Original Article

The Effect of an Educational Intervention Based on Protection Motivation Theory on Pregnant Women's Knowledge and Self-Protection Regarding COVID-19. An Intervention Study

Abstract

Background: COVID-19 infection endangers pregnant women and newborns. Infection prevention measures are available and easy to apply, but the problem is the application continuity. Empowering pregnant women to increase their intention for self-protection is very important. This study explores the effect of educational intervention based on the Protection Motivation Theory (PMT) on pregnant women's knowledge and self-protection regarding COVID-19. **Materials and Methods:** A randomized, controlled trial was conducted at the Obstetrics and Gynecology outpatient clinic at El Shatby Hospital, Alexandria governorate/Egypt, from November 2020 to May 2021. The study included a convenient sample of 163 pregnant women using the randomization block technique. A self-reported questionnaire was used for data collection. For the intervention group, the PMT-based education included need assessment, planning, implementation, and evaluation. Two months later, a reevaluation was done. **Results:** ANCOVA showed a significant improvement in the intervention group's knowledge ($F_1 = 8.56$, $p < 0.001$) when taking the pretest as a reference. The effect size shows that 25.8% of the intervention group's knowledge improvement and 58.80% of the difference between the two groups were due to intervention. ANCOVA showed a significant improvement in the intervention group's PMT constructs when taking the pretest or group as a reference ($p < 0.001$). The effect size shows that 56.10% of the intervention group's total PMT constructs improvement and 89.60% of the differences between the two groups were due to the intervention. **Conclusions:** PMT-based intervention is effective in improving pregnant women's knowledge and self-protection intention regarding COVID-19. PMT is recommended to tailor educational intervention for pregnant women.

Keywords: *COVID-19, knowledge, motivation, pregnant women*

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Introduction

COVID-19 is a serious, highly contagious disease with numerous new generations as Omicron that have several mutations that may impact its behaviors.[1] Two years have elapsed now, COVID-19 still restricts normal life, and it seems that the world must learn to accommodate with it. COVID-19 is a contagious virus that endangers the whole world, specifically the high-risk population of pregnant women. Furthermore, older maternal age, obesity, pregnancy-related complications, and co-morbidity can lead to serious COVID-19 complications.[2] The influence of COVID-19 on pregnant women and their fetus is still poorly understood. It is mainly based on lessons learned from Sever Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS). Although both have a higher mortality rate, COVID-19 is more contagious.[3,4] This previous data illustrated that around one-third of infected pregnant women are dying from infection.[4] Pregnant women are experiencing numerous physiological changes that make COVID-19 infection more serious. They are more susceptible to severe respiratory complications, intensive care unit admission, disseminated intravascular coagulation, renal failure, mechanical ventilation, and other serious cardiovascular complication.[5] Pregnancy may delay the diagnosis of COVID-19, which leads to a poor prognosis. For example, the high estrogen level during pregnancy may lead to gestational rhinitis

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among 20% of healthy women in late pregnancy, leading to unrecognized COVID-19 infection. Furthermore, the physiological dyspnea and shortness of breath resulting from high metabolic rate increased fetus oxygen requirement, and anemia during late pregnancy should be distinguished from that of COVID-19. The total lung capacity and residual volume are severely altered due to gravid uterus compression on the lung and the inability to completely clear lung secretions.[6] This may increase the risk for severe hypoxia and respiratory failure.[7] The classical COVID-19 clinical feature also occurs among pregnant women, including high fever, dry cough, lymphopenia, leucopenia, generalized weakness, body ache, headache, dyspnea, and respiratory distress. It is reported that COVID-19 has an incubation period of 7–14 days, in which the person acts as a reservoir for infection and may be contagious. COVID-19 is transmitted mainly through direct exposure to the droplets or aerosol of infected persons or indirectly through contaminated surfaces or objects. Fecal oral transmission was also reported in some rare cases.[8] Recently, two neonates of COVID-19-infected mothers tested positive, which hypnotized the presence of vertical transmission.[9,10]. However, 49 other neonates of COVID-19-infected mothers tested negative, which denies this possibility. They also reported that the virus was not found in amniotic fluid, umbilical cord blood, neonatal throat swap, and breast milk.[11,12] Most of the reported cases were infected in the third trimester, and no data is available regarding infection in the first trimester.[13,14] COVID-19 generally results in many complications, including sepsis, secondary bacterial infection, disseminated intravascular coagulation, renal failure, and dysregulation of immune response and respiratory microbiome. Postpartum complications can also occur, which necessitate continuous monitoring. Fetal complications of coronaviruses can lead to miscarriage, intrauterine growth retardation, and prematurity. Childhood inattention disorders may develop later due to maternal hyperthermia's effect on the fetus's nervous system.[15]

