Pregnant Women's Knowledge, Practice and Attitude toward COVID-19: Instructional Organized Sessions via Mobil-Based Application

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Abstract

The coronavirus COVID-19 pandemic is the global health crisis of our time and the greatest challenge we have faced since World War II. Pregnant women are considered to be a high-risk group for severe acute respiratory syndrome coronavirus infection, and the potential adverse effects of the virus on maternal and perinatal outcomes are of concern. One of best ways to avoid these potential adverse effects is to provide the women with knowledge to improve awareness. Mobile application is the brightest hope to provide accurate practical knowledge by nurses who have a key role in the management of pregnant women during pandemic crisis. **Aim:** evaluate the effect of the instructional organized sessions via a mobile-based application on pregnant women's knowledge, practice, and attitude toward COVID-19. **Research design:** A quasi-experimental study design was utilized. **Setting:** antenatal outpatient's clinics, obstetrics, and gynecological hospital, at El-Manial Maternity Hospital – El Kaser Aliniy, Cairo University, Egypt. **Methods:** A convenience sample of 200 pregnant women regardless the gestational age was recruited for the study. **Tools**: Data collection tools included five tools: Maternal Structured Interview questionnaire; Knowledge, practices, and attitude assessment questionnaires about COVID-19 and pregnant women's satisfaction regarding instructional method. **Results:** The result of the study revealed that there were statistically differences in the total mean score of knowledge, practice and attitude after receiving instructional organized sessions via Mobile-based application compared to before intervention. **Conclusion:** The findings of the study support the research hypotheses that pregnant women who received instructional organized sessions via Mobile-based application showed a positive effect on level of knowledge, practice and attitude as compared to before intervention. **Recommendations:** Government agencies in the healthcare sector should reinforce more effective primary preventive measures and policies by developing mobile-based applications to provide quality and safety information that can help in flattening the curve of this pandemic.

Keywords: COVID-19, Instructional organized sessions, Mobile-based application, Pregnant Women, Prenatal care, Knowledge, Practice, Attitude.

Introduction

A novel corona virus pandemic disease (COVID-19) is that the vast majority of infectious respiratory disease caused by the severe acute respiratory syndrome coronavirus (SARS-CoV-2), which was first detected in Wuhan, China in December 2019 **(Guan et al., 2020).** It first presented as severe cases of pneumonia of unknown origin and was identified as a coronavirus in January 2020 **(Vardavas and Nikitara, 2020)**. Also, it has already evolved into a pandemic spreading rapidly worldwide. SARS-CoV-2 affects individuals of all ages and spreads through droplets when the infected individuals cough or sneeze **(Ge et al., 2020).** The droplets can still be infectious even after deposition onto surfaces. Infection occurs when these droplets are inhaled or when the contaminated surfaces are touched followed by the touching of one's eyes, nose, or mouth **(Huang and Zhao, 2020).** Transmission of infection is possible during its incubation phase (2-14 days) **(Chen et al., 2020 and Huang et al., 2020).**

According to clinical characteristics, individuals can develop COVID-19, an influenza-like illness targeting that primarily affects the respiratory system following infection. Recent studies stated that clinical characteristics vary greatly among individuals; ranging from asymptomatic to serious consequences like pneumonia, acute respiratory distress syndrome,

organ failure, and a high fatality rate **(Phelan et al., 2020).** Common clinical features include major symptoms such as fever, dry cough, breathlessness, and minor symptoms such as anosmia, loss of taste, sore throat, headache, myalgia, diarrhea, and fatigue **(Vardavas and Nikitara, 2020).** Based on the data from China, about 81 percent of patients' experienced mild illness, 14 percent had severe disease, and 5 percent became critically ill, with an overall case fatality rate ranging from 2.3% to 5%. The cases also indicated that illness severity was associated with patients 60 years and older, as well as with patients that had other underlying illnesses or medical conditions **(Wu and Mc-Googan, 2020).** Persons of advancing age and those with pre-existing comorbidities disease like diabetes, hypertension, respiratory, cardiac and /or metabolic disorders, HIV, anemia, past tuberculosis, obesity, and smokers are at higher risk of moderate to severe symptoms when infected **(Hu and Wang, 2021).**

Pregnant women also might be at risk for severe illness, morbidity, or mortality compared to the general population as observed in cases of other related coronavirus infections including severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV), and other viral respiratory infections, such as H1N1 influenza (Fan, et al., 2021 and Michel et al., 2021). Infectious diseases can play a significant role in pregnancy, particularly by affecting maternal and fetal outcomes. With the spread of the coronavirus, concerns have been raised about its intrauterine transmission from mother to fetus **(Panahil et al., 2020).** Prenatal respiratory infections may also result in stillbirth, miscarriage, and preterm delivery. It is noted that pregnant women are more susceptible to developing severe cases of viral respiratory infections, including COVID-19 and consequently being admitted to hospitals and intensive care units because of experience reduced lung function, increased oxygen consumption, immunologic and physiologic changes during pregnancy **(Liang and Acharya, 2020).** Previous studies have indicated that SARS and MERS during gestation are linked with the risk of miscarriage, preeclampsia, preterm birth, and perinatal death. To date, studies in pregnant women with COVID-19 have indicated few maternal and neonatal complications, but more concrete evidence is required as these studies involved a small number of women over a short period **(Rasmussen et al., 2020).** While, there is no evidence at present of an increased risk of miscarriage, teratogenicity, or vertical transmission of the COVID-19 virus. There is no evidence demonstrating transmission by breastfeeding, however, research is underway to investigate this further **(Di-Mascio et al., 2020).**

