

Utilizing Smartphone Apps in Improving Pregnant Women's Knowledge and Practices towards Pandemic COVID-19 Precautionary Measures

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Abstract

The current study aimed to evaluate the effect of utilizing smartphone apps in improving pregnant women's knowledge and practices towards pandemic COVID-19 precautionary measures. **Materials and method:** A quasi-experimental pre-posttest design was used. The study was conducted at antenatal clinics in Mansoura University Hospital, Egypt. Purposive sample technique was applied and included fifty-seven high-risk pregnant women. Data was collected through a structured interview questionnaire, an online electronic survey on the Google platform to assess the level of knowledge and practices regarding covid-19 precautionary measures, and the Satisfaction Likert scale. **Results:** There was a statistically significant improvement among the pregnant women regarding covid-19 knowledge in favor of post-intervention ($P < 0.001$) as the percentage of good levels increased from 19.3 before intervention to 77.2% after the intervention. Likewise, there was a significantly ($P < 0.001$) higher average practical score after the intervention, and a good practice level significantly ($P < 0.001$) improved from 12.3% before intervention to 89.5% after the intervention. It was evident that there was a significant, mild, positive correlation between the knowledge score of the studied women after intervention and their scores of reported practical preventive measures ($r = +0.274$, $P = 0.039$). Moreover, the satisfaction level of studied women regarding the method and content was high ranging from 91.2% to 96.5% and 84.2% to 94.7% respectively. **Conclusion:** It was evident that utilizing smartphone apps was effective and had significantly improved knowledge level and practices average score among pregnant women toward COVID-19 protective measures. **Recommendations:** Utilizing modern technologies such as smartphone apps should be launched to solve the challenges posed by the COVID-19 crisis and bring innovative solutions to the problems associated with this major disruption, as well as an attempt to stem contagion and effectively increase awareness, especially during the COVID -19 outbreak and Quarantine.

Keywords: COVID-19, Knowledge, practices, precautionary measures, pregnant women.

Introduction:

Coronavirus disease (COVID-19) is considered an infectious disease due to the newly recognized severe acute respiratory syndrome coronavirus (SARS-CoV-2) that was first detected in December 2019 in Wuhan city, China (Zhou et al., 2020). World health organization (WHO) reported that coronavirus has become pandemic, the outbreak of coronavirus disease 2019 affected more than 100,000 persons and produce over three thousand deaths around the world (Zhang et al., 2020). COVID-19 infection has raised concerns for pregnant women because of pregnancy-related physiological changes that make her increase their susceptibility to the virus and respiratory infections (Lee et al., 2020; Madjunkov et al., 2020). The recent literature reported that pregnant women

especially those who are old age and complain of obesity and any associated medical diseases such as gestational diabetes and hypertension are at more risk than others to be infected with covid-19, at this situation the pregnant women will required to intensive care more than non-pregnant women. Therefore, they need to commit to protective precautions to keep themselves healthy against COVID-19 and be aware of the possible symptoms of their healthcare provider (WHO, 2020).

The findings of recent scientific publications showed that pregnant women infected with COVID-19 were more expected to give preterm labor. The findings also show that one in four of all newborn babies delivered from COVID-19 infected women, were transferred to a neonatal unit, the evidence shows that having pre-existing chronic health

diseases such as diabetes or high blood pressure, situates the pregnant woman at greater risk (WHO, 2020). Similarly, a recent study by the Center for Disease Control and Prevention (CDC) found that pregnant women with COVID-19 infection are more likely to be hospitalized, admitted to the intensive care unit, and connected to mechanical ventilation with the same mortality risk relative to non-pregnant women (Singapore General Hospital, 2020; Dang et al., 2020).

Evaluating the human readiness and acceptance to change the behavioral measures recommended by the health authorities play a vital role and it can be achieved by assessing knowledge, attitudes, and practices toward COVID-19. Several types of research have been carried out to identify the clinical consequences and virologic features of COVID-19; however, few studies interested in evaluating the knowledge, perceived severity, and precautionary measures of COVID-19 among women with special conditions such as pregnancy and living this pandemic (Huang et al., 2020; Chan et al., 2020).