The COVID-19 prevention and management guidelines are similar for pregnant and nonpregnant. It includes social distancing, staying at home, frequent hand washing with soap and water, hand rubbing with alcohol, and face masking. Pregnant women must be alert to any pregnancy-related warning signs and seek medical assistance in case of the appearance of any COVID-19-related symptoms. Online counseling with a midwife or obstetrician can be better to avoid the risk of infection. Even during the COVID-19 pandemic, hospital delivery arrangements are much safer than home delivery. Hence, women will be assessed by the hospital staff as low, moderate, and high risk for COVID-19 with the relevant protocol of care.[16]

Although COVID-19 preventive measures are available and feasible, the problem is the community of its application. Thus, it is very important to empower women to motivate self-protection. Ronald Rogers first developed Protection Motivation Theory (PMT) in 1983 to explain human behaviors concerning specific health threats. It explained how and why different people respond differently to the same threat. It proposed that personal and environmental factors can significantly affect health-related human behaviors, and certain cognitive and emotional mediating processes mediate these factors. The cognitive and emotional processes are affected by fear of certain or imagined risks.[17] In applying PMT for COVID-19, it can be elaborated that knowledge and past experiences regarding COVID-19 are the starting point toward protection motivation behaviors. This may exaggerate the internal sense of vulnerability (threats appraisal), which generates fear. This fear can lead to evaluating the person's risk for COVID-19 (perceived threats vulnerability) and to what extent COVID-19 may be life-threatening (perceived threats severity). This perceived threat appraisal can be influenced by external environmental motivators (extrinsic reward) and personal internal power to perform COVID-19 prevention practices (intrinsic reward).[17] Knowledge and experience can motivate power to perform self-protection appraisal, including efficacy appraisal and response cost. The women's evaluations of the extent to which COVID-19 self-protective measures may be effective in decreasing COVID-19-related morbidity and mortality (response efficacy). In this context, self-efficacy may refer to the women's ability to learn and master COVID-19 preventive measures. Lastly, the women may evaluate COVID-19 self-protection related to physical, emotional, and social costs (response cost). The evaluation of the previous factors can significantly correlate with the women's intention to perform COVID-19 preventive practices and make it a normal part of her lifestyle.[18] Therefore, this study aims to explore the effect of educational intervention based on the PMT on pregnant women's knowledge and self-protection regarding COVID-19.

Materials and Methods

This study was applied from the beginning of November 2020 to May 2021. It is a randomized, controlled trial registered in the Iranian Registry of Clinical Trial with the number IRCT20210612051555N1. The PMT-based intervention was considered an independent variable, and its effect was examined on two dependent variables, pregnant women's COVID-19 knowledge and self-protection intention. It was conducted at the Obstetrics and Gynecology outpatient clinic at El Shatby Hospital, Alexandria governorate/Egypt. A convenient sample of 163 pregnant women in the first trimester of pregnancy was included in the study. The sample size was calculated using the Epi-Info program, where the expected frequency = 50%, acceptable error = 5%, confidence coefficient = 99%, sample size = 163, and power analysis = 80%. The inclusion criteria were pregnant women in the first trimester, free from visual and auditory problems, psychological or mental disorders, and keen to participate in the study. The participants were randomly assigned to either the intervention or control group through the randomization block technique using six steps conducted by the investigators. First, wrote a list containing numbers from 1 to 170. Second, prepare small pieces of papers that comprise numbers from 1 to 170. Third, folded each piece of paper to hide the written number, and then it was collected in a large bowl. Fourth, divide the 170 pieces of paper into 17 blocks randomly and blindly; each block contains 10. Fifth, in each block, the ten pieces of paper were divided equally in a random blind manner to either the intervention group or control group. A total of 85 numbers were assigned to each group. Sixth, the classification of cases was recorded in the pre-prepared list (the word intervention (G1) or control (G2) was recorded in front of each number) to be considered during data collection time. The participants were included in the study according to the following follow chart.