Because of the aforementioned circumstances, prevention in the course of this outbreak is very vital for pregnant women. Since knowledge, practice and attitude can play key roles in the prevention of infectious disease and to preserve the health of mothers and children in this critical situation. To date, no medications or vaccines are approved to treat or prevent COVID-19 **(Mohamed, Elsayed, Abosre and Eltoham, 2020).** Therefore, implementation of preventive measures is important to avoid its further spread. During this period, pregnant women have a great need to look for information to improve their awareness. Pregnant women may use the Internet to access online discussion sites to obtain information about COVID-19 and contact other women who are experiencing the same condition **(Fikadu et al., 2021).**

Education and access to information at this stage are highly valued by pregnant women, moreover when it is provided in optimal circumstances and from a safe source like a professional nurse. The mobile-based application is more effective and cost-effective than other systems because it supports pregnant women from their home or place, calls for review, advising, interactive. As a result, it is important to provide pregnant women with the most up-to-date information on COVID-19 to prevent obstetrical complications. Pregnant women should be educated about personal hygiene, basic infection prevention and control measures, and how to care for the person suspected of having COVID−19 as safely as possible. So, the current study was conducted on a statistical sample of pregnant Egyptian women to determine their knowledge, practice, and attitude and provide instructional sessions toward COVID-19. Therefore, the aim of this study is to evaluate the effect of the instructional organized sessions via a mobile-based application on pregnant women's

knowledge, attitude, and practice toward COVID-19.

Significant of the Stuyd

The coronavirus infection pandemic has been identified as a global public health emergency of international concern, reported in 215 countries and territories. By 25 May 2020, 5371 700 cases of COVID-19 had been reported around the world, including 344 815 deaths **(WHO, 2021).** The highest numbers of new cases were reported from India, the United States of America, Brazil, Turkey, and France **(WHO, 2021).** Egypt is among the five countries reporting the highest number of cases in Africa with a total of 225528 confirmed cases of COVID-19 and 13219 deaths, reported to WHO, from 3 January 2020 to 29 April 2021 **(WHO, 2020 and Radwan, 2020).**

According to current evidence showed that older age, obesity, smoking, alcohol, physical inactivity, pollution, diabetes, cardiovascular disease, respiratory disease, and cancer are high risk factors of serious cases with COVID-19 (WHO, 2021). Also, some research mentioned that pregnancy is a physiological state that predisposes women to viral infection. In addition to the effects of COVID-19 infection on a pregnant woman, there are concerns about the possible impact on fetal and neonatal outcome; hence, pregnant women are a population that requires special consideration in relation to prevention, diagnosis, and management (Chen et al., 2020). Preventive measures such as physical and social distancing, more rigorous hygiene practices, and wearing protective face coverings are most effective when pregnant women are used. Pregnant women who constitute a vulnerable group need to be more vigilant and hence preventive measures education improve knowledge; thereby affecting attitude and practice against the spread of the virus among them are of utmost importance **(Omer, Ali and Babar, 2020).**

In order to minimize prevalence and flatten the curve, various governments in health care sector implemented a variety of measures, including lockdown and home quarantine which were found to be effective in many countries (**WHO**, **2020**). Also, digital technology innovations have been shown to improve the efficacy of the health-care system's response to an epidemic through increasing public awareness and dissemination of COVID-19 related information on prevention strategies **(Ahmed et al., 2021).** The capacity of information technologies allow for low-cost dissemination and collaboration of data. WhatsApp is currently one of the most popular applications worldwide and allows its users to communicate via text/voice messages, photos, and videos. The need for only a mobile Internet connection, with no extra cost for sharing unlimited information, makes it a useful platform **(Bassi, Arfin, John and Jha, 2020).**

As an effort, the researchers focused on mobile technology as a solution for serving the health of pregnant women. The reason for exploring up this option was its efficiency, rapid nature, guarded user privacy as well as ability to bridge the data gap between healthcare staff and individuals accurately. On the other hand, it provided an important link between researchers and pregnant women, avoiding the need to travel to overburdened hospitals in order to avoid crowded areas and time of contact with pregnant women to avoid risk for transmission of COVID - 19 infection. As well, rapid data sharing is critical because it allows for a better understanding of the infection's origins and spread, as well as a basis for effective prevention, treatment, and care.

