An educational intervention utilizing Health Belief Model for Pregnant Women's compliance with preventive measures regarding COVID-19

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Abstract

Background: Covid-19 is an emerging disease which spread rabidly and causes serious problems with pregnancy as pregnant women is considered a high-risk group that needs special care. ***AIM:*** Evaluate the effect of an educational intervention utilizing Health Belief Model on Pregnant Women's compliance with preventive measures regarding COVID-19. ***DESIGN:*** A quasi-experimental design was utilized***. SETTING:*** The study was conducted in Outpatient clinics of obstetrics and gynecology at Benha university hospital. ***SAMPLING*****:** Simple random sample included 100 pregnant women. ***TOOLS:*** Three tools were used for data collection included a structured interviewing questionnaire, Health Belief model and compliance of pregnant women with preventive measures regarding COVID-19. ***RESULTS:*** there was a highly statistically significant difference in the mean scores of the total knowledge and total Compliance with preventive measures pre and post program application and pre-program and after 3 months and a highly statistically significant improvement was found pre and post program application in all items of health belief model (P<0.001). ***CONCLUSION:*** The application of an educational intervention utilizing Health Belief Model had improved pregnant women's knowledge, beliefs and compliance with preventive measures regarding COVID-19. ***RECOMMENDATION:*** An educational program should be carried out for pregnant women at all MCH centers regarding prevention of COVID-19 infection.

Key words: *COVID-19, Health belief model, Pregnant women.*

Introduction

In December 2019, a new viral infection type discovered in Wuhan, China called novel coronavirus disease according to the World Health Organization. The unknown nature of the virus has caused an outburst of infection generating an alarming mortality rates in many countries worldwide ***(Petrosillo, et al., 2020)*.**

COVID-19 infection is almost associated with upper respiratory tract infections and the signs and symptoms include fever, cough, and headache while, lower respiratory tract infections may appear in some patients. On the other side, covid-19 infections may still asymptomatic at the beginning of infection until severe pneumonia, dyspnea or renal insufficiency occurs, and even death ***(Li et al., 2020).***

Pregnancy is the period in which a fetus matures inside the woman's uterus usually about 40 weeks and characterized by modulated immunity and elevated hormone levels to actively tolerate the semi-allogeneic fetus. Several adaptive changes occur in the respiratory system during pregnancy that may predispose to greater respiratory morbidity, as a decrease in respiratory volumes, elevated oxygen consumption, and edema of the respiratory tract mucosa ***(CDC, 2020).***

Pregnant women who are older, over weight and have pre-existing medical condition as hypertension, diabetes as well as cardiac disease are more susceptible to sever form of COVID-19 infection and often require care in intensive care units than non-pregnant women. So it's important that pregnant woman should follow preventive measures to protect themselves against COVID-19 infection ***(WHO, 2020)***.

According to ***Rasmussen et al., (2020)***, general principles can be followed for the management of COVID-19 infection during pregnancy that involve isolation, aggressive infection control procedures, testing for SARS-CoV-2 and any associated infection, oxygen therapy as needed, avoidance of fluid overload,

empiric antibiotics due to secondary bacterial infection risk, fetal and uterine contraction monitoring, early mechanical ventilation for progressive respiratory failure, individualized delivery planning, and a team-based approach with multispecialty consultations.

Actually, no definitive treatment or vaccine for COVID-19 is found so, pregnant women's behaviors are considered very important to prevent and control the incidence of infection. Hence, an educational intervention is the most significant approach to prevent COVID-19 infection. Moreover, it is necessary to assess pregnant women's beliefs about COVID-19 prevention and their motivation to follow the preventive measures, such as personal hygiene, use of personal protective equipment, maintaining social distance, and isolation. Therefore, psychological and behavioral responses of the general population are considered very important for the prevention and control of COVID-19 outbreak ***(Mirzaei et al., 2021).***

The Health Belief Model (HBM) is a tool that was developed to illustrate patient's behavior in facing illness or the risk of disease and developed in 1950s showing that positive factors increase healthy behaviors while negative factors reduce or prevent them. So, in order to prepare health care behavior that prevent the risks of disease, the woman must know that she is susceptible to infection and that the disease will negatively affect her life, even in a slight way and must be confident that adopting certain behaviors is actually beneficial to reduce vulnerability or severity of disease in cases of occurrence of infection (***Costa, 2020)***.

Health Belief Model includes six main constructs that involve *perceived susceptibility* where woman should recognize that they are vulnerable to health threat (e.g., COVID-19), *perceived severity* where the woman should perceive the risks and complications of the health threat, *perceived benefits* suggests that the woman should perceive the value and usefulness of adopting new behaviors concerning decreasing the risk of an illness and ability to adopt new behaviors based on their perceptions of their benefits in reducing threats. *Perceived barriers* that include trying to diminish barriers to preventive measures, while, *perceived self-efficacy* involves woman's confidence to successfully perform a behavior. Finally, *cues to action*s which are symptoms, strategies, or information sources that facilitate the implementation of a behavior ***(Carico et .al., 2020).***

Significance of the problem

Covid-19 infection can cause severe complications during pregnancy that require endotracheal intubation and intensive care admission also, kidney failure and even death. The case fatality rate of coronavirus among pregnant women is up to 25%. However, there is no currently evidence that pregnant women are more likely to have COVID-19 infection ***(Poon et al., 2020).***

On 30 June, 2020, the virus infected more than 10 million people, and caused about 518,000 deaths worldwide (***Hong & Li., 2020)***. In Egypt there were 107.555 confirmed cases of COVID-19 and 6.266 deaths on 26 October, 2020 ***(WHO, 2020)***.