A self-reported questionnaire was used for data collection. It is composed of four parts. Part I assessed participants' basic data as age, residence, education, occupation, and monthly income. Part II assessed the medical and obstetrical history, including the presence of chronic illness, chest diseases, and current pregnancy complications. Obstetrical history includes gravidity, parity, weeks of gestation, and follow-up visits. Part III incorporates six multiple choices questions to evaluate the participants' COVID-19 knowledge: definition, signs and symptoms, mode of transmission, high-risk group, preventive practices, and COVID-19 vaccine. Each question scored as complete (2), incomplete (1), and incorrect (0). The total knowledge score ranged from 0 to 12 and leveled as poor (less than 50%), fair (50–75%), or good (more than 75%). Part V: PMT scale. It included the nine constructs of the PMT: perceived vulnerability, perceived severity, intrinsic reward, extrinsic reward, fear, response efficacy, self-efficacy, response cost, and intention. Each construct was assessed through three items scored on five-point Likert scale ranging from strongly disagree (1) to strongly agree (5), where the score was reversed for the response cost items. The total scale was composed of 27 items where a higher score indicates higher self-protection. All tools were tested for content and face validity by a jury of five experts in the field. Tool's reliability was tested through the Cronbach's alpha coefficient test and revealed a high-reliability score (r = 0.79 for part III and r = 0.81 for part IV). The pilot study was conducted on 10% of the study participants (excluded from the main study sample) to ensure the clarity, applicability, and feasibility of the tool. The fieldwork was conducted from the beginning of November 2020 to May 2021. The researchers went to the outpatient clinic two days weekly from 9 AM to 1 PM. The pregnant women who came for regular follow-up visits were recognized by the nurses' help. Each woman was interviewed alone to take her oral consent after explaining the aim of the study. The basic data and medical and obstetrics histories were completed from the women's records and interviews. Consequently, the woman was assigned to either the intervention or control group according to the preprepared list for the randomization block technique. For the intervention group, the PMT-based education was conducted in four sequential phases. *Needs assessment:* A pretest was done to evaluate the participants' COVID-19 knowledge, and self-protection elements based on PMT. This phase aimed to address deficiencies in the participants' COVID-19 knowledge and self-protection to be considered during the educational intervention construction. It also provides baseline data for comparison with the post-test. *Planning:* Based on the results of the need assessment, an educational intervention based on PMT constructs was designed after reviewing the related current literature. *It encompasses four sessions. The first* was concerned with COVID-19 definition, causative agent, mode of transmission, signs and symptoms, high-risk groups (perceived vulnerability), and expected complications (perceived severity). *The second* targeted the physiological changes during pregnancy and how they can increase the risk for COVID-19 complications (fear). A special emphasis is directed to the infection control precautions and immunity enhancement methods (Response efficacy). The *third* discussed the COVID-19 vaccine, including its benefits versus risk (response cost) with correction of any misinformation about COVID-19 preventive practices and vaccination (intrinsic reward). This session aimed to foster positive attitudes and beliefs among pregnant women about COVID-19 preventive practices. *The fourth* aimed to foster self-efficacy and self-protection intention regarding COVID-19. Extra time was allowed to address each women special needs and answer questions. PowerPoint presentations, printed booklets, and audiovisual aids were used during the intervention. *Implementation:* The educational sessions were done in the outpatient department with the help of the nursing staff. A session was conducted for three to four women each time (continued for 30–45 min), considering infection control precautions. The teaching strategies included lectures, video shows, group discussions, and brainstorming. A summary of the content was provided at the end of each session and at the beginning of the second session. A sample of the protective equipment was provided to each woman to help in the practical application. Copious-printed educational materials were given to motivate knowledge preservation and help concepts strengthen to support desired changes. Gloving and other infection control precautions were followed during the distribution of the printed materials and protective equipment. The researchers accessed the participants through mobile phones to arrange for the sessions. *Evaluation*: The post-test was conducted two months after the intervention to evaluate the pregnant women's knowledge and protection motivation regarding COVID-19. The telephone interview was used to complete the post-test if the women could not attend the antenatal clinic. *For the control group:* A pretest was done in the outpatient clinic, then they left for routine hospital care and education. Two months later, reevaluation was done using the same pretest tools. After completing the study, the educational presentation and printed materials were made available for the control group to maximize the benefits. Data were analyzed using the Statistical Package for Social Science (SPSS) software, version 23 (SPSS Inc. Chicago, IL, USA). Thirteen sheets were excluded from the statistical analysis because of missing data. Descriptive statistics such as arithmetic mean and standard deviation were conducted to examine normally distributed variables. Numbers and percentages were conducted to analyze categorical variables. The differences in categorical variables between the intervention and control groups were examined through the Chi-square test or Fisher's exact test. Differences in pregnant women's knowledge and PMT constructs among the two groups before and after the intervention were examined through analysis of variance (ANCOVA) to adjust the effect of the pretest score. A significance level was considered as $p < 0.05$.