To monitor and prevent the transmission of the disease and its associated mortality development, specific preventive measures have been suggested by (WHO), such as maintaining social distance, frequent hand washing, using a face mask/shield, covering hands and mouth when coughing, avoiding touching eyes, mouth, and nose. Following preventive health measures, which include continuous use of personal protective practices such as the use of face masks, wearing of gloves, frequent hand washing, restriction of movement to the known affected areas, maintaining social and physical distance, avoiding touching the nose, mouth, and eyes, were known to be the only proven preventive measures to halt the spread of the pandemic. The effectiveness of the precautionary measures will mainly depend on the behavioral response of the society and the acceptance level of the recommended measures (WHO, 2020).

Nevertheless, the level of awareness and practice of these precautionary measures among pregnant women, who are a vulnerable group, needs to be evaluated and improved (WHO, 2020; Nwafor et al., 2020).

Smartphone apps and media are the most suitable method for disseminating information and accessing the necessary knowledge worldwide (Lee et al., 2020). With the development of the use of online social websites (e.g., Facebook, WhatsApp), online surveys are now trending for health surveys. Google forms as a free online survey platform, can be utilized by health professionals for conducting surveys, especially during a pandemic (Mondal et al., 2018). In Egypt smart apps are readily accessible through the internet with the majority owning mobile devices. Thus, increasing the awareness regarding COVID-19 through using smartphone apps is easily achieved in a developed country like Egypt by using information technology for disseminating the necessary information. Therefore, the current study was conducted.

Significance of the study

COVID-19 pandemic is correlated with high morbidity and mortality among populations worldwide. In Egypt, it was estimated that 23 095 women of reproductive age had confirmed COVID-19 between February and July 2020. Of those, 408 (1.8%) were pregnant (Bahaa Eldin et al., 2021). Each person is at risk to be infected; however, an immune-compromised state due to pregnancy and the physiological changes that occur may predispose a pregnant woman to increased risk of infection by Covid-19 (Zhao et al., 2020). In addition, fear and anxiety from the risk of being infected can increase the risks of abortion and cesarean section deliveries (Chan et al., 2020). It is therefore imperative that significant efforts be made to protect pregnant women and their fetuses from the scourge of COVID-19. This can only be done if the pregnant woman becomes knowledgeable about how to protect herself and her family and others from the virus and its spread. So, the present study was conducted to improve the knowledge and practices of pregnant women towards COVID-19 precautionary measures by using smartphone apps.

The study Aim:

It aimed to evaluate the effect of utilizing smartphone apps in improving pregnant

women's knowledge and practices towards pandemic COVID-19 precautionary measures.

Study hypothesis:

Utilizing smartphone apps was expected to be an effective method in improving pregnant women's knowledge and practices towards COVID-19 precautionary measures evidenced by:

H₁: Significant improvement in the level of women's knowledge in comparison to pre-intervention.

H₂: Significant difference between the pre & post-test as regards women's practices score.

Operational definitions:

Smartphone apps: It is a software application primarily designed for use on lightweight, wireless devices, such as smartphones and tablets. They still managed to provide consumers with quality services and experiences, even though the apps are typically small software units.

Precautionary measures: Preventative, anticipatory actions that should be taken to be safe and to prevent dangerous consequences that could be happened.

Subjects and Method

Study design:

A quasi-experimental pre-post research design.

Study setting

This study was conducted in Antenatal Clinic at Mansoura University Hospitals, Mansoura city, Egypt.

Sample type:

A purposive sample was used.

Study sample:

The study sample included (57) high-risk pregnant women who were attending antenatal care clinics from April 2020 to September 2020 and were selected according to the following criteria.

Inclusion criteria:

- All women who gave informed consent to participate in the study.

- Pregnant women with high-risk conditions such as (overweight, chronic disease, gestational diabetes /hypertension, placenta previa).

- Having Smartphone with internet access and able to handle smartphone apps.

- Using What's app media.

Exclusion criteria:

- Pregnant women have verbal communication problems.

- Women who have signs or symptoms of COVID-19 or suspected

- Women who were diagnosed with preterm labor.

- Women with any obstetric warning signs that required them to admit to the hospital.