Pregnant women seem to have different attitudes, beliefs and behaviors concerning preventive measures regarding corona virus. Some pregnant women evaluate the given instruction based on their views and experiences and change them if do not feel useful. Hence, it is important that pregnant woman receive more accurate information as possible regarding corona virus infection. So, the present study was conducted to evaluate the effect of an educational intervention utilizing Health Belief Model on Pregnant Women's compliance with preventive measures regarding COVID-19.

Research aim

The study aimed to evaluate the effect of an educational intervention utilizing Health Belief Model on Pregnant Women's compliance with preventive measures regarding COVID-19.

Research objectives:

1- Assessing pregnant women's knowledge, beliefs and compliance with preventive measures regarding COVID-19 infection.

2- Designing, implementing and evaluating the effect of an educational intervention utilizing Health Belief Model on improving Pregnant Women's knowledge, beliefs and compliance with preventive measures regarding COVID-19 infection.

Research hypothesis:

Pregnant women's knowledge, beliefs and practices regarding compliance with preventive measures about COVID-19 will be improved after the implementation of an educational intervention utilizing health belief model.

Method

Design A quasi-experimental design was utilized to achieve the aim of study (One group, Pre/Post-test design).

Research setting

The study was conducted in Outpatient clinics of obstetrics and gynecology at Benha University Hospital which is the main hospital serving Qalyubia Governorate and the surrounding areas and provides emergency and routine care for pregnant women.

Sample

Type: simple random sample

Size and technique: the study was conducted on 25% of the total pregnant women who attended the previous mentioned setting for 6 months and recruited for the study so; the sample size was 100 pregnant women.

Tools of data collection

Three main tools were used for data collection:-

Tool (I): A structured interviewing questionnaire:

The researchers designed questionnaire based on literature review, and written in simple clear Arabic language and encompassed two parts:

Part I: A- Demographic characteristics of pregnant women and included 8 questions related to age, educational level, occupation, duration of pregnancy, residence, transportation, family number and family monthly income.

B. Medical history of pregnant woman as: respiratory disorder, immunological disorders, diabetes mellitus, hypertension, liver disease and renal problems.

Part II: Pregnant women's knowledge regarding COVID-19 infection and consisted of 8 close ended questions about (definition, signs and symptoms, causes, high risk groups, diagnosis, complications, management and methods of prevention from COVID-19 infection.

Knowledge scoring system

Each item was assigned a score (2) for complete correct answer, a score (1) for incomplete correct answer and a score (0) for unknown or incorrect answer. The total scores of knowledges were calculated by the addition of the total scores of each item.

Total knowledge scores:

-Good ≥ 75%
-Average 60 - < 75%
-Poor < 60%

Tool (II) Health Belief model

It was adapted from ***Shahnazi et al., (2020)*** and composed of (20) questions related to health belief model and divided into six sections: **Sections of health belief model include:**

Section (1) perceived susceptibility included (3) items as (pregnant women considered to be at risk of coronavirus, pregnant women are more likely to get Corona, don't care about this disease and do daily activities like before).

Section (2) perceived severity included (3) items as (Corona has a high mortality rate, Corona is not very dangerous, the transmission power of this disease is high).

Section (3) perceived benefits included (2) items as (corona can be easily prevented by washing hands regularly with soap and water, and corona can be prevented easily by personal protective equipment such as masks and disposable gloves).

Section (4) perceived barriers**,** consisted of (8) items as (difficult to follow the instructions to prevent corona, don't have the patience to follow preventative instructions, difficult to wash hands regularly with soap and water, mask is scarce in the market, disinfectant gels and solutions are scarce and expensive in the market, alcohol pads are scarce in the market, difficult not to touch hands, mouth, nose and eyes, and staying at home to prevent the disease is difficult.

Section (5) perceived self-efficacy**,** it consisted of (1) item (have ability to follow every preventive instruction against corona).

Section (6) Cues to action**,** it consisted of (3) items (TV and radio information about corona has been helpful, local government encourage following preventive measures for the disease and family members encourage following preventive behaviors for the disease).

Scoring system of Health Belief model

It was assigned based on a 3-point Likert scale to rate the items. A score (1) was given for never, score (2) for sometimes and a score (3) was given when the answer was always.

The total scores ranged from 20 to 60. As 20 is the lowest score and 60 is the highest score that indicated high health beliefs and considered as the following:

- High health beliefs ≥ 60%
- Moderate health beliefs 50- < 60%
- Low health beliefs < 50%

Tool (III): Pregnant women's compliance with preventive measures regarding COVID-19 it was developed by researchers and consisted of (14) items as (use a tissue when coughing or sneezing, Wear a face mask, Keep a distance from others, Don't shake hands with others, Don't leave the house unless absolutely necessary, Wash hands regularly with soap and water, don't touch eyes, nose and mouth by hands, safe disposal of wastes such as tissues, masks, and gloves, follow a healthy and balanced diet, get enough sleep and rest, don't take cell phone out of pocket, don't touch anything after entering home until after washing hands, consult a doctor when feel a high temperature, cough, or difficulty breathing, finally calling the hotline of the Ministry of Health and Population (105) in emergency.

