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The Effect of Smartphone-based Self-care Education on Awareness, Perceived Severity and Self-care Behaviors in Pregnant Women at Risk of Preterm Birth during COVID-19 Pandemic: A Quasi-Experimental Study

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ABSTRACT

Background & aim: The fear of being affected by COVID-19 has significantly reduced perinatal care. The current study aimed to evaluate the impact of smartphone-based self-care education on awareness, perceived severity, and self-care of pregnant women at risk of preterm birth during a covid-19 pandemic. Methods: This quasi-experimental study was conducted on 115 pregnant women at risk of preterm birth that was assigned into intervention (N=58) and control (N=57) groups. The research tools included the demographic and preterm delivery screening checklist, awareness, perceived severity, and self-care questionnaires. The intervention group received training files using WhatsApp software within two weeks. The control group received no intervention. The questionnaires were completed before (T1), 8 (T2) and 12 (T3) weeks after the implementation of the intervention in two groups. ANOVA, ANCOVA, independent t-test, chi-square, and Fisher's exact test were used to analyze the data using SPSS software (version 24)

Results: No significant difference was found between baseline data (T1) before the intervention in two groups ($p>0.05$); while after the intervention, a significant increase was observed in the mean score of awareness at T2 and T3 compared to T1 ($P<0.001$) as well as self-care at T2 and T3 compared to T1 ($P<0.001$). Also, a significant decrease was observed in the mean score of perceived severity ($P<0.001$) in the intervention and control group over time.

Conclusion: It appears that distance learning to provide care for pregnant women and informing healthcare providers about their condition can be useful, especially for those who are at risk during pandemics.

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Introduction

Preterm birth (<37 weeks' gestation) is one of the significant public health concerns and the leading cause of morbidity and mortality after congenital anomalies in the neonatal period (1). The global prevalence of this obstetric complication was reported as much as 6 and 10% in developed countries, 15% in low-income countries (2), and 12.9% in Iran (3). Various factors are effective in its occurrence, the experience of natural crises is one of the proven cases (4).

The increased complications of pregnant women during the H1N1 influenza pandemic in 2009 (5) and severe fetal complications following the Zika virus in recent studies (6) revealed the severity of the vulnerability of pregnant women and fetuses to emerging infections (7-8). COVID-19, which currently challenged the world, is no exception to this rule. Although the complications and mortality of this virus have decreased with global vaccination, pregnant mothers refused to inject

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the vaccine due to the fear of harming the fetus (9). Therefore, self-care behaviors by pregnant women are essential to reduce infection and its complications (10). Self-care behaviors during pregnancy are defined as behaviors consciously performed by a pregnant woman to maintain the health of mother and fetus during pregnancy, delivery, and postpartum (11). The fields of self-care include health promotion, lifestyle modification, and disease prevention and symptom evaluation and disease treatment, which is done consciously by the individual, but its knowledge and skills must be taught (12). Nonetheless, factors such as awareness and perceived severity of the disease affect self-care behaviors in pandemic diseases (13).

The perceived severity of a disease depends on people's perception of the disease's seriousness. The factors such as level of awareness regarding mortality, disability, complications caused by a disease, and even social results are effective (14). Pregnant women also have a different perception from the disease and the recommendations of health care providers. Some pregnant women evaluate the instructions based on their views and experiences and change them based on their feeling of usefulness (15). Therefore, perceived severity of the risk is considered an essential determinant in adopting healthy behaviors and an effective factor in designing interventions related to behavior change (16). The conditions occurred during the coronavirus pandemic have affected people's lives. Adopting preventive and protective measures such as social distancing, quarantine and fear of contracting the disease have reduced people's visits to receive health care (17, 18). In addition, pregnant women are advised to avoid crowded and public places; it became a global problem to receive prenatal care (10), because reports indicated the absence or reduction of mothers' refer to health centers due to the fear and perceived risk of COVID-19 (19). Such conditions lead prenatal care providers to use distance learning to provide safe and healthy care for mothers (20).