- Women with psychiatric disorders.

Sample size

According to data from the pilot study, given the significant level of 5% and the study power of 80%, the sample size can be calculated. **Using the following formula:**

$$n = [(Z\alpha/2 + Z\beta)^2 \times \{2(SD)^2\}] / (\text{mean difference between the two groups})^2$$

where SD = standard deviation. $Z\alpha/2$: This depends on the level of significance, for 5% this is 1.96. $Z\beta$: This depends on power, for 80% this is 0.84.

Therefore, $n = [(1.96 + 0.84)^2 \times \{2(2.1)^2\}] / (3.9 - 2.8)^2 = 57.1$. Based on the above formula, the sample size required per group is 57.

Tools of Data Collections

The tool I: Structured interview questionnaire:

It was developed by the researchers after reviewing the related literature (Nwafor et al., 2020) to be filled from each pregnant woman who visited the Antenatal care clinic. The questionnaire was in the form of multiple choices (MCQ), closed-ended questions. **It consisted of two parts:**

Part 1: General Characteristics. It was used for assessment of the general characteristics of pregnant women (age, level of education, occupation, residence, etc.) & What's app No).

Part 2: Obstetrical & Medical History. It included closed-ended questions to assess the obstetrical and medical history such as (number of gravidities, parity, abortion, gestational age, mode of previous delivery & chronic disease, and presence of any pregnancy complications).

Tool II: An Online Electronic Survey Google Platform (Google Form): adopted according to Mondal et al., (2018):

Google form method for designing and submitting an online questionnaire by using an online electronic survey on Google platform using quick response. The questionnaire consisted of MCQs divided into 2 sections to assess knowledge and practices toward COVID-19 precautionary measures. This questionnaire was adopted from WHO, (2020) and translated into the Arabic language.

Section 1: Knowledge of pregnant women about COVID-19 and its precautionary measures:

The questionnaire was developed following reviewing specifically related literature on WHO recommendations regarding measures to prevent human-to-human transmission of COVID-19 infection (WHO, 2020 & Nwafor et al., 2020). It included 8 items as (etiology, incubation period, signs and symptoms, high-risk population, consequences, mode of transmission, diagnostic measures and treatment as well as COVID-19 precautionary practices). The scoring system was applied as each question scored "0" if the answer is not correct and "1" if it is correct. When the answer includes multiple choices, when the correct choices are below half (for example 2 from 6) it is scored "0" and when the correct choices are more than half (for example 4 from 6) it is scored "1". So, the maximum total knowledge score is 8. The total score is categorized into poor (<50% of the total score), fair (50-<75.0% of the total score), and good ($\geq 75.0\%$ of the total score).

Section 2: Precautionary practices against COVID-19 checklist:

It was developed by researchers after reviewing the national and international literature and based on the WHO recommendations (WHO, 2020) to assess practices of preventive measures against

COVID-19 infection done by pregnant women such as (hand washing with water and soap or sanitizer for at least 20 seconds, avoiding shaking hands, wearing a protective mask, maintaining social distance, not touching eyes, nose or mouth, covering your nose and mouth with the bent elbow or tissue when cough or sneeze, keeping at least one meter away from others when shopping, staying home if you feel sick. The scoring system was applied to each recorded item of the practice using a 3-point Likert scale (not done = 0, sometimes = 1, always =2). The total maximum practice score is 44 (2 points for 22 practices). The practice is categorized as poor practices (<75.0% of the total possible score) and good practices ($\geq 75.0\%$ of the total possible score).

Tool III: Satisfaction Likert scale:

It was developed online by the researchers to assess women's satisfaction regarding electronic apps used and the content provided that was introduced through it. Each item of the satisfaction tool is recorded on a Likert scale (dissatisfied = 1, Neutral =2, and satisfied=3). The total score is the algebraic sum of the individual items. The satisfaction level is categorized as unsatisfied (<50% of the total possible score) and satisfied ($\geq 50\%$ of the total possible score).