Scoring system

Each item was given a score (1) for done and a score (0) for not done, the total scores ranged from 0-14 and calculated as the following:

High compliance ≥ 60%

Moderate compliance 50- < 60%

Low compliance < 50%

Content validity

Tools of data collection were reviewed by panel expertise of five specialized university professors in the field of obstetrics and genecology and community Health Nursing to ensure clarity, relevance, comprehensiveness, applicability, and validity of the tools and to test validity of the contents.

Reliability

The reliability was done by Cronbach's Alpha coefficient test to ensure that three tools of data collection consisted of relatively homogenous items (reliability for knowledge was 0.871, health belief model was 0.895 and practices was 0.930).

Ethical considerations

Approval to participate in the study was taken from pregnant women after the purpose of the study was explained. Before data collection, the subjects were informed about the aim of the study. They were given an opportunity to refuse participation or withdraw from the study at any time and the information would remain confidential and used for the research purpose only.

Pilot study

The pilot study was applied on 10% of the sample and included (10) pregnant women and aimed to assess the tool feasibility, clarity, and applicability and time needed to fill the sheet. No modifications were done, so the pilot study sample was included in the total sample size.

Collection of data

The researchers adopted the following phases to achieve the aim of the study: Interviewing and assessment phase, designing, implementation and evaluation of the program. These phases were carried out from the start of September, 2020 to the end of February, 2021 covering 6months. The researchers visited the previously mentioned study setting three days/week from 9.00 Am to 2.00 Pm.

A- Interviewing and assessment phase

This phase included interviewing pregnant women to obtain socio-demographic characteristics, knowledge, beliefs and compliance of preventive measures regarding COVID-19. Firstly, the researchers greeted the woman, introduced themselves, explained the aim of the study, gave the woman all information about the study such as duration, activities and took oral consent. The Average time for each woman was (20-30 minutes) and the number of women interviewed was done according to the admitted cases who accepted participation in the study.

B- Designing of the program

Based on results obtained from interviewing and assessment phase, the educational program based on health belief model was developed, session's number, contents, various methods of teaching, and educational media were selected. The objectives of the program were constructed and involved the following:

General objectives

General objectives were aimed to provide pregnant women with knowledge and desired health practices regarding prevention of coronavirus infection for optimum healthy life.

Specific objectives

It was aimed to:

-Improve knowledge of pregnant women regarding corona virus disease.

-Modify health practices of pregnant women toward corona virus disease.

-Enhance health beliefs of pregnant women toward corona virus disease.

C-Implementation of the program

The pregnant women were divided into small groups and the researchers asked the women to follow precaution measures during the sessions as wearing mask, gloves, use alcohol and maintain social distance. Then the educational program was conducted through two sessions for each group, one theoretical session took about thirty minutes and one practical session took about twenty minutes. Different methods of teaching were used such as lecture, discussion, demonstration and re-demonstration. Instructional media as videos contain all content of the program and educational booklet about COVID-19 infection was used and distributed to each woman and these sessions were repeated for each group. At the end of each session the women were encouraged to ask questions to correct any misunderstanding.

D- Evaluation of program phase

During this phase, the effect of educational intervention based on health belief model was evaluated by utilizing the same format of tools which used preprogram implementation.

Follow up via telephone was scheduled three months after the program implementation to evaluate pregnant women's knowledge, beliefs and compliance with preventive measures regarding COVID-19 and test retention of knowledge and improving of practice.

Statistical design

Data was verified then entered to computer using SPSS program version 20.0, followed by data tabulation and analysis. Descriptive statistics were applied (e.g., mean, standard deviation, frequency and percentages). Also, tests of significance used as t test, chi-square and Pearson correlation coefficients.

Results

1. **Demographic Characteristics of the studied pregnant women**

The results showed that32% of the studied pregnant women aged from 25<30years old with Mean ±SD (33.21±5.32) and 45% of them had moderate education, while 37% had high education. Also, about 52% of them were housewives and live in rural areas and 51% had insufficient monthly income (Table1)
Moreover, 42% of studied pregnant women were in the third trimester of pregnancy, 29% of them were in first trimester of pregnancy and equal to them were in the second trimester of pregnancy (figure1).

Additionally, the results illustrated that15%, 8%, and 7% of the studied pregnant women reported having hypertension, renal problems and diabetes mellitus sequentially (table 2).

2. **Knowledge of the studied pregnant women regarding COVID-19 infection**.

The results revealed that there was highly statistically significant difference in the mean scores of the total knowledge pre and post program application and pre-program and after 3 months of program (P<0.001). While, no statistically significant difference was found post program application and after 3 months (P>0.05) (table 3).

Also, 32% of studied pregnant women had good knowledge pre-program which increased to 71% post-program and 60% after 3 months of follow-up (figure 2).

3. **Application of health belief model**

The results demonstrated that a highly statistically significant improvement was found pre and post program application in all items of health belief model except for perceived susceptibility also, pre and after 3 months of program application except for perceived benefits (p<0.001) (table 4).
Also, about (18%) of the studied pregnant women had high health beliefs pre-program and improved to (73% and 68%) post program and at follow up phase respectively (figure 3).