Ethical considerations

Ethical approval from the nursing college at Damanhur University and permission from El Shatby Hospital were obtained before performing the study. Ethical approval No (04-07-03-2020 EC) was issued on March 07/2019. Informed oral consent from each participant was obtained. The participants were informed about their right to refuse participation or withdraw at any time. The data were treated confidentially and used for research purpose only.

Results

Basic data of the study participants

Table 1 clarifies the absence of statistically significant differences between the intervention and control groups regarding the participants' basic data. Around two-thirds of the intervention (63.41%, 58.54%) and control (69.37%, 60.49%) groups are rural residents and employed, respectively. Also, 58.54% of the intervention group has secondary education compared to 46.91% of the control

Table 1: Basic data of the study participants

	Intervention group *n* (82) *n* (%)	Control group *n* (81) *n* (%)	X^2/FET/*t*	df	*p*
Residence					
Urban	30 (36.59)	24 (29.63)	0.89	1	0.345
Rural	52 (63.41)	57 (69.37)			
Occupation					
Housewife	34 (41.46)	32 (39.51)	0.00*	1	0.950
Employee	48 (58.54)	49 (60.49)			
Monthly income					
Less than 2000 EP/month	37 (45.12)	37 (45.68)	3.66**	2	0.168
2000-5000 EP/month	34 (41.46)	40 (49.38)			
More than 5000 EP/month	11 (13.41)	4 (4.94)			
Education					
Read and write	16 (19.51)	21 (25.93)	2.23**	2	0.342
Secondary education	48 (58.54)	38 (46.91)			
University education	18 (21.95)	22 (27.16)			
History of chronic illness					
Yes	12 (14.63)	4 (4.94)	4.33*	1	0.038***
No	70 (85.37)	77 (95.06)			
History of chest diseases					
Yes	16 (19.51)	10 (12.35)	1.56*	1	0.212
No	66 (80.49)	71 (87.65)			
Pregnancy-related complications					
Yes	8 (9.76)	4 (4.94)	1.39*	1	0.239
No	74 (90.74)	77 (95.06)			
	Mean (SD)	**Mean (SD)**	t_{161}		*p*
Age	22.38 (3.50)	23.02 (5.17)	−0.93***		0.355
Family number	3.45 (1.10)	3.35 (0.99)	−0.64***		0.521
Gravida	2.45 (1.10)	2.65 (0.66)	−1.43***		0.155
Para	1.42 (1.10)	1.20 (89)	−1.62***		0.107
Gestational age	12.77 (2.76)	12.23 (2.32)	−1.34***		0.183
Number of follow-up visits	1.79 (0.84)	1.88 (0.67)	−0.69***		0.490