Validity & Reliability of Research Tools

Content validity of the study tools was revised by three experts in the woman's health and midwifery nursing field to test its validity; according to the pretest, understandability, clarity, and organization of the questionnaire were checked Pre-testing of the tools revealed that the tool was clear, feasible and there was no ambiguity in the language. Modifications were done accordingly based on their comments and remarks. The reliability of the questionnaire was checked by conducting a pretest among pregnant women in the antenatal clinic by using Cronbach alpha. Cronbach's alpha value was 0.903 for the knowledge, 0.821 for the practice, and 0.857 for the satisfaction scale.

Pilot Study

Lucidity, precision, and applicability of the study tools were tested on six pregnant women included in the pilot study. It was done to estimate the period required to fill the questionnaire. The required modifications were

done. Women involved in the pilot study were excluded from the study.

Ethical Considerations

The approval of the Women's Health and Midwifery Department at Mansoura University was obtained. The research was approved by the research ethics committee at the faculty of nursing, Mansoura University. In addition, obtaining informed consent from each woman before the intervention. They are informed of the right to withdraw at any time. The search process does not harm women. After statistical analysis, the tools of collecting data were deleted to ensure the confidentiality of the research, as well as the data collection tools, did not deal with ethical and religious, or cultural issues and maternal dignity.

Method

The study was accomplished from April 2020 to September 2020. To fulfill the aim of the study, the researchers followed the following phases:

Assessment phase:

➤ An official written approval was obtained from the director of the woman's health and midwifery nursing department and the director of the Obstetrics and Gynecology department at Mansoura university hospital after reviewing the relevant published literature and designing the tools for data collection. Then the pilot study was conducted on six pregnant women.

Planning Implementation phase:

➤ The researchers collected the data throughout two stages (face-to-face interview & an online google form method).

Face-to-Face Interview Stage:

➤ The researchers visited the antenatal clinic and introduced themselves, greeted each woman, and explained the aim of the study for obtaining approval. Subsequently, the researchers interviewed each pregnant woman attending antenatal clinics for 20 minutes and collect the baseline data including (general characteristics / medical and obstetrics history), and informed them about the online survey and the planned intervention.

An Online Stage:

➤ The Online stage has been chosen as a consequence of the partial lockdown during the pandemic.

- Based on the basic data that has been collected, the What's-app group was established and included the pregnant women's what's app numbers.
- Pregnant women included in the study were provided with an internet link to complete an online electronic survey on the Google platform through quick response (QR) code on the mobile device with internet access to submit the pre-test that was designed to investigate women's knowledge and practices toward COVID-19 and its precautionary measures. The researchers browsed the website <https://docs.google.com/forms> on the internet browser. After logging in on the website, **by using the following:**
 - Set up a new google form and insert the questionnaire including (Knowledge, and practice questions).
 - According to the type of question, response options were added.
 - After completing the questionnaire, the researchers sent the link and shared it via WhatsApp group to all pregnant women included in the study. It was available at: <https://forms.gle/ggAAA63LaB8XKfir9> the pre-test was coded and could be finished within 15 min.
- Four online sessions via Zoom were conducted and the link was disseminated 1 day before the session throughout the WhatsApp group which has been originally established to include all the study participants. Each session lasts for two hours and includes a PowerPoint presentation and e-learning videos and animation. They included:
 - 1st session was concerned with the basic knowledge about COVID -19 including etiology, incubation period, signs and symptoms, high-risk population, consequences, mode of transmission, diagnostic measures and treatment as well as COVID-19 precautionary practices.
 - Both 2nd and 3rd sessions concerned with the precaution practices against COVID -19 among the study participants for example (hand washing with water and soap or sanitizer for at least 20 seconds, avoiding shaking hands, wearing a protective mask, maintaining social distance, not touching eyes,

nose or mouth, covering your nose and mouth with bent elbow or tissue when cough or sneeze, keeping at least one meter away from others when shopping, staying home if you feel sick. If you have a fever, cough, and difficulty breathing, immediately seek medical attention, etc....).

- 4th session focuses on the revision of what has been provided previously through interviews and open discussion with the study participants.
- The intervention sessions consumed four weeks.

Evaluation phase:

- Two weeks later post-intervention, the researchers evaluated the pregnant women's knowledge and practices regarding COVID-19 as well as evaluated their satisfaction regarding the online method and contents by using the same pre-designed tools to compare the difference between pre-and post-test results and evaluate the effect of the study.