4. **Compliance of pregnant women with preventive measures regarding COVID-19**

The results demonstrated highly statistically significant difference in the mean scores of the total Compliance pre and post-program application and pre-program and after 3 months (P < 0.001) while, no statistical significant difference in the mean scores of the total compliance was found post-program application and after 3 months (P>0.05) (table 5).

Also, 21% of studied pregnant women had high level of compliance with preventive measures pre-program and improved to 82% post-program and 65% at follow-up phase (figure 4).

5. **Correlations between the study variables**

A positive statistical correlation was found between total knowledge and total compliance and between total health belief and total compliance while, negative statistical correlation was found between total knowledge and total health belief preprogram. While, post program a positive statistical correlation was found between total knowledge and total compliance and between total health belief and total compliance. Moreover, a positive statistical correlation was found between total knowledge and total health belief and between total health belief and total compliance after 3 months of follow up (p<0.001) (table 6).

Also, there was a positive statistical correlation between total knowledge and occupation preprogram and between total knowledge, residence and income post program while, there was a positive statistical correlation between total knowledge and education, occupation, residence and income at follow up phase (table 7).

Moreover, there was a positive statistical correlation between total health belief and age, occupation, residence and income preprogram and between total health belief and age, education, occupation, residence and income post program application. While, there was a positive statistical correlation between total health belief and age, occupation, residence and income at follow up phase (table 8).

Additionally, there was a positive statistical correlation between total compliance and education, occupation, and income preprogram and between total compliance and age, education, occupation, residence and income post program application and at follow up phase (table 9).

Table (1): Frequency distribution of studied pregnant women regarding their demographic characteristics (n=100).

Demographic Characteristics	No.	%
Age / years:		
20<25	25	25.0
25<30	32	32.0
30<35	30	30.0
35≤40 **Mean ±SD**33.21±5.32	13	13.0
Education:		
Read and write	18	18.0
Moderate education	45	45.0
High education	37	37.0
Occupation:		
Working	48	48.0
Housewife	52	52.0
Residence		
Rural	52	52.0
Urban	48	48.0
Transportation		
Public	78	78.0
Private	22	22.0
Family number		
2	11	11.0
3-5	66	66.0
> 5	23	23.0
Family monthly income:		
Insufficient	51	51.0
Sufficient	23	23.0
Sufficient and safe	26	26.0

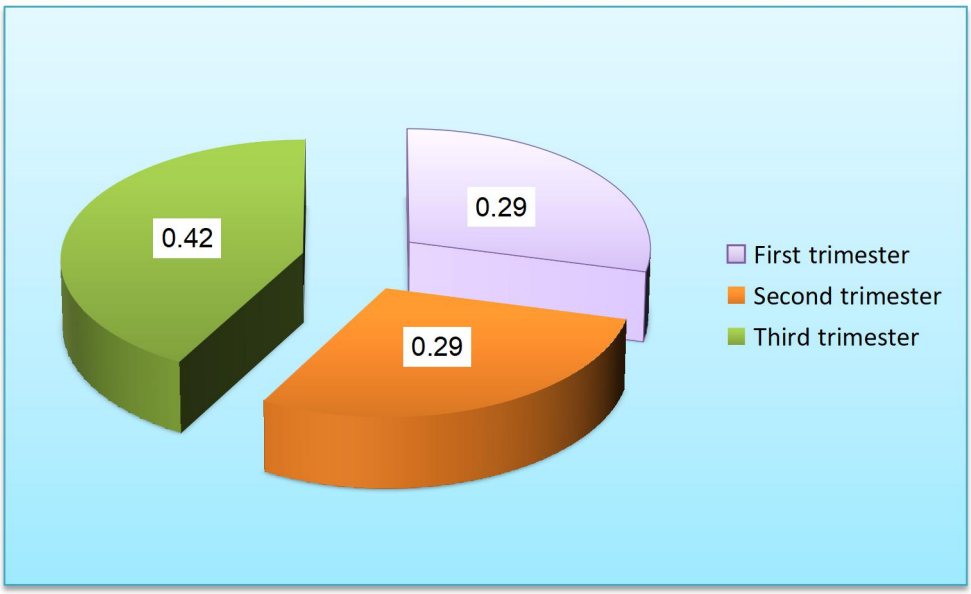

Figure (1): Percentage distribution of studied pregnant women regarding their duration of pregnancy (n=100).

Table (2): Frequency distribution of the studied pregnant women regarding their medical history (n=100).

Medical History of diseases	No.	%
Respiratory disorder	1	1.0
Immunological disorder	3	3.0
Diabetes mellitus	7	7.0
Hypertension	15	15.0
Liver disease	2	2.0
Renal problems	8	8.0

Table (3): Mean and standard deviation of studied pregnant women regarding their total knowledge (n=100).

Items	Pre- program	Post- program	Follow-up (3months)	t1 test	p-value	t2 test	p-value	t3 test	p-value
Total knowledge	Mean ±SD	Mean ±SD	Mean ±SD	6.694	.000	1.136	.252	3.950	.000
	8.36±4.46	11.88±2.77	11.54±3.24						

*** Statistically significance p<0.05 ** Highly statistically significance p<0.001**

t1 between pre and post program
t2 between post and after 3 months
t3 between pre and after 3 months

Figure (2): Percentage distribution of studied pregnant women regarding their total knowledge level through the program phases (n=100).