*X^2: Chi-square test; **FET: Fisher's exact test; ****t*: independent sample; ****Significant at $p \leq 0.05$

group. A large proportion of the intervention (85.37%, 80.49%, 90.74%) and control (95.06%, 87.65%, 95.06) groups have no history of chronic illness, chest diseases, or pregnancy-related complications, respectively. There are no statistically significant differences between the two groups in relation to age, family number, gravidity, parity, gestational age, and the number of follow-up visits.

Participants' knowledge about COVID-19 before and after the intervention

Table 2 shows a significant improvement in the intervention group's knowledge after the program implementation compared to the control group and pretest results. Also, 92.68% of the intervention group has good knowledge regarding COVID-19 compared to 22.22% among the control group postintervention. The application of PMT improved the participants' knowledge about preventive practices and the COVID-19 vaccine among 68.29% and 64.63% of the intervention group compared to 27.16% and 12.35% among the control group, respectively. In addition, 79.27% and 60.98% had complete knowledge regarding the mode of transmission and high-risk group among the intervention group compared to 43.21 and 11.11 among the control group, respectively.

Knowledge means scores before and after PMT-based intervention among the two groups

Table 3 clarifies that the knowledge mean score increased significantly in the intervention compared to the control group after PMT-based intervention ($F_1 = 211.113$, $p < 0.001$). ANCOVA results showed a significant improvement in the intervention group's knowledge ($F_1 = 8.595$, $p < 0.001$) when taking the pretest as a reference. In addition, the effect size shows that 25.8% of the intervention group's knowledge improvement and 58.8% of the difference between the two groups were due to PMT-based learning.

PMT construct mean scores before and after the intervention among the two groups

Table 4 illustrates that PMT mean construct score increased significantly in the intervention compared to the control group after the intervention ($F_1 = 302.97$, $p< 0.001$). ANCOVA results showed a significant improvement in the intervention group's perceived vulnerability, perceived

Table 2: Distribution of the participants' knowledge about COVID-19 before and after the intervention

Knowledge	Before		Significant test (FET*)	df	*p*	After		Significant test (FET*)	df	*p*
	Intervention *n* (%)	Control *n* (%)				Intervention *n* (%)	Control *n* (%)			
Definition										
Incorrect	49 (59.76)	46 (56.79)	0.15	1	0.701	15 (18.29)	34 (4198)	10.87	2	0.002**
Incomplete	00 (00.00)	0 (00.00)				0 (00.00)	0 (00.00)			
Complete	33 (40.24)	35 (43.21)				67 (81.71)	47 (58.02)			
Signs and symptoms										
Incorrect	6 (7.32)	8 (9.88)	1.76	1	0.410	0 (00.00)	0 (00.00)	33.30	1	<0.001 **
Incomplete	65 (79.27)	67 (82.72)				11 (13.41)	45 (55.56)			
Complete	11 (13.41)	6 (7.41)				71 (86.59)	36 (44.44)			
Mode of transmission										
Incorrect	00 (00.00)	0 (00.00)	1.59	1	0.208	0 (00.00)	0 (00.00)	23	1	<0.001**
Incomplete	62 (75.61)	54 (66.67)				17 (20.73)	46 (56.79)			
Complete	20 (24.26)	27 (33.33)				65 (79.27)	35 (43.21)			
High-risk group										
Incorrect	4 (4.88)	13 (16.05)	1.61	2	0.455	2 (2.44)	3 (3.70)	45.29	2	<0.001**
Incomplete	60 (73.17)	61 (75.31)				30 (36.59)	67 (82.72)			
Complete	18 (21.95)	7 (8.64)				50 (60.98)	9 (11.11)			
Preventive practices										
Incorrect	00 (00.00)	0 (00.00)	3.30	1	0.069	0 (00.00)	0 (00.00)	28.48	1	<0.001**
Incomplete	74 (90.24)	65 (80.25)				26 (31.71)	59 (72.84)			
Complete	8 (9.76)	16 (19.75)				56 (68.29)	22 (27.16)			
COVID-19 vaccine										
Incorrect	39 (47.56)	28 (34.57)	4.10	2	0.141	2 (2.44)	22 (27.16)	56.37	2	<0.001**
Incomplete	41 (50.00)	47 (58.02)				27 (32.93)	49 (60.49)			
Complete	2 (2.44)	6 (7.41)				53 (64.63)	10 (12.35)			
Total knowledge										
Poor	21 (25.61)	14 (17.28)	4.06	2	0.060	2 (2.44)	2 (2.47)	97.67	2	<0.001**
Fair	59 (71.95)	64 (79.01)				4 (4.88)	59 (72.84)			
Good	1 (1.22)	3 (3.70)				76 (92.68)	18 (22.22)			