Aim:

The aim of this study was to evaluate the effect of the instructional organized sessions via a mobile-based application on pregnant women's knowledge, practice and attitude toward COVID-19.

Hypotheses:

The following research hypotheses were developed to fulfill the intent of the current study:

H_1: There will be a significant difference in the level of knowledge toward COVID-19 among pregnant women after instructional organized session via Mobile-Based Application as compared by before intervention (as measured by Knowledge Assessment Questionnaires).

H_2: There will be a significant difference in practice toward COVID-19 among pregnant women after instructional organized session via Mobile-Based Application as compared by before intervention (as measured by Practice Assessment Questionnaires).

H_3: There will be a significant difference in attitude positively toward COVID-19 among pregnant women after instructional organized session via Mobile-Based Application as compared by before intervention (as measured by Attitude Assessment Questionnaires).

Research Design:

Quasi-experimental research design with pre- test and post-test was used. One-group Pre-Test / Post-Test research design was used to evaluate causal relationships between intervention and outcome. It is a method for assessing the effect of an intervention by comparing scores on a variable before and after an intervention (LoBiondo -Wood, 2014 and Nieswiadomy, 2012).

Subjects and Methods

Setting:

The study was conducted at antenatal outpatient's clinics, obstetrics and gynecological hospital, at El-Manial Maternity Hospital – El Kaser Aliniy, Cairo University, Egypt.

Sample:

A convenience sample of 200 pregnant women regardless of gestational age was recruited for the study. Women with any medical or psychological disorders were excluded.

Sample size: A total of 200 pregnant women were selected according to the following statistical formula n = Z2p (1-p) /d2, where z = level of confidence according to the standard normal distribution (for a level of confidence of 95%, z = 1.96); p = estimated proportion of the population that presents the characteristic (when unknown we use p = 0.5) and , d = (d is considered 0.05) (Dahiru, Aliyu, and Kene, 2006).

Tools for data collection

Data pertinent to the study variables were collected through five main tools which are:

Tool I: Maternal Structured Interview questionnaire: It was developed by the researchers and divided into two aspects: (a): Scoio-demograhic characteristics of pregnant women: it includes personal data as (age categories, place of residence educational status, and occupation). (b) Obstetric profile such as parity status (primigravida, multigravida), and stage of pregnancy (first, second or third trimester).

Tool II: Knowledge Assessment Questionnaires about COVID-19: The questionnaires have a 12-items for knowledge assessment which covered: Primary signs and symptoms (1 - item), mode of transmission (7-items), availability and effectiveness of treatment (1-item), preventing spread of infection (1-items); risks of COVID-19 on pregnancy and fetus (1-item); and preventive measures during breast feeding (1-items). The scoring system of woman's knowledge was either zero (for incorrect answer) or 2 (for correct answer). The minimum score was 0, whereas maximum score was 24. The total knowledge scores were categorized into two levels: a) Unsatisfactory level of knowledge (less than 60 percent); b) Satisfactory level of knowledge (more than 60 percent).

Tool III: Practices Assessment Questionnaires about COVID-19: Preventive behavior practices were measured using 6- items that covered the following: practice hand hygiene, practice hand sanitation, wearing facial masks, avoiding crowded places, stay at home and follow rules of government and the ministry of health. Women had to make their response using three-point Likert scale (1= never, 2 = sometimes, 3 = always). The total practice scores were categorized into two categories: a) Poor level of practice (less than 60 percent), and b) Good level of practice (more than 60 percent).

Tool IV: Attitude Assessment Questionnaires about COVID-19: The questionnaires have 4-items for women attitude as if they think infection increases in crowding, disinfection of the public and buildings protect against COVID-19, the country instructions taken to limit the spread of COVID-19 … etc. Women had to make their response using three-point Likert scale (1= never, 2 = sometimes, 3 = always). The total attitude scores were categorized into two levels: a) Negative (less than 60 percent), and b) Positive (more than 60 percent).

Tool V: Pregnant women's satisfaction regarding instructional method: The questionnaires have 8-items which covered: sufficient

knowledge, suitable teaching method, answer all questions, chances for asking questions….etc. Women had to make their response using satisfactory and unsatisfactory.

Validity and Reliability:

Knowledge, practice and attitude assessment questionnaires were designed and adapted after extensive literature review and sent to a panel of five expert staff in the field of maternity health nursing, Faculty of Nursing – Cairo University. Each one of the experts in the panel was asked to examine the instrument for face and content validity. Modifications were made based on the judgment of panel concerning the clarity of the sentences and appropriateness of the content.