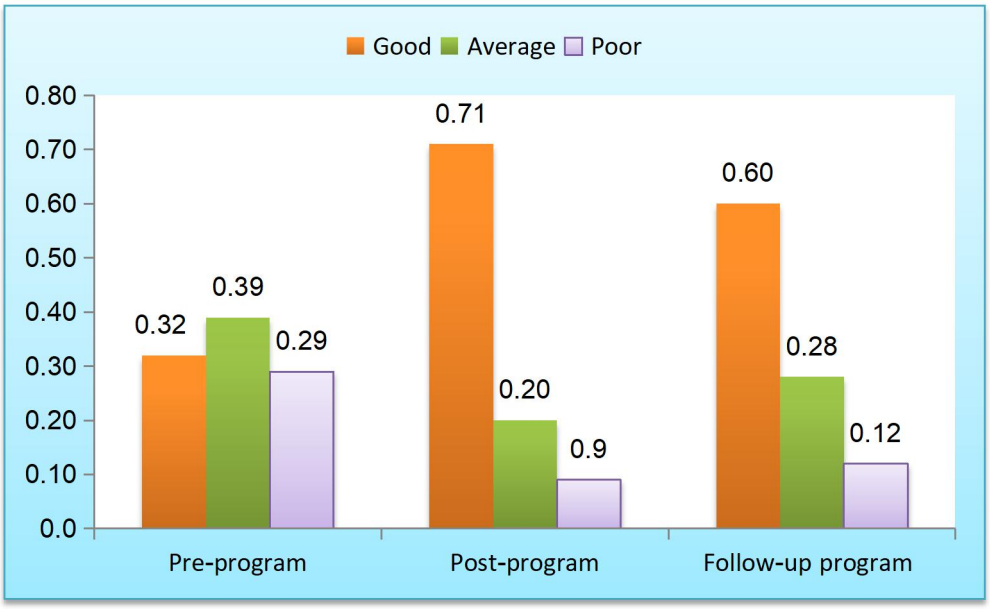

Table (4): Mean and standard deviation of studied pregnant women regarding their total health belief (n=100).

Items	Pre -program	Post -program	Follow-up (3months)	t1 test	p-value	t2 test	p-value	t3 test	p-value
	Mean ±SD	Mean ±SD	Mean ±SD						
Perceived susceptibility	3.62±1.83	4.20±1.19	3.92±1.46	2.652	.009	1.408	.161	4.808	.000
Perceived Severity	2.41±1.86	4.21±1.77	3.94±1.49	6.999	.000	1.892	.421	4.730	.000
Perceived Benefits	2.33±1.20	3.41±.73	2.86±1.27	7.631	.000	1.943	.514	1.991	.048
Perceived Barriers	11.04±3.22	4.66±4.66	4.53±4.42	11.253	.000	1.354	.177	10.069	.000
Perceived self-efficacy	0.79±0.62	1.50±.74	1.42±.74	7.302	.000	.761	.447	6.502	.000
Cues to action	3.15±1.22	4.95±.92	4.06±1.44	11.721	.000	1.197	.321	4.810	.000

* Statistically significance p<0.05 ** Highly statistically significance p<0.001

t1 between pre and post program
t2 between post and after 3 months
t3 between pre and after 3 months

Figure (3): Percentage distribution of studied women regarding their total health belief model items level through the program phases (n=100).

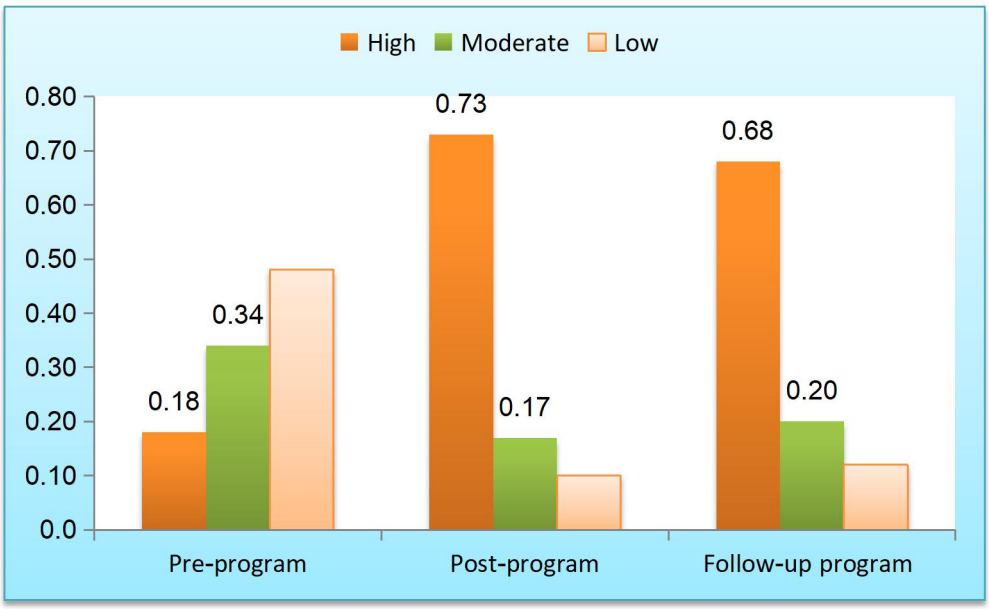

Table (5): Mean and standard deviation of studied pregnant women regarding their total compliance with preventive measures about COVID-19 (n=100).