*FET: Fisher's exact test; **Significant at $p \leq 0.05$

Table 3: Knowledge mean scores before and after Protection Motivation Theory (PMT)-based intervention among the two groups

Knowledge	Groups				ANCOVA*							
	Before		After		Reference group				Reference pretest			
	Intervention *n* (%)	Control *n* (%)	Intervention *n* (%)	Control *n* (%)	df	*F*	*p*	Partial Eta Squared	df	*F*	*p*	Partial Eta Squared
Definition	0.80 (0.99)	0.86 (1)	1.63 (0.78)	1.16 (0.99)	1	19.63	<0.001 <0.001**	0.11	1	82.15	<0.001 <0.001**	0.34
Signs and symptoms	1.06 (0.45)	0.98 (0.49)	1.869 (0.34)	1.444 (0.50)	1	40.41	<0.001 <0.001**	0.20	2	3.19	0.047**	0.04
Mode of transmission	1.24 (0.43)	1.33 (0.40)	1.97 (0.48)	1.432 (0.47)	1	42.92	<0.001 <0.001**	0.21	2	24.87	0.029**	0.03
High-risk group	0.83 (0.49)	0.93 (0.49)	1.59 (0.54)	1.07 (0.38)	1	63.97	<0.001 <0.001**	0.29	2	17.69	0.029**	0.18
Preventive practice	1.10 (0.230)	1.12 (0.40)	1.682 (0.47)	1.27 (0.45)	1	4.37	0.038**	0.03	1	10.81	0.002**	0.06
COVID-19 vaccine	0.55 (0.55)	0.73 (0.59)	1.622 (0.54)	0.85 (0.61)	1	7.26	0.008**	0.04	1	3.37	0.037**	0.04
Total knowledge	5.59 (1.34)	6.02 (1.48)	10.695 (1.29)	7.241 (1.66)	1	211.11	<0.001 <0.001**	0.59	1	8.56	<0.001 <0.001**	0.26

*ANCOVA analysis of variance; **Significant at $p \leq 0.05$

Table 4: PMT construct mean scores before and after Protection Motivation Theory (PMT)-based intervention among the two groups