The reliability was tested to determine the consistency of the measurement tool which an instrument measures the same way each time if used under the same condition with the same subjects. The reliability of the questionnaire was checked by conducting a test-retest among pregnant women in antenatal clinic, by taking 10 women which was 5% of the total sample size. The Cronbach's alpha model, which is a model of internal consistency, was used to test tool reliability. The reliability factor was 0.84 for knowledge, 0.86 for practice, and 0.78 for attitude. The statistical equation of Cronbach's alpha reliability coefficient normally ranges between 0 and 1; higher estimation more than 0.7 indicate acceptably reliability (Tavakol and Dennick., 2011).

Pilot Study

Once permission was given to begin the proposed research, a pilot study was carried out on 10 women from antenatal outpatient's clinic to assess time required to answer the questions; to judge the feasibility, objectivity, test the ability of the tool to elicit the desired information and to test appropriateness of content, and wording. Pilot study revealed that the average time required to complete the questionnaire was approximately 20 - 30 minutes for each woman. Based on its outcome, modifications have been carried out. The pregnant women involved in the pilot study were excluded from the sample.

Procedure

Data was collected from November 1, 2020, to February 28, 2021. After sending an official letter from the Dean of the Faculty of Nursing at Cairo University outlining the study's aims and data collection methods, the director of the previously listed settings granted official permission to conduct the study. The data collection procedure has been done through three phases: interviewing and assessment, implementing and evaluation phase.

Phase I: **Interviewing and assessment**

An informed written consent was obtained from pregnant women to obtain their permission to share in the study in order to protect their human rights. After that, an interview was conducted in the antenatal outpatient clinic to collect data regarding the Socio-demographic, obstetrical profile, and the pretest questionnaire. This phase took about 15-20 min for each woman.

Phase II: Implementing

The researchers developed the instructional organized sessions via Mobil-based application after review of literature and WHO recommendations on the measures to prevent human –to-human transmission of COVID-19 infection. The following aspects are included in the Mobile-Based sessions (Fikadu et al., 2021, Chen et al., 2020, Omer, Ali & Babar, 2020 and WHO, 2020). (a) COVID-19 definition; (b) Signs and symptoms; (c) Mode of transmission; (d) COVID-19 risk factors; (e) Preventive measures include avoiding public areas, keeping at least 2 meter distance from others, wearing a face mask, washing or sanitizing hands frequently, avoiding touching eyes, nose and mouth with hands, covering mouth and nose while coughing or sneezing, staying in door and avoiding handshaking, hugging and kissing; and avoiding dealing or close contact with infected or suspected people; (f) comply with any restriction imposed by the government.

An instructional organized session via mobile-based application (phone calls, SMS message, and WhatsApp application) was provided to each woman. The researchers sent information and colored brochure containing the instructions about COVID-19. Continuous contact was done within one week to ensure that

the women attain the right information, understand the instruction, and any misunderstand points were explained and clarified. Frequent contact within 2 weeks to make sure that the pregnant women change their attitude and follow practices of COVID-19 preventive measures.

Phase III: Evaluation

Then, all pregnant women completed the questionnaires again using the same tool after one month from the first contact; regarding the level of knowledge, practice, attitude; and pregnant women's satisfaction regarding instructional method via mobile-based application.

Ethical Considerations

The ethical committee of the Faculty of Nursing at Cairo University approved the current study. Official permission to conduct the proposed study was obtained from the hospital administrators. The participants were provided with information about the study's aim and benefits. The study's purpose, goals, and significance were explained, as well as the study's safety and confidentiality. Women confidentiality and anonymity was granted. Pregnant women were informed that participation in the study is completely voluntary and that they can withdraw at any time without affecting their antenatal care routine.

Statistical Analysis

Data collected, tabulated, and statistically analyzed using an IBM personal computer with Statistical Package of Social Science (SPSS) version 22 (SPSS, Inc., Chicago, Illinois, USA). The following statistics were used: (a) Descriptive statistics, which included quantitative data presented in the form of the mean ($\overline{X}$), standard deviation (SD), range, and qualitative data in the form of numbers and percentages; and (b) Analytical statistics, which included a one-group t-test to determine the statistical significance of the results at $p < 0.05$. Paired sample t-test was used to analyze data and comparing the mean of the pre- and post-test for the same group.

Results

Statistical findings of the current study were presented in the following order: The first section is devoted to description of the socio-demographic characteristics and obstetric profile. The second section presents the result that answered the research hypotheses in relation to variables regarding level of knowledge, practice, and attitude.

Section I: Socio-demographic characteristics and obstetric profile

Table (1): In terms of socio-demographic characteristics; the sample included 200 pregnant women ranging in age from 18 to 39 years, with a mean age of 27.02 ± 4.99 years. The majority of them (71%) were over the age of 25. Furthermore, almost half of the pregnant women (58%) lived in urban areas and (43.5%) had a university degree. Regarding occupation, (52%) of them are working. Added to that, (62%) of the pregnant women were multigravida. Regarding pregnancy stages, (43.5%) were in the first trimester, (34%) were in the second trimester and (22.5%) were in the third trimester.