Item	Pre -program	Post-program	Follow-up (3 months)	t1 test	p-value	t2 test	p-value	t3 test	p-value
	Mean ±SD	Mean ±SD	Mean ±SD	9.654	.000	1.202	.167	5.159	.000
Total compliance with preventive measures	5.65±4.95	11.55±3.57	10.82±4.54						

* Statistically significance p<0.05 ** Highly statistically significance p<0.001

t1 between pre and post program
t2 between post and after 3 months
t3 between pre and after 3 months

Figure (4): Percentage distribution of studied pregnant women regarding total compliance with preventive measures about COVID-19 through the program phases (n=100).

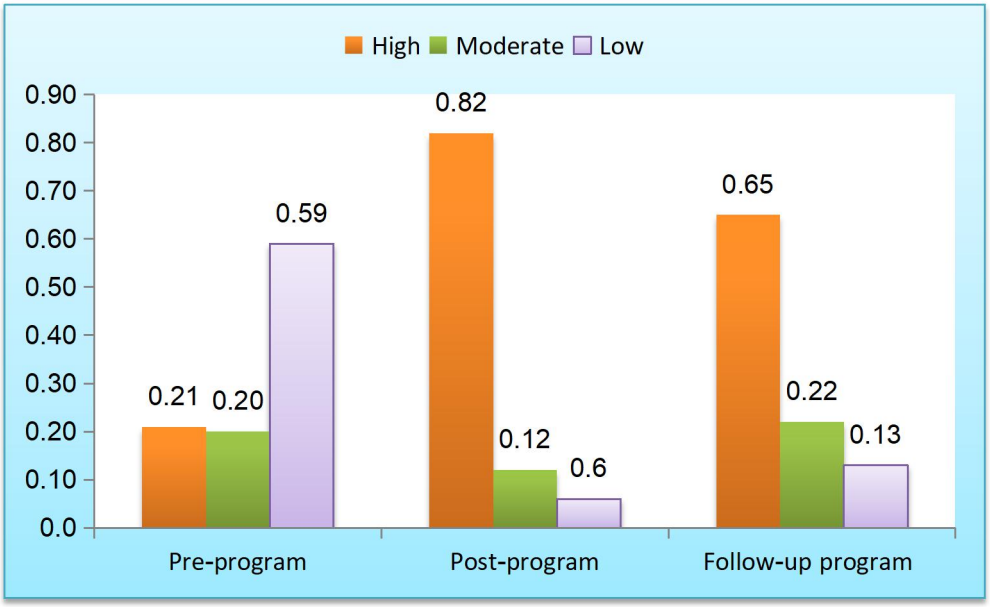

Table (6): Correlation matrix between total knowledge, belief, and compliance among studied pregnant women through the program phases (n=100).

Items			Total knowledge	Total health belief	Total compliance
Pre –program	Total knowledge	r	1	0.057	.405
		p-value		.573	.000**
		N	100	100	100
	Total health belief	r	.057	1	.213
		p-value	.573		.033*
		N	100	100	100
	Total compliance	r	.405	.213	1
		p-value	.000**	.033*	
		N	100	100	100
Post- program	Total knowledge	r	1	.146	.371
		p-value		.147	.000**
		N	100	100	100
	Total health belief	r	.146	1	.433
		p-value	.147		.000**
		N	100	100	100
	Total compliance	r	.371	.433	1
		p-value	.000**	.000**	
		N	100	100	100
Follow-up	Total knowledge	r	1	.391	.031
		p-value		.000**	.758
		N	100	100	100
	Total health belief	r	.391	1	.400
		p-value	.000**		.000**
		N	100	100	100
	Total compliance	R	.031	.400	1
		p-value	.758	.000**	
		N	100	100	100

* Statistically significance p<0.05 ** Highly statistically significance p<0.001

Table (7): Correlation between total knowledge and demographic characteristics among studied pregnant women through the program phases (n=100).

Items	Total knowledge					
	Pre -program		Post –program		Follow-up	
	r	p-value	r	p-value	r	p-value
Age	-.069	.496	-.124	.218	-.125	.216
Education	-.106-	.293	.853	.019	-.213	.034*
Occupation	.242	.015*	.158	.118c	.640	.047*
Residence	.071	.484	.655	.000**	.842	.020*
Income	.096	.340	.893	.014*	.795	.026*

* Statistically significance p<0.05 ** Highly statistically significance p<0.001

Table (8): Correlation between total health belief and demographic characteristics among studied pregnant women through the program phases (n=100).

Items	Total health belief					
	Pre -program		Post -program		Follow-up	
	r	p-value	r	p-value	r	p-value
Age	.727	.035*	0..815	.024*	0.744	.033*
Education	0.183	0.069	0.640	0.002*	0.482	0.004
Occupation	0.333	0.001**	0.792	0.000**	0.594	0.001*
Residence	0.342	0.032*	0.875	0.000**	0.722	0.036*
Income	0.216	0.031*	0.781	0.028*	0.236	0.013*

* Statistically significance p<0.05 ** Highly statistically significance p<0.001

Table (9): Correlation between total compliance with preventive measures and demographic characteristics among studied pregnant women through the program phases (n=100).

