Alsulaiman and Rentner (2021) [64] revealed that participants with higher scores on the health belief model were more probable than those with lower scores to adhere to COVID-19 preventive measures. Nowak et al., (2020) [65] stated that individuals who have low belief in the susceptibility plus severity of COVID-19 are less willing to practice COVID-19 preventive behaviors. Also, Halimatunnisa et al., (2021) [66] mentioned that the adoption of preventive behaviors increases with perceived severity, risk, and vulnerability. Mehanna et al., (2021) [51] highlighted that willingness to comply to COVID-19 preventive measures were considerably associated with all constructs of the HBM.

In contrast, Yıldırım and Guler, (2020) [44] pointed out that participants with a lower perception of the severity of the disease demonstrated greater preventative. This discrepancy can be attributed to demographic characteristics of the study participants.

Conclusion

The study's findings concluded that the application of the health belief model-based educational intervention was effective in improving the knowledge and health beliefs, as well as self-reported compliance with COVID-19 preventive behaviors of pregnant women in the study group compared to the control group. Thus, the aim was achieved, and research hypotheses were supported.

Recommendations

The following recommendations areproposed based on the findings of the present study:

- Provide continuous educational programs based on the health belief model to enhance pregnant women's knowledge and compliance with COVID-19 pandemic preventive behaviors.
- Emphasize the necessity of following COVID-19 preventative precautions during standard antenatal care instructions.
- Determine predictors of compliance with COVID-19 preventive behaviors in pregnant women using HBM.

Further studies:

- Identify barriers to COVID-19-related health behaviors during pregnancy by applying the health belief model.
- Examine the impact of health belief model-based education on pregnant women's intention to get the COVID-19 vaccine.

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