Section II: Knowledge, practice and attitude level among pregnant women

Figure (1): shows that social media (51.5%) was the most common source of information about COVID-19, followed by television, physician and friends (19, 16 and 13.5 %) respectively.

Table (2): After intervention, the majority of pregnant women were aware of the COVID-19 pandemic, with adequate knowledge, good practices and positive attitude (75, 94.5, and 95) respectively. There was a statistically significant increase in overall mean knowledge level score after intervention as compare to before intervention (10.15± 3.61 and 22.73± 4.42) respectively at p-value (0.001). In terms of practice level, the current study found a statistically significant increase in overall mean score of practice after intervention as compared to before intervention (6.65 ±1.07 and 10.91 ±0.94) respectively at p-value (0.001). Furthermore, there is a statistically significant improvement in overall mean attitude score after intervention as compared to before intervention (7.62 ±2.44 and 10.83± 1.01) respectively at p-value (0.001).

Table (3): confirms that the relationship between knowledge and practice is weak, whereas the relationship between attitude and practice is strong.

Table (4): the relationship between COVID-19 knowledge, practice, and attitude was investigated using a variety of socio-demographic variables (age categories, place of residence, educational status and occupation). There was a strong correlation between knowledge and educational status, as well as between practice and residence. The attitude had a significant positive relationship with (age, residence and educational level).

Table (5): in terms of pregnant women's feedback regarding instructional methods via Mobil-Based application; the majority of pregnant women were satisfied with the sufficiency of knowledge, suitability of teaching methods, useful to improve practice and useful for prevention of COVID-19 regarding (59, 60.5, 73.5, and 78.5) respectively.

Table (1): Frequency and percentage distribution of socio-demographic characteristics and obstetric profile among pregnant women (n = 200).

Variables	No.	%
Age categories		
< 25 years	58	29
>25 years	142	71
Mean ± SD	27.02 ± 4.99	
Place of Residence:		
Urban	116	58
Rural	84	42
Educational status:		
Read and write	31	15.5
Primary.	39	19.5
Secondary.	43	21.5
University.	87	43.5
Occupation:		
Housewife	96	48
Working	104	52
Parity:		
Primigravida	76	38
Multigravida.	124	62
Stage of pregnancy:		
First trimester	87	43.5
Second trimester	68	34
Third trimester	45	22.5

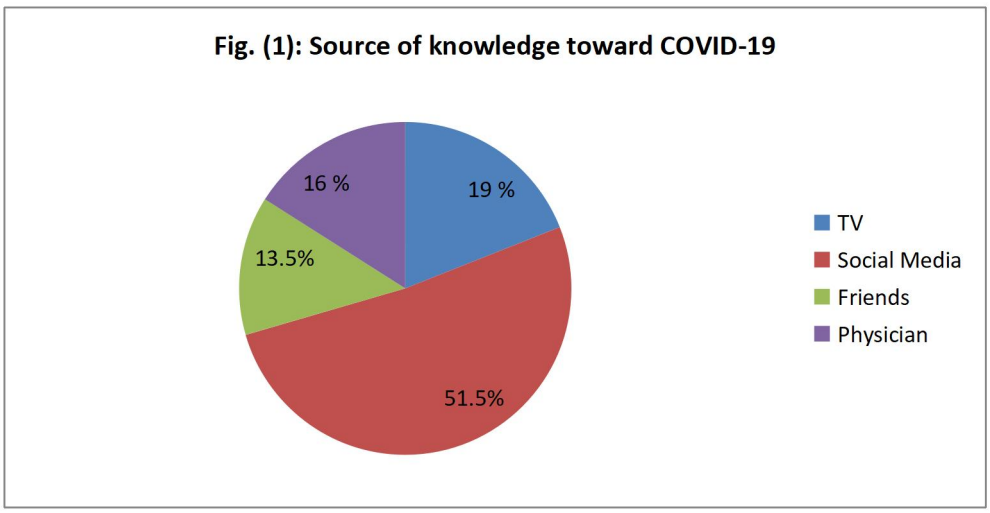

Table (2): Comparison of knowledge, practice and attitude mean score toward COVID-19 before and after intervention among pregnant women (n = 200)

Total Categories of variables	Before intervention		After intervention		t-test (p-value)
	No.	%	No.	%	
Knowledge:					
Unsatisfactory.	161	80.5	50	25	6.47 (0.001)
Satisfactory.	39	19.4	150	75	
M ±SD	10.15± 3.61		22.73± 4.42		(0.001)*
Practice:					
Poor.	51	25.5	11	5.5	5,43 (0.001) *
Good.	149	74.5	189	94.5	
M ±SD	6.65 ±1.07		10.91 ±0.94		(0.001)*
Attitude:					
Negative	57	28.5	10	5	-13,29 (0.001) *
Positive	143	71.5	190	95	
M ±SD	7.62 ±2.44		10.83± 1.01		(0.001)*

*Statistically significant p-value ≤ 0.05

Table (3): Correlations between Knowledge, practice and attitude using Pearson Correlation value.