The World Health Organization (WHO) in its latest guidelines supported digital technology as a solution to provide care (21). Smartphones are one of the most common technology devices, and studies have shown the effectiveness of smartphones in the self-care of mothers to improve the health of the mother and fetus (22-24), especially in pregnant women with little access to care (25). Sistan and Baluchistan is a vast and low-income province in the southeast of Iran, the center of which is Zahedan. This province has the highest total fertility (more than 3.5 births per woman) (26-27) and mortality (48.6 cases per 100,000 live Births) rates (28) in the country and the mean self-care in the normal conditions is only 44% (29). The face-to-face perinatal visits in this province decreased by 81.64% due to the fear of infection (19). Adverse pregnancy outcomes such as premature birth have increased during the Coronavirus (7-8, 30) and according to the research conducted in Iran, 25% of women had a premature birth during COVID-19pandemic (31). It seems that in critical situations, using technology instead of direct education can be effective, especially in mothers who are not only at risk of preterm labor but according to what was said, referring to the health center and self-care behaviors are low. The literature search did not find a study on the effect of distance education using smartphones on self-care behaviors considering the level of awareness and perceived severity, especially in pregnant women at risk of preterm birth. Therefore, the present study aimed to evaluate the impact of using smartphone-based self-care education on awareness, perceived severity, and self-care behaviors of pregnant women at risk of preterm birth during the COVID-19pandemic in Zahedan, Iran.

Materials and Methods

This quasi-experimental study was conducted on 115 pregnant women at risk of preterm birth referring to the comprehensive health centers from March 2021 to February 2022 in Zahedan, Iran. The inclusion criteria were obtaining a score of ≥10 from Holbrook's preterm delivery screening questionnaire, no infection of the person or first-degree family members by COVID-19 (self-report), minimum reading and writing literacy to understand and answer the questions, gestational age of 20 to 24 weeks (based on first-trimester ultrasound or last menstrual period (LMP)), having a mobile phone or smart tablet, the ability to access the internet and using WhatsApp messenger to

download files, no history of physical, psychological, and debilitating problems requiring treatment, no obstetrics problems in the current pregnancy (either maternal or fetal), and lack of participating in similar studies. The exclusion criteria were withdraw from the study, not reading the sent messages, no completion of more than 10% of the questions, and occurrence of any pregnancy-related complications during the study.

The sample size was calculated as 55 subjects in each groups using the formula of self-care behavior score based on Ming Guo (32) with a confidence level of 95% and statistical power of 90%. Considering the possibility of 10% dropout, the final sample size of 60 subjects was determined in each group and a total of 120 subjects were considered in this study.

$$N = \frac{\left(z_{1-\alpha/2}+z_{1-\beta}\right)^2\left(s_1^2+s_2^2\right)}{\left(\bar{x}_1-\bar{x}_2\right)^2}$$

S_1=26.8 S_2= 23.9

$\bar{x}_1 = 86.7$ $\bar{x}_2 = 71$

The multi-stage sampling was performed. Zahedan has 32 comprehensive health centers. First, using the Randomizer software of these centers, 8 health centers were selected by simple random sampling. Then, four health centers were randomly selected as intervention centers and four health centers as control centers. Then, the list of eligible pregnant women was extracted from the household information system used in health centers in Iran (https://sib.iums.ac.ir/). Mothers were selected by convenience sampling. The pregnant women were called and invited to participate in the study and fill out the preterm birth screening questionnaire. In the case of not participating, other eligible participants were asked to join the study to complete the final sample size (Figure 1).

Demographic and obstetrics characteristics questionnaire: This questionnaire consisted of demographic and obstetrics variables including age, education, number of pregnancies, gestational age, history of infertility, and number of prenatal cares.

Holbrook's preterm delivery screening checklist: This checklist is a scoring system designed based on the items predicting premature birth in obstetric guidelines and reviewing the literature (33) that was modified by Holbrook in 1989 (34). The checklist includes main risk factors with 13 questions, secondary risk factors with 14 questions, and underlying risk factors with 12 questions. The options are in yes-no form, and a score of 10 or more shows the high-risk group for premature birth. In Iran, the reliability of the checklist was confirmed with Cronbach's alpha of 0.95 (35). In the current study, the reliability of the checklist was re-evaluated, which was confirmed with alpha as much as 89%. It was used as one of the criteria for entering the study to predict pregnant women at risk of preterm labor.

Awareness and perceived severity questionnaires: These two questionnaires were researcher-made ,and designed based on the studies related to COVID-19 (36-37). The awareness questionnaire included 13 questions about the mother's information regarding COVID-19and its symptoms, its effect on pregnancy and fetus, ways of transmission, how to prevent and treat it during pregnancy, etc., for example a person infected with COVID-19can transmit the virus to a pregnant mother even if it is asymptomatic. In this questionnaire, a score of 2 was given to the correct or yes answer, a score of 1 to I do not know, and a score of 0 to the wrong or no answer. Higher scores indicate a greater level of awareness.