Items	Total compliance with preventive measures					
	Pre -program		Post -program		Follow-up	
	r	p-value	R	p-value	r	p-value
Age	0.450	0.076	0.732	0.002*	0.661	0.006*
Education	0.608	0.035*	0.871	0.000**	0.307	0.002*
Occupation	0.206	0.040*	0.610	0.003*	0.442	0.014*
Residence	0.404	0.084	0.551	0.012*	0.425	0.03*
Income	0.865	0.017*	0.704	0.000**	0.630	0.010*

* Statistically significance p<0.05 ** Highly statistically significance p<0.001

Discussion

COVID-19 is an emerging disease that has rapidly spread all over the world, and there are no studies concerned with application of educational intervention utilizing Health Belief Model (HBM) for pregnant women toward COVID-19, So, the current study was conducted to evaluate the effect of educational intervention utilizing Health Belief Model on pregnant women's compliance with preventive measures regarding COVID-19.

Regarding demographic data, the current study demonstrated that about one third of the studied sample aged 25<30years with mean age 33.21±5.32 and more than half of studied sample was from rural areas and were housewives. This result agrees with ***Mohamed et al., (2020***) found that more than half of study subjects aged 25 to <30years with a mean age of 27.84±3.75 & 26.97±2.76 years, also more than half of studied subjects had secondary education, while more than two thirds of them were lived in rural area and weren't work. Also, ***West et al., (2021***) found that the mean age of the study group was 30.78 ± 4.71years.

This result is not consistent with ***Elgzar et al., (2020)*** who found that mean age was 21.86±1.99 for intervention group and 21.08±1.39 for control group and around three-quarters of the group are from urban area. The difference may be due to variations in socio-demographic characteristics, study setting and sample.

Regarding educational level, the study found that, less than half of the studied sample had moderate education, this result agrees with ***Elgzaret al., (2020)*** who found that around half of the studied group had secondary school education.

Also, more than three quarters of studied sample had used public transportation; this is an important result to identify risk perception. This result agrees with ***Costa, (2020)*** who revealed that public transportation provides greater contamination susceptibility than using personal vehicle or walking.

Also, more than half of studied sample had insufficient monthly income. This result is supported by ***Costa, (2020)*** who found that low income is an important factor in the spread of the virus, as it is associated with low information, unsanitary housing conditions and difficulty interruption of daily activities for economic reasons.

The study revealed that less than half of studied sample were in the third trimester of pregnancy, while more than quarter were in first trimester of pregnancy and equal them were at the second trimester of pregnancy. Some studies pointed out that the risk of preterm delivery and fetal distress increased if the pregnant woman infected by covid-19 in third trimester while there is no data about risk of miscarriage or early pregnancy loss as study conducted by ***López et al., (2020).***

In the present study, the pregnant women reported medical history of diseases as hypertension which was the highest reported disease followed by renal problems and Diabetes mellitus. While in a study conducted by ***Maharlouei et al., (2020)*** showed that the most common comorbidities were hypothyroidism followed by diabetes mellitus and gestational diabetes.

Also, ***Costa, (2020)*** pointed out that people with diseases associated with a high risk of exposure to Covid-19 virus, such as diabetes and hypertension, do not have a significantly different perception of corona infection compared to people without chronic diseases, this may be due to stability and control of disease as they have no symptoms and act as if they do not suffer from chronic diseases. This confirms the need to publish information that specifically targets these patients.

As regards pregnant women's knowledge about corona virus infection, the findings of the current study showed a highly statistically significant difference of the total knowledge pre and post-program application and pre-program and after 3 months, this result agrees with ***Mohamed et al., (2020)*** who showed that after the application of educational intervention a highly statistical significant improvement of pregnant women knowledge regarding Corona virus prevention occurred. Also, ***Elgzar et al., (2020)*** found that after intervention there were significant differences observed between intervention and control groups in all areas of awareness assessed.

Lack of pregnant women's knowledge pre-program may be due to the acquisition of information from social media, which is not necessarily correct and complete, as mentioned by ***Anikwe et al., (2020)*** who found that more than four-fifths of the sample had their main source of information from mass media. Also ***Mirzaei et al., (2021)*** showed that "the internet and virtual social networks are extensively used to obtain the information in short time. However, this media can create misconceptions and unauthorized recommendations for the prevention and treatment of COVID-19 by invalid information, such as using hair dryer to mouth heating, antibiotic use, mouthwash by salt water, rubbing sesame oil on the skin, and eating garlic and alcohol. These falsehoods can lead to serious disruption in the management of the COVID-19". So, people should follow health advices from approved health centers to avoid misconceptions.

The improvement of pregnant women's knowledge regarding COVID_19 post-program is evidence on the effectiveness of the educational intervention based on health belief model.

Pregnant woman education about COVID-19 is very important to avoid health hazards for both mother and fetus. Such goal has been achieved through the results of the present study that showed that 32% of studied pregnant women had good knowledge pre-program and increases to 71% post program.

This is also supported by ***Elgzar et al., (2020)*** who found that 2.4% of intervention group had good knowledge before intervention and increased to 60.5% after intervention. Also, ***Maharlouei et al., (2020)*** found that total knowledge regarding COVID-19 was poor in less than 9% of pregnant women, and about 70% of them achieved acceptable knowledge score.

On the other hand, ***ShewasinadYehualashet et al., (2021)*** and ***Degu et al., (2021)*** revealed that more than half of the respondents had adequate knowledge on COVID-19. Also, ***Anikwe et al., (2020)*** found that the majority of respondents had adequate knowledge about COVID-19 infection. The difference may be due to disparities in the presence of trained human resources and health care system of the countries to increase awareness regarding to the pandemic.