Items	Practice		
	Pearson Correlation	Significant value	Strength of relation
Knowledge	0.033	0.64	Weak – No significance
Attitude	0.85	0.001*	Strong correlation

*Statistically significant p-value ≤ 0.05

Table (4): Relationship between knowledge, practice, and attitude about COVID-19 and Socio-demographic characteristics among pregnant women (n=200)

Variables	X (p-value)			
	Age Categories	Place of Residence	Educational Status	Occupation
Knowledge	2.62 (0.07)	0.00 (0.56)	13.54 (0.001)*	0.00 (0.56)
Practice	0.31 (0.40)	8.42 (0.002)*	1.95 (0.74)	0.20 (0.44)
Attitude	4.29 (0.03)*	7.62 (0.004)*	10.33(0.03)*	0.27 (0.42)

*Statistically significant p-value ≤ 0.05

Table (5): Frequency and percentage distribution of pregnant women's satisfaction regarding instructional method as reported by pregnant women (n = 200).

Items	Satisfactory		Unsatisfactory	
	No	%	No	%
Sufficient knowledge.	118	59	82	41
Suitable teaching method.	121	60.5	79	39.5
Answer all questions.	131	65.5	69	34.5
Chances for asking questions.	137	68.5	63	31.5
Help to reduce anxiety.	121	60.5	79	39.5
Useful to improve practice.	147	73.5	53	26.5
Easy language.	130	65	70	35
Useful for prevention of COVID-19.	157	78.5	43	21.5

Discussion

The novel severe acute respiratory syndrome - coronavirus 2 (SARS-CoV-2) has played havoc worldwide. COVID-19 is a global public health emergency and could cause devastating health issues during pregnancy **(Guan et al., 2020).** Pregnant women have a high propensity to acquire this infection due to their altered physiological and immunological function as observed from SARS and MERS **(Fan et al., 2021 and Omer, Ali & Babar, 2020).** Pregnant women are at increased risk of admission to an intensive care unit, receiving invasive ventilation and extra corporeal membrane oxygenation treatment, compared with non-pregnant women

of reproductive age **(Allotey et al., 2021).** Risk factors for severe COVID-19 in pregnancy include increasing maternal age, high body mass index, non-white ethnicity, pre-existing comorbidities, and pregnancy specific disorders such as gestational diabetes and preeclampsia **(Liu et al., 2020).** It is thought that COVID-19 may significantly increase the maternal and fetal risks **(Michel et al., 2021).** As a result, it was emphasized that supporting pregnant women is crucial. Pregnant women deserve a more sensitive approach and understanding during the current dramatic pandemic (**CDC, 2020 and Malinowski, Noureldin & Othman, 2020).**

So, the aim of this study was to evaluate the effect of the instructional organized sessions via a mobile-based application on pregnant women's knowledge, practice, and attitude toward COVID-19. The findings of this study confirmed the hypotheses that there was a significant difference in the level of knowledge, practice, and attitude positively toward COVID-19 among pregnant women after instructional organized session via Mobile-Based Application as compared by before intervention. The discussion of results was presented in two key sections as follows: (I) Demographic characteristics and obstetric profile, and (II) Evaluation of knowledge, attitude, and practice.

Section I: Socio-demographic characteristics and obstetric profile

For the current study, a convenience sample of 200 pregnant women, regardless of gestational age, was recruited, their ages ranged from 18 years to 38, with a mean age of (27.02 ± 4.99) years. Furthermore, almost three quarter of the pregnant women was over the age of 25. Moreover, more than half of the pregnant women lived in urban areas and over a third had university degree. In terms of occupation, nearly half of them are working. Added to that, more than half of the pregnant women were multigravida, with nearly a third in the first trimester, a third in the second trimester and nearly a quarter in the third trimester. These findings were in the same line with other researchers who founded that the mean age of the study subjects was 24.6 ± 6.3 years, ranged from 18 to 42 years, had secondary education and reside in urban area, were primigravida, and at gestational age of 2nd and 3rd trimester **(Nwafor, Aniukwu, Anozie, Ikeotuonye and Okedo-Alex, 2020).**

Section II: Evaluation of knowledge, practice and attitude

The population will constantly learn about this infectious disease from different sources of information such as television and social media because of the seriousness of the epidemic outbreak and the overwhelming news reports on this public health emergency **(Institute for Integrated Development Studies, 2017).** In the current research, social media was the most common source of knowledge about COVID-19, accompanied by television, physician, and friends as nowadays utilization of the internet is widening and the information also worldwide. Besides that, the sample's characteristics of the current study as younger pregnant women have access to the internet, television, and radio. In another way younger participants have a better educational level, more than half of the pregnant women had a high school or bachelor's degree. This hypothesis is supported by the strong positive association between education levels and COVID-19 knowledge scores. This finding was consistent with many researchers who concluded that there are many difficulties and challenges in taking face-to-face consultations during the COVID-19 pandemic. Therefore, an alternative method as smartphone technology has played an important role in an outbreak crisis management. [26] Also, WHO has launched a Chabot in partnership with WhatsApp to sharing up-to-date information quickly, spreading the proper guidelines regarding the COVID-19; encouraging desired health-impacting behaviors, and combat misinformation **(Fikadu et al., 2021, Institute for Integrated Development Studies, 2017, Miner, Litiana & Kocaballi, 2020 and Arumugam, 2019).**