The perceived severity questionnaire also included 11 questions. In this questionnaire, the questions are related to the severity and complications of the disease during pregnancy on the mother and fetus, and then the effect on the family, for example infection with COVID-19can cause the death of the fetus. The questionnaire is scored based on a 5-point Likert scale from 5 to 1 (completely agree = 5, agree = 4, no opinion = 3, disagree = 2, and completely disagree = 1). The range of scores in this questionnaire was 11 to 55, and higher scores indicated higher perceived severity. The content validity ratio (CVR) and content validity index (CVI) were evaluated to check the validity. After designing, the questionnaires were given to seven reproductive health experts and three health education experts from Zahedan University of Medical Sciences and their opinions were used. In the present study, CVR for the awareness dimension was calculated

(0.85), and the perceived intensity dimension (0.80). CVI for the awareness questionnaire was obtained 0.91 and the perceived severity was 0.89. To assess the reliability, these questionnaires were given to 20 pregnant women who was not included in the study. The reliability of these questionnaires were confirmed using internal consistency (Cronbach's alpha coefficient of 0.90 for awareness and 0.84 for perceived severity).

Questionnaire of self-care behaviors during COVID-19: This questionnaire was researcher-made designed based on the guidelines of the Ministry of Health of Iran and included 20 questions. The questionnaire was scored based on a four-point Likert scale (never = 0, sometimes = 1, often = 2, and always = three). The score range was between 0 and 60, and a higher score indicated higher self-care.

The content validity ratio (CVR) and content validity index (CVI) were evaluated to check the validity. In the present study, CVR was calculated (0.89) and CVI was obtained 0.94. Internal consistency (Cronbach's alpha) was used for the reliability of this questionnaire. The questionnaire was distributed among 20 pregnant women who were not included in the study. The reliability was confirmed by Cronbach's alpha coefficient of 0.93 for the self-care questionnaire.

To perform the intervention, after selecting the centers and pregnant women at risk of preterm birth (who obtained the required score from the Holbrook questionnaire (≥10) and met other inclusion criteria), the participants in both groups were invited to complete the questionnaires of awareness, perceived severity, and self-care behaviors before the intervention (T1) in the selected healthcare centers, then the procedure was explained to the participants. In the next step, four groups of 15 subjects were formed on WhatsApp for the intervention group. The time of sending the educational content was coordinated with the mothers and the most appropriate time was chosen. Training files included information related to pregnancy and changes in the mother's physiological system, preterm delivery and its causes and symptoms, COVID-19disease and ways of transmission with an emphasis on pregnancy, familiarity with personal health and how to take care during and after pregnancy during the coronavirus, etc. This content was designed based on a review of related texts and articles, on self-care protocols during pregnancy by the Ministry of Health in Iran (38-39). Then for the validity of the content, it was given to four faculty members who were experts in health education and reproductive health. After using the suggested comments, the content was given to three pregnant women to ensure its fluency, simplicity, and comprehensibility. These files were prepared in the form of timekeeper files of up to 15 minutes, which were sent every other day in the form of audio and voice slides converted into movies and health pictures within two weeks (Supplementary File). The day after sending the file, a short question and answer session was held individually on the same software to ensure that people read the contents. During two weeks, two phone calls were made to mothers for advice or to answer possible questions and remove ambiguities. No intervention was performed for the control group except for receiving routine pregnancy care in the case of visiting the centers. Finally, the two groups were again invited to refer to the selected centers 8 (T2) and 12 (T3) weeks after the implementation of the intervention to complete the questionnaires.

Data were analyzed using SPSS software (version 24) (IBM, Armonk, NY, USA). Descriptive statistics, including frequency, mean and standard deviation were utilized. The difference between the basic variables in two groups was analyzed independent t-test, chi-square and Fisher's exact test. The repeated measures analysis of variance (ANOVA) test was used to investigate the impact of the intervention before and after the intervention in the two groups. Regarding to the significance of the interaction effect of time and group, the comparison between the groups was done separately. ANCOVA was used for intragroup comparisons in weeks 8 and 12 after the intervention to control the effect of baseline time. The normality of the data was also determined by the Shapiro-Wilk test. $P \leq 0.05$ was considered statistically significant.