Statistical analysis

All statistical analyses were conducted using SPSS for windows version 20.0 (SPSS, Chicago, IL). Before any calculations, data were tested for normality of distribution. All variables with continuous data displayed normal distribution and were expressed in mean \pm standard deviation (SD). Categorical data were expressed in numbers and percentages. The comparisons were determined using paired T-test for variables with continuous data. The Chi-square test was used for the comparison of variables with categorical data. Pearson's correlation between knowledge and practice score was tested. The reliability (internal consistency) of the knowledge, practice, satisfaction with social media, and satisfaction with content tools were calculated. Statistical significance was set at $p < 0.05$.

Results:

Table (1) shows the general characteristics of the studied women. Among 57 studied pregnant women, aged 20-37 years, with an average age of 27.54 ± 3.49 years, more than half of them

(54.4%) were university educated, and about two-thirds (64.9%) were from rural areas. 91.2% of them reported that they have previous knowledge about covid-19 from the following sources including the internet (43.9%), TV (28.0%), Friends/relatives (15.8%), and radio (12.3%).

Table (2) shows that 52.6% of studied women were gravida ≥ 4 times, multiparity was reported among 57.9%, no abortions among 54.4%, one-third of last deliveries were vaginal and two-thirds were CS. Only 9.1% of the delivered newborn with low birth weight. Gestational age of the current pregnancy ranged from 4-39 weeks; 42.1% below 28 weeks, 38.6% within 28-34 weeks, and 19.3 within 35-39 weeks. The following current pregnancy complications: gestational D.M. (49.1%), placenta previa (24.6%), pregnancy-induced hypertension (14.0%) and heart diseases (10.5%) (Table 2).

Table (3) shows that the level of knowledge was significantly ($P < 0.001$) improved after the intervention. The percentage of good levels increased from 19.3 before intervention to 77.2% after the intervention. Also, there was a significantly ($P < 0.001$) higher average practical score after the intervention, and a good practice level significantly ($P < 0.001$) improved from 12.3% before intervention to 89.5% after the intervention.

Figure (1) shows that the level of knowledge among the studied women regarding covid-19 was significantly ($P < 0.001$) improved after the intervention. The percentage of good levels increased from 19.3 (before intervention) to 77.2% (after intervention).

Figure (2) showed a significant, mild, positive correlation between the knowledge score of the studied women after intervention and their scores of reported practical preventive measures ($r = +0.274$, $P = 0.039$).

Table (4) showed that the satisfaction level reported by the studied women about the smartphone app method used in the education about COVID-19 was high; ranging from 91.2% to 96.5%. Also, the satisfaction level reported by the studied women about content this education about COVID-19 was high; ranging from 84.2% to 94.7%.

Table (1): General characteristics of the studied women

General characteristics	No (57)	%
Age (years)		
- 20-	8	14.0
- 25-	35	61.4
- 30-37	14	24.6
	Range: 20 – 37 years, Mean \pm SD = 27.54 \pm 3.49 years	
Education		
- Diploma	14	24.6
- Technical	8	14.0
- University	31	54.4
- Master	4	7.0
Residence		
- Urban	20	35.1
- Rural	37	64.9
Occupation		
- Employed	52	91.2
- Not employed	5	8.8
Previous Information		
- Yes	57	100.0
- No	0	0.0
Sources of information		
- Internet	25	43.9
- TV	16	28.0
- Friends/relatives	9	15.8
- Radio	7	12.3