Knowledge and attitude toward infectious diseases play a crucial role in precise practices for limiting the spread of the disease (Miner et al., 2020). Adherence to preventive measures by the population is crucial for the control of spread, which is mainly affected by their knowledge, attitudes, and practices toward COVID-19 **(Kamal, Thakur, Swain and Vikneshram 2021).** Pregnant women who constitute a vulnerable group need to be more cautious and hence knowledge, attitudes, and practices of

preventive measures against the spread of the virus among them are of utmost importance **(Alshdefat, Natarajan, Joseph, Baker and Qutishat, 2021).** So, the primary aim of the current study was to educate pregnant women about preventive measures toward COVID-19 through Mobil-based application.

More than three quarters of pregnant women had inadequate knowledge prior to intervention. Three quarters of them had adequate knowledge after intervention. It was observed that after intervention, the total mean score of knowledge level increased statistically significantly as compared to before intervention, implying a higher overall correct rate on this knowledge test. From point of view that good preparation by providing adequate knowledge in simple and clear manner to women enhances understanding and awareness about COVID-19 in order to increase awareness and improve practice. Knowledge provided in the current study using Mobile-based application was more effective in order to improve knowledge. Therefore, the researchers can conclude from the findings of this research that experts and healthcare professionals should share useful information and effective schemes to curb the rate of outbreaks through digital technology as WhatApp Mobile based application.

These findings agreed with many researchers who found that the majority of studied subject included in the study group had a good level of knowledge as compared with more than two third of control group's subjects that had a poor level of knowledge. This might be due to the educational guidelines succeeding in increasing the study group knowledge (Mohamed, Elsayed, Abosre, and Eltoham, 2020). Therefore, many researchers recommended that preventive measures, including frequent hand washing, refraining from excessive outdoor activities unless an emergency, and avoiding infected individuals, crowded places, and public gatherings, should be strictly informed. Also, pregnant women should inform their maternity-care provider regarding their health status and seek advice regularly **(Bassi, Arfin, John & Jha, 2020 and Alshdefat, Natarajan, Joseph, Baker & Qutishat, 2021).**

Except for educational status, no significant association was identified between socio-demographic characteristics as (age categories, place of residence and occupation) and knowledge. This finding was in line with the findings of researcher which concluded that the determinants of knowledge scores were education and place of residence ($P < 0.01$). However, no significant association was found between age group and knowledge **(Kamal, Thakur, Swain, and Vikneshram, 2021).**

According to the findings of this study, approximately three quarters of pregnant women had low level of practice score prior to intervention, but almost all of them had high levels of practice after intervention. Furthermore, as compared to before the intervention, there is a statistically significant improvement in the average mean score of practice after the intervention. This finding supported by researchers who founded those pregnant women skills including wearing mask, and recognizing the importance of self-protection, and recognizing that COVID 19 may be avoided by demonstrating protective measures as educated during educational intervention **(Mohamed, Elsayed, Abosre, and Eltoham, 2020).** In the previously mentioned Chinese study, a highly better practice level was observed where almost of the participants avoided crowded places, and wore masks on leaving home. This high compliance to preventive measures was attributed to the very strict prevention and control measures taken by the governments **(Zhong et al., 2020).** Another researcher concluded that poor practices of preventive measures among pregnant women would put these women at high risk of infection, which could worsen maternal morbidity and mortality profile during the pandemic owing to the poor healthcare system **(Kasemy, et al. 2020).** Hence, other researchers recommended that pregnant women require special attention in relation to prevention, diagnosis, and management **(Nwafor, Aniukwu, Anozie, keotuonye and Okedo-Alex, 2020).**

There was no substantial relationship between socio-demographic characteristics (age categories, educational status, and occupation) and practice, with the exception of the place of residence. This result was concurrent with the results of researchers which concluded that the practice score had a significant association with age and place of residence. However, no significant association was found between

education and practices **(Alshdefat, Natarajan, Joseph, Baker and Qutishat, 2021).**