PMT ** constructs	Groups				ANCOVA*							
	Before		After		Reference group				Reference pretest			
	Intervention *n* (%)	Control *n* (%)	Intervention *n* (%)	Control *n* (%)	df	*F*	*p*	Partial Eta Squared	df	*F*	*p*	Partial Eta Squared
Perceived vulnerability	6.05 (1.88)	6.45 (2.56)	12.33 (1.79)	10.15 (2.77)	1	86.82	<0.001***	0.58	1	10.69	<0.001***	0.57
Perceived severity	7.63 (2.11)	6.83 (2.19)	12.50 (1.06)	8.30 (1.64)	1	152.24	<0.001***	0.71	9	2.71	0.010***	0.28
Fear	7.25 (2.51)	6.60 (1.77)	13.25 (1.50)	8.15 (2.01)	1	42.92	<0.001***	0.21	2	4.87	0.029***	0.03
Total perceived threats	17.68 (3.88)	16.70 (4.64)	42.28 (2.37)	27.10 (5.11)	1	173.86	<0.001***	0.77	2	2.24	0.012***	0.44
Intrinsic reward	7.275 (1.60)	6.33 (1.89)	13.38 (1.78)	8.05 (1.91)	1	63.98	<0.001***	0.290	2	17.69	0.029***	0.18
Extrinsic reward	6.88 (2.30)	6.60 (20.28)	12.03 (1.40)	7.20 (2.21)	1	119.54	<0.001***	0.67	9	2.63	0.012***	0.28
Total reward appraisal	14.15 (2.37)	12.93 (3.27)			1	133.12	<0.001***	0.70	14	2.34	0.012***	0.37
Response efficacy	8.28 (2.64)	9.30 (2.55)	11.03 (1.85)	9.18 (1.24)	1	42.55	<0.001***	0.42	1	2.66	0.008***	0.33
Self-efficacy	8.13 (2.02)	6.73 (1.89)	12.08 (1.38)	8.60 (1.98)	1	67.85	<0.001***	0.51	1	2.13	0.045***	0.21
Total efficacy appraisal	15.90 (3.80)	13.65 (3.62)	26.23 (1.83)	16.43 (3.36)	1	139.42	<0.001***	0.71	9	3.71	0.014***	0.23
Response cost	8.28 (2.64)	7.24 (1.28)	10.03 (1.88)	9.30 (2.55)	1	42.55	<0.001***	0.42	1	2.66	0.008***	0.33
Protective behaviors intention	6.98 (2.52)	7.20 (2.23)	12.88 (1.86)	7.28 (1.96)	1	154.96	<0.001***	0.72	1	5.87	<0.001***	0.46
Total PMT score	67.10 (8.66)	62.95 (11.12)	111.33 (5.90)	77.58 (7.63)	1	302.97	<0.001***	0.90	1	8.64	<0.001***	0.56

*ANCOVA analysis of variance; **PMT Protection Motivation Theory; ***Significant at $p \leq 0.05$

severity, intrinsic reward, extrinsic reward, extrinsic reward, fear, response efficacy, self-efficacy, response cost, and intention score when taking the pretest or group as a reference ($p<0.001$). The effect size shows that 56.1% of the intervention group's total PMT construct improvement and 89.6% of the difference between the two groups were due to the intervention.

Discussion

The study hypothesized that pregnant woman who receives PMT-based intervention exhibit a higher knowledge score and self-protection score regarding COVID-19 than the control group. The current study findings indicated a significant improvement in the intervention group's mean score of COVID-19 knowledge after the program implementation compared to the control group. This is in accordance with four studies. The first study[19] evaluated an intervention based on PMT in reducing skin cancer risk. It indicated a significant difference between the intervention and control groups in the utilization of skin cancer prevention methods after the program implementation. Theory-based intervention can motivate the alteration of attitudes and behaviors regarding sun exposure. The second study[20] showed a significant positive change in all PMT constructs, knowledge, and vitamins E and C consumption in intervention groups at immediate postintervention and six months follow-up. Knowledge and intention also remained higher in the intervention than in the control group. The third study[21] was a randomized controlled trial that assessed the effect of an HIV/AIDS prevention intervention program based on PMT among preadolescents in the Bahamas after 24 months. Their results indicated that the program significantly increased youths' HIV/AIDS knowledge, perceptions of the ability to use condoms, and the effectiveness of condoms and abstinence. The fourth study[22] concluded that the perceived knowledge significantly and positively influenced protection motivation via its positive influence on the threat appraisal and coping appraisal. Such similarities between the studies mentioned above and the current one may be attributed to what is elicited in the literature about PMT uses in studying static existing beliefs. The literature emphasized the changes produced by persuasive communication in selected health attitudes and behavior. According to the PMT model, individuals are supposed to be influenced by either external or internal stimuli when making decisions on continuing, changing, and intensifying a concrete behavior according to their expectation about positive consequences and awareness of negative ones either for themselves (direct consequence) related to individual or other social groups including the whole society[23] Conversely, *Singh et al.*[24] reported that exposure to varying information about date rape was not significantly related to the dependent variables of date rape-related protection behavior (intent), belief, and knowledge. This dissimilarity between the current findings and *Singh et al*. may be attributed to the dissimilarity of the study methodology and implementation. In addition, the rapid spread associated with COVID-19 increased the community's fear of the infection. Fear is associated with increased perceived vulnerability and threats. Pregnant women specifically are vulnerable to fear and anxiety because of physiological and psychological changes during pregnancy.