Table (2): Obstetric history and current pregnancy status of studied women

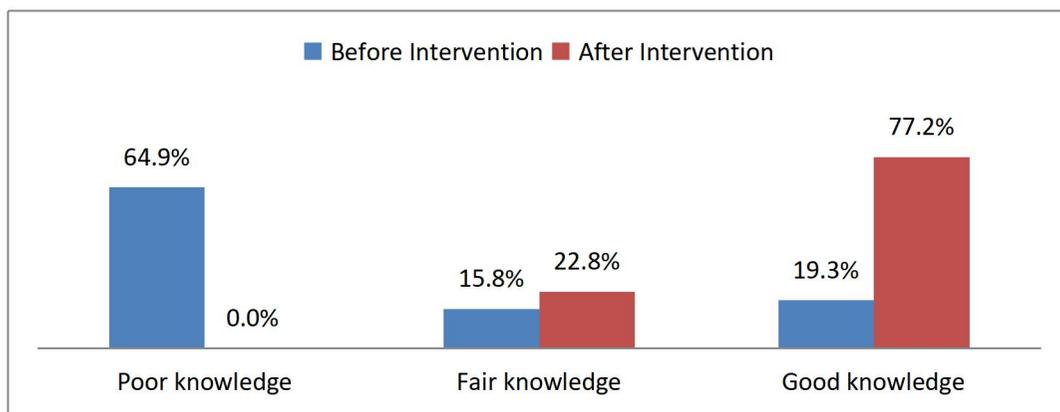
Obstetric history and current pregnancy status	No (57)	%
No of gravidity		
- 1-3	27	47.4
- ≥ 4	30	52.6
Parity		
- Nulliparous	24	42.1
- Multiparous	33	57.9
Abortions		
- Non	31	54.4
- Once	19	33.3
- Twice	7	12.3
Mode of previous deliveries (N= 33)		
- Vaginal	11	33.3
- CS	22	66.7
No. of living children		
- Non	24	42.1
- 1-2	32	56.1
- 3	1	1.8
No. of low birth weight (N= 33)		
- Non	30	9.1
- Once	3	90.9
No. of stillbirth (N= 33)		
- Non	33	100.0
Gestational age of current pregnancy		
- < 28 weeks	24	42.1
- 28 – 34 weeks	22	38.6
- 35 – 39 weeks	11	19.3
Range, Mean \pm SD	4 – 39, 28.91 \pm 6.52	
Current pregnancy complications:		
- Gestational DM	28	49.1
- Placenta previa	14	24.6
- Pregnancy-induced hypertension	8	14.0
- Heart disease	6	10.5

Table (3): Average knowledge and practice scores of the studied women about COVID-19 before and after intervention

Knowledge Score	Before intervention		After intervention		Significance test
Mean ±SD	3.45 ± 1.16		6.59 ± 1.46		t*=18.932, P<0.001
Knowledge Level	No	%	No	%	χ ² – 57.53, P<0.001
Poor (<50.0%)	37	64.9	0	0.0	
Fair (50-<75.0%)	9	15.8	13	28.8	
Good (≥ 75.0%)	11	19.3	44	77.2	
Practice Score	Before intervention		After intervention		Significance test
Mean ±SD	14.28 ± 7.34		41.88 ± 3.87		t*=28.132, P<0.001
Practice Level	No	%	No	%	χ ² – 67.95, P<0.001
Poor practice (<75.0%)	50	87.7	6	10.5	
Good practice (≥75.0%)	7	12.3	51	89.5	

* Paired T-Test.

Figure (1): Knowledge level of the studied women about COVID-19 before and after intervention



(χ² = 57.53, P <0.001)

Figure (2): Correlation between total knowledge and total practice score after intervention