This study has been approved by the Ethics Committee of Zahedan University of Medical Sciences, Iran (code number:

IR.ZAUMS.REC.1400.010). After obtaining permission from the Research Deputy of Zahedan University of Medical Sciences and providing an introduction letter to the health center of the province, all participants were informed about the study and confidentiality protocols. Informed consent was obtained from all the participants and they were free to leave the research at any stage (Table 1).

Table 1. Brief description of the training sessions

Sessions	Educational objective
Session 1	Knowing premature birth, predisposing factors, prevention methods, danger signs
Session 2	Familiarity with COVID-19, symptoms of the disease, and ways of transmission and diagnosis
Session 3	Awareness of the effect of the virus, and the importance of its prevention in pregnancy, disease symptoms in pregnancy and how it is transmitted to the mother and her fetus
Session 4	Familiarity with personal hygiene and self-care, virus prevention in public places, hospitals, and centers, nutrition, and not taking chemical and herbal medicines without meeting and prescribing a doctor in case of any symptoms
Session 5	Being aware of labor symptoms, visiting the hospital, and awareness in the field of protection in the hospital to prevent mother and baby from getting sick
Session 6	Being informed about the principles of breastfeeding at the time of infection, ways to reduce mother-to-baby transmission, and postpartum care

Results

Two subjects from the intervention group and three from the control group were excluded from the study because they had no tendency to continue the study, and finally, 115 pregnant women at risk of premature delivery were evaluated. The mean age of the participants in both groups was 26.34±2.02 years with a maximum of 37 and a minimum of 19 years. No significant difference was found between the two groups in terms of mean age (p=0.478). Most women (84.3%) in both groups were housewives and 84 (73%) had primary and secondary education. Most women (65.2%) in both groups had not received any perinatal care, and the fear of affecting by COVID-19 was the most common reason (60.86%). The mean number of pregnancies in the two groups was 3.19 ± 0.42. Pregnancy was wanted in both groups (83.5%). There was no significant difference between the two groups in terms of obstetric information (Table 2).

Outcome changes were evaluated using repeated measures analysis of variance (ANOVA). Intragroup comparison showed no significant difference between the two groups at baseline in the mean score of awareness (T1) (P=0.622), but it was significantly different at 8 (T2) and 12 (T3) weeks after the implementation of the intervention in two groups (p<0.001). The mean score of awareness in the intervention group increased in T2 and T3 compared to the control group. Intergroup – comparison indicated that in the intervention group the mean score of awareness significantly increased at 8 (T2) and 12 (T3) weeks after the intervention compared to the baseline (T1) (P<0.001); however, this difference was not significant in T2 and T3 (P=0.058) but the mean score of awareness was not significant in the control group at three times (T1, T2, T3) (P=0.442). Intragroup comparison showed that the mean score of perceived severity was not significantly different in the two groups at baseline (T1) (P=0.061), but it was significantly different at 8 (T2) and 12 (T3) weeks after the intervention in the two groups (p<0.001).

The mean score of perceived severity in the intervention group decreased in T2 and T3 compared to the control group. Intergroup comparison showed that in the intervention group the mean score of perceived severity significantly decreased at 8 (T2) and 12 (T3) weeks after the intervention compared to the baseline (T1) (P<0.001); however, this difference was not significant in T2 and T3 P=0.268) but the mean score of perceived severity was significantly changed in the control group in three times (T1, T2, T3) and the mean perceived severity was increased (P<0.001). Intragroup comparison showed that the mean score of self-care behaviors was not significantly

different in the two groups at baseline (T1) (P=0.075), but it was significantly different at 8 (T2) and 12 (T3) weeks after intervention (p<0.001).