Regarding application of health belief model, the current study indicated that there was high statistically significant improvement of health beliefs of pregnant women regarding all items of health belief model.

This results in line with ***Elgzar et al., (2020)*** whose results showed that there is a

statistically significant difference between intervention and control groups in all elements of the health belief model after the program, also other study conducted by ***Shewasinad Yehualashet et al., (2021)*** found that 84% of the participants have cues to perform prevention measure activities towards COVID-19 and 64% of study participants have self-efficacy to apply preventive measures regarding COVID-19 infections. This result indicated that there are still gaps on the belief of COVID-19 infection.

These results emphasize the effectiveness of health belief model in increasing awareness and improving pregnant women's behaviors regarding preventive practices against corona virus infection.

As regard pregnant women's compliance with preventive measures regarding COVID-19, the current study showed a high statistically significant difference of total compliance pre and post-program application and pre-program and after 3 months of follow up.

This result comes in line with ***Mohamed et al., (2020)*** who found that the educational guideline has improved pregnant women practices regarding COVID-19.

The result of this study also revealed that more than half of studied pregnant women had low level of compliance with preventive measures pre-program and less than one quarter of studied pregnant women had high level of preventive practices pre-program that increased to 82% post-program.

On the other hand, there is a study conducted by ***Anikwe et al., (2020)*** in Abakaliki, southeast Nigeria revealed that the majority of respondents showed a good preventive practice of COVID-19 disease.

Regarding correlation between the studied pregnant women's knowledge, health beliefs and preventive practices, the current study illustrated that post program a positive statistical correlation was found between total knowledge and total compliance and between total health belief and total compliance. This means that the greater the knowledge, understanding, and also health beliefs about a particular corona epidemic, the health practices to prevent this epidemic increase significantly. Moreover, a positive statistical correlation was found between total knowledge and total health belief and between total health belief and total compliance after 3 months of follow up ($p<0.001$) .This is a clear evidence of the effectiveness of the program even after a period of time from its application (3 months).

These results are supported by ***Elgzar et al., (2020)*** who found that that there were positive, statistically significant correlations between participants' total HBM score and their total awareness score.

The previous results are logic because when knowledge increased all items of health belief model as (perceived susceptibility, severity, benefits, cues of actions and self-efficacy to overcome the barriers to disease prevention also would be increased.

Regarding correlation between total knowledge and socio-demographic characteristics of studied women through the program phases, the current study showed that there was a positive statistical correlation between total knowledge, residence and income post program while, there was a positive statistical correlation between total knowledge and education, occupation, residence and income at follow up phase.
This result is supported by ***Degu et al., (2021)*** who found that woman's age, educational status, occupational status and status of current pregnancy were statistically significant with knowledge of COVID- 19.

While in a study conducted by ***Maharlouei et al, (2020)*** found that pregnant women who lived in urban areas also achieved significantly higher knowledge scores than their peers in rural areas and mean score of knowledge was significantly higher in working individuals than housewives. Furthermore, pregnant mothers with a university degree had significantly higher knowledge score regarding COVID-19 than those with lower levels of education. Also other study conducted by ***Barakat, and Kasemy, (2020)***found that less educated people had insufficient knowledge of the disease and facing significant barriers to complying with social distancing rules.

Moreover, the results of the current study demonstrated that there was a positive statistical correlation between total health belief and age, occupation, residence and income preprogram and between total health belief and age, education, occupation, residence and income post program application. While, there was a positive statistical correlation between total health belief and age, occupation, residence and income at follow up phase. Additionally, there was a positive statistical correlation between total compliance with preventive measures and education, occupation, and income preprogram and between total compliance and age, education, occupation, residence and income post program application and at follow up phase.

It's known that commitment with healthy practices is linked to increasing age and experience and also linked to education, as ignorance may also include ignorance of the seriousness of the disease. There is no doubt that income also has a great impact, as the prevention of this disease requires a healthy diet and the use of masks, gloves, alcohol and washing hands with water and soap constantly and all of these equipment need money, and the area in which a person lives affects the extent of his commitment to healthy habits, as rural areas are among the least committed areas.

Also, ***Barakat, and Kasemy, (2020)*** in their study found that the performance of preventive behaviors was higher in urban residents than rural and preventive behaviors were increased among highly educated persons. The reason of this result may be that educated persons have a greater ability to understand what they read also, can understand the health education.

Conclusion

The results of the present study concluded that the application of an educational intervention utilizing Health Belief Model has improved pregnant women's knowledge, beliefs and compliance with preventive measures regarding COVID-19. Hence, the finding of the present study has supported the stated hypothesis.

Recommendations

The study recommended the following:

1-An educational program should be carried out for pregnant women at all MCH centers regarding prevention of COVID-19 infection.

2-Vaccination against COVID-19 is recommended for women planned for pregnancy to protect pregnant women and newborn from coronavirus infection.

3- Pregnant women should attend all routine care appointments, according to local policies and follow preventive measures to reduce possible transmission of the virus.

Limitations of the study

- Lack of national and international researches that apply health belief model on COVID-19 infection.
- Sometimes the sessions were postponed due to noise, interruptions and finding place to conduct the sessions.

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