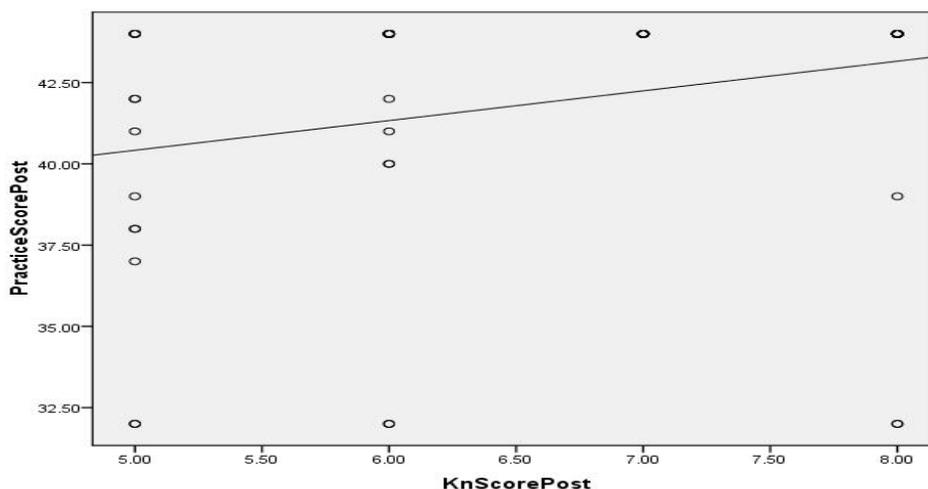


Table (4): Satisfaction of the studied women with the intervention

Satisfaction with smart apps methods	Dissatisfied		Neutral		Satisfied	
	No	%	No	%	No	%
-Easy method for communication	1	1.8	3	5.3	53	93.0
-Fast reach for your need of information	1	1.8	4	7.0	52	91.2
-Available at any time	1	1.8	3	5.3	53	93.0
-Attractive method of getting knowledge and learning practices	1	1.8	1	1.8	55	96.5
-Safe time, effort, and money	0	0.0	4	7.0	53	93.0
-Positive effect on your knowledge	2	3.5	2	3.5	53	93.0
-Positive effect on your practice	0	0.0	4	7.0	53	93.0
Satisfaction about content						
-The content was interesting	2	3.5	5	8.8	50	87.7
-The content is presented in a logical sequence	2	3.5	7	12.3	48	84.2
-The scientific content enhances knowledge and practice experience	3	5.3	6	10.5	48	84.2
-The scientific material included in the social media had been clear and easy to understand	2	3.5	1	1.8	54	94.7

Discussion:

This study highlights the COVID -19 pandemic and its risk on pregnant women and provides insight into pregnant women's knowledge and practices regarding COVID-19 precaution measures. Moreover, the main objective of the study is to utilize smartphone apps in improving pregnant women's knowledge and practices towards COVID-19 precautionary measures. This aim was achieved through the references of the current study hypotheses as the current research has shown that there was a statistically significant difference between pre-and post-intervention results, as the average score of knowledge and practices of precaution measures against covid-19 among the pregnant women had improved in favor of post-intervention. So that the findings of the present study supported the research hypothesis.

Regarding the source of information about the coronavirus, this study revealed that about half of the women attained their information from the internet followed by television. This finding is consistent with **Bekele et al., (2020)** who assessed knowledge and practice of coronavirus among residents in Ethiopia and reported that most of the cases were heard about coronavirus infection from the internet and social media which they considered the main source of the information followed by the television. Moreover, **Nwafor et al., (2020)**, reported that more than half of

the pregnant women attained their knowledge regarding the preventive mechanisms of COVID through the internet. Also, this finding is in line with the multinational study conducted in India by **Kamate et al., (2020)**, who reported that the main source of information is the internet. Furthermore, this finding is lower than the finding conducted by **Saqlain et al., (2020)** in Pakistan as the knowledge of COVID 19 prevention represented 92.3% on the internet. Furthermore, our result contradicts a study conducted in Nigeria in which the key source of information was television and mass media **Olapegba et al., (2020)**. This disparity can be explained by the difference in the population studied and the availability and accessibility of mobile apps in this country.

As regards the pregnant women's knowledge regarding COVID-19 and its protective measures, this study concluded that there was statistically significant improvement concerning the knowledge level of the studied women after interventions, which clarifies the positive effect of smartphone apps as a method of conveying and disseminating education during the quarantine period. These findings were in agreement with **Wu et al., (2020)** who conduct an online education regarding covid-19, and reported that women's knowledge was improved via online education and antenatal care. In addition, **Zhao et al., (2020)** reported that online health information about covid-19 has a positive impact on the knowledge of the

participants. Similarly, **Huang et al., (2020)** found that social media play an important role in improving the knowledge of the study participants and getting early attention to the covid-19 pandemic. In a like manner, **Fridman et al., 2020** found that trusted sources of information regarding covid-19 positively affect the level of knowledge among study participants. These findings are inverse to **Olapegba et al., (2020)** who reported that social media and the internet did not improve Nigerian women's information regarding the covid-19 pandemic. This contrast may be due to a lack of internet services as most of the study participants are from rural areas and do not have the appropriate skills to use this app, so they couldn't have the same chance of counseling and information.