The current study indicated that PMT mean constructs score increased significantly in the intervention compared to the control group after the intervention. ANCOVA revealed a significant improvement in the intervention group's perceived vulnerability, perceived severity, intrinsic reward, extrinsic reward, fear, response efficacy, self-efficacy, response cost, protective behavior, and intention scores when taking the pretest or group as a reference. Many studies are congruent with the current study. Malmir *et al.*[25] showed that educational manipulation based on PMT had significant effects on the experimental groups' average response for perceived vulnerability, perceived severity, perceived reward, self-efficacy, response efficacy, response cost, and protection motivation. Their intervention also affected the intention and behavior of physical activity in patients with type 2 diabetes. Ali Morowatisharifabad *et al.*[26] also reported that the utilization of PMT could help to improve self-efficacy as the most powerful factor in predicting physical activity intention and behavior. Dashti *et al.*[27] studied the effectiveness of training programs based on PMT in improving nutritional behaviors and physical activity in military patients with type 2 diabetes mellitus. They reported that in the intervention group, there was a significant difference between the mean scores of all PMT constructs before and after the educational intervention. They also concluded that PMT could be used as a framework for designing educational programs to improve the diet and physical activity among diabetic patients. Mirkarimi *et al*.[28] illustrated that PMT-based intervention significantly increased susceptibility, severity, rewards, self-efficacy, response efficacy, and costs compared to the control group. Moreover, our study findings portrayed that PMT helps to empower women internally to motivate self-protection against coronavirus. This may be attributed to the fact established by Ronald *W Rogers*[17] in his PMT which suggested that a person is motivated to protect himself by assessing the threat of potentially harmful behavior and coping with the behavior to decrease the risk severity. Otherwise, the current study does not fit with Wang *et al*.,[29] who reported that the components of coping appraisal in PMT (self-efficacy to have COVID-19 vaccination, response efficacy, costs of COVID-19 vaccination, and knowledge concerning the mechanism of COVID-19 vaccination) did not significantly predict the motivation to have COVID-19 vaccination. Dehdari *et al*.[30] also reported no significant differences in the perceived severity, response efficacy, response cost, and fear between the two groups following the intervention. This dissimilarity between the current findings and Dehdari *et al*. findings may be attributed to the dissimilarity of the study design and implementation.

Although the double-blinded technique would have been perfect for the current study, this was not possible in this study due to the nature of the intervention. The researchers who conducted the interventions and data collection for postintervention were not blinded. The research reflects only one geographical area in Egypt; therefore, more studies should be done on larger samples from different geographical areas.

Conclusion

The application of PMT improved the participants' knowledge about preventive practices and the COVID-19 vaccine compared to the control group. PMT mean construct score increased significantly in the intervention compared to the control group after the intervention. Hence, PMT may be an effective model for pregnant women's education that stimulates their internal intention for self-protection.

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Conflicts of interest

Nothing to declare.

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