The perceptive, motivational, emotional, and cognitive beliefs that affect an individual's practice or actions in a positive or negative way are referred to as attitude (Li et al., 2019). According to the results, almost three-quarters of pregnant women had a pessimistic attitude before the intervention, compared to almost all of them having a positive attitude after the intervention. As compared to before the intervention, there is a statistically significant improvement in the overall mean attitude score. After intervention, the vast majority of the pregnant women held an optimistic attitude towards the COVID-19 epidemic after clarification of misconception information: the country instructions taken to limit the spread of COVID-19; nearly all avoided crowded places and wore mask when leaving the home. This result was congruent with researchers who concluded that educational guidelines was effective in changing pregnant women's attitude because improve knowledge and practice is highly associated with change attitude positively **(Maharlouei et al., 2020 and Yassa et al., 2020).**

Except occupation, there is a significant association with various demographic variables (age categories, place of residence and educational status) with attitude. This finding was in line with the findings of researchers which concluded that attitude score had a significant association with age, education, and place of residence **(Kamal, Thakur, Swain, and Vikneshram, 2021).**

As regarding pregnant women's satisfaction regarding instructional methods via Mobil-Based application; the majority of pregnant women were satisfied with the sufficiency of knowledge, suitability of teaching methods, useful to improve practice and useful for prevention of COVID-19. These findings may be due to those preventive measures was prepared with simple Arabic language and had a proper picture for clarification, provide a single answer to most questions, available any time, delivered in place at any time without burden to travel or risk to exposure for infection. Several researchers concurrent with these results who concluded that the majority of studied sample added that educational guideline answer all of their questions and were useful in prevention of COVID-19 **(Mohamed, Elsayed, Abosre, and Eltoham, 2020)**

According to knowledge, attitude and practice (KAP) theory, good knowledge and attitude are reflected in better practices **(Arumugam, 2019).** However, the relationship between knowledge and practice is weak, whereas the relationship between attitude and practice is strong in the current study. This is not adherent in line with the KAP theory. From my point of view, this might be due to the strong emphasis by social media, newspapers, television channels, and government health agencies to educate the population mainly on attaining good practices such as enforcing social distancing, restriction of movements, and compulsory usage of masks. Hence, they could have been more casual in practice despite the good and adequate knowledge. This result was in line with the findings of researchers who recommended that improving residents' COVID-19 knowledge via health education may also result in improvements in their attitudes and practices towards COVID-19. Also, changes in practice were found contributed by changes in knowledge to a large extent and by attitude to some extent **(Miner, Litiana and Kocaballi, 2020).** Hence, other study is congruent with the outcome of this research that relationship attitude and practice are stronger than knowledge and practice where people will consume the medicinal plants when they have good attitudes and beliefs **(Arumugam, 2019 and Lee, Kang & You, 2021).**

The findings of the current study confirmed the stated hypotheses that there was a significant difference in the level of knowledge, practice, and attitude positively toward COVID-19 among pregnant women after instructional organized session via Mobile-based application as compared by before intervention. Therefore, awareness about disease forms the cornerstone for educational activities and is used as an index by the health authorities. This research offers critical and timely insights into how the governments and public health agencies develop and implement appropriate policies and programs that do not underestimate or deprioritize those who are most in need as pregnant women. Mobile application is the brightest hope to fight this pandemic as an integral part by nurses who have a key role in the

management of pregnant women during pandemic crisis. Also, it is imperative to implement policies that reduce risk of transmission of COVID-19 to pregnant women.

Conclusions

During health crises and emergencies, pregnant women need to practice preventive behaviors such as lockdown-exit strategies and physical distancing as an effective strategy in order to reduce COVID-19 transmission and prevent an uncontrolled upsurge of the epidemic to ensure a positive pregnancy and childbirth experience. As the novelty and unpredictability of epidemics may exceed a health system's capability to a significant degree. This study provides evidence that knowledge is an essential predictor of attitudes and behaviors, contributing to advancing intervention strategies to promote and sustain the public's precautionary behaviors in the context of the COVID-19 pandemic. In addition, it is crucial to stress that the use of the simplest modern technologies such as mobile applications is one of the assistive means in disseminating correct health information from health team members to all age groups especially risk groups as pregnant women. Because it provides a single answer to most questions, able to present concise information from credible sources, which may be less overwhelming than social media. Also, it can be available any time of the day to answer questions with up-to-date information from trusted and experts' persons. The findings of current study support the research hypotheses that pregnant women who received instructional organized sessions via Mobile-based application showed a positive effect on level of knowledge, practice and attitude as compared to before intervention.

Recommendations

According to the study results, the following recommendations were proposed: a) Continuous follow-up support is required to sustain new knowledge and practices. This mechanism will help participants walk through the unlearning, relearning, and freezing processes. b) Antenatal heath care especially nurses should have a plan to communicate online with pregnant women to manage such these crisis situations. c) To facilitate outbreak management of COVID-19 in Egypt, there is an urgent need to increase the public's awareness of COVID-19 at this critical moment through social media by professional health team members with scientific knowledge. d) Telehealth technologies can be a cost-effective means to slow the spread of the virus and to lessen the pressure on hospital capacity by operating as a possible filter, keeping those with moderate symptoms at home while routing more severe cases to hospitals.

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