Regarding the level of practices of the precautionary measures against COVID-19 among the studied sample. It evidenced that there was a significantly higher average practical score after intervention and a good practice level significantly improved. These findings are in adherence with **Ning et al., (2020)** who reported that protective practices of the study participants were improved after following the guideline of protective behaviors which included avoiding crowding, wearing face masks, keeping fresh indoor airflow, maintaining good health, following recommended guidelines, encouraging others for behavioral compliance, frequent good hand hygiene, and avoiding close contact with high-risk people. Furthermore, these findings are in line with **Ali et al., (2020)** who reported that effective information source has an improvement in the practice of precautionary measures among study participants. This can be explained by selecting a suitable method of education and information through mobile apps that are the available way of transmission of required knowledge during the indoor period of staying hence women cannot be able to seek required knowledge through direct contact with health care providers.

Concerning satisfaction with the method and the provided information, the study revealed that most women were satisfied with the method used (Video hosting sites) and the provided information. These findings are in agreement with **Hager et al., (2019)** who

reported that most of the respondents had a higher score of satisfaction towards protective measures and identify the importance of proper hygiene, self-isolation, the wearing of a face mask while going out and the optimal distance between two individuals to avoid the spread of the virus. Furthermore, **Yassa et al., (2020)**, reported that most of the study participants were satisfied with the social media in providing necessary information related to the covid-19 pandemic and resolving the impact of regional differences.

Concerning the correlation between the women's knowledge and total practice score after the intervention. This study reported a significant, mild, positive correlation between the knowledge score of the studied women after intervention and their scores of reported practical preventive measures. This finding power the effectiveness of the intervention as it may be evidence that when the level of knowledge was improved, their level of practice becomes good. This is in the same line with **Fridman et al., (2020)** who concluded that an improvement in the practice of study participants regarding precautionary measures after receiving essential information about covid-19 precaution measures. Similarly, **Coroiu et al., (2020)** found that adherence to social distance as one of the important protective measures of covid-19 is highly improved among study participants after following the appropriate recommendation.

Moreover, **Meier et al., (2020)** surveyed three European countries and showed that the protective measures were more effective as the studied population reported feeling sufficiently informed. The protective measures effectiveness was increased among respondents and the most extensive measures followed are social lockdown, frequent hand washing, using personal protective devices, considering a balanced diet, and avoiding people with cold or flu symptoms. Furthermore, **Wang et al., (2020)** reported that using smartphone apps is very effective to improve women's knowledge regarding protective measures during pregnancy. This is in contrast with **Bekele et al., (2020)** who found that despite the knowledge scores of Ethiopia's populations regarding coronavirus prevention was high, the practice of preventative measures was poor.

This may be due to several factors, as the availability of personal protective equipment was insufficient in Ethiopia, the population's economic status was substandard, and their lives relied on everyday activity.

Conclusion:

Finally, it was evident that utilizing smartphone apps was effective and had significantly improved knowledge and practice scores among pregnant women regarding covid-19 precautionary measures and it is considered an effective method to transmit appropriate information during this intense crisis all over the world.

Recommendations:

- Utilizing modern apps in disseminating information in all aspects of maternity care is very essential to enhance better outcomes and decrease maternal morbidity and mortality during the current pandemic.
- Conducting counseling programs to psychologically support pregnant women to cope with the covid-19 pandemic.
- Study the outcome of covid-19 on infected pregnant women.
- Seeking strategies to cope with covid-19 pandemic isolation among pregnant women.

Limitation of the study

A limited number of related published studies address the research topic. Consequently, there are limited references that focus on providing necessary intervention and counseling to pregnant women regarding the covid-19 pandemic using smartphone apps. The second major limitation of the current research was that the intervention was conducted by an online google form of the survey through the smart apps and only women who have the access to social media and internet access could participate in the study, hence the study cannot represent the overall population of the country.

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regardless of all limitations that occurred as a result of covid-19 pandemic conditions.

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Conflict of interest

The authors declared no conflict of interest.

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