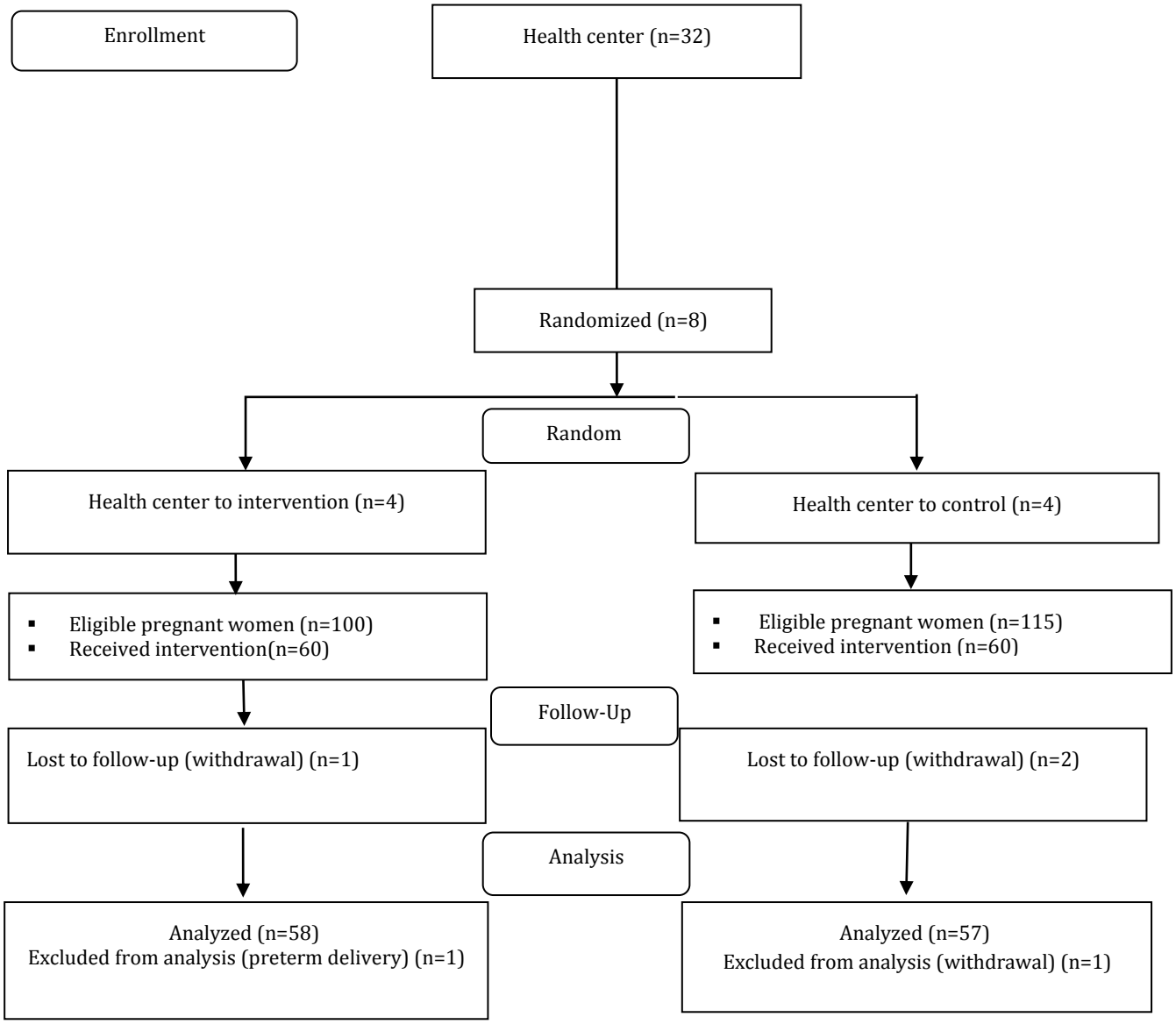

Figure 1. Flowchart of the study

Table 2. Characteristics of participants at baseline (N=115)

Variable	Intervention group (N=58)	Comparison group (N=57)	P-Value
Age (years) Mean±SD	26.62(3.90)	26.03(3.63)	0.478*
Gravid Mean±SD	3.28(0.43)	3.12(0.38)	0.600*
Educational	**N (%)**	**N (%)**	
Primary, secondary	45(77.58)	46(80.70)	0.637**
Middle & upper	13(22.42)	11(19.3)	
Spouse education	**N (%)**	**N (%)**	
Primary, secondary	43(74.13)	41(71.93)	0.215 **
Middle & upper	15(25.87)	16(28.07)	
Occupation	**N (%)**	**N (%)**	
Housewife	51(87.9)	46(80.7)	0.286 **
Employee	7(12.1)	11(19.3)	
Spouse occupation	**N (%)**	**N (%)**	
Unemployed	7(12.1)	9(15.89)	0.715**
employee	51(87.9)	48(84.11)	
Having insurance	N (%)	N (%)	
Yes	47(81)	46(80.07)	0.964**
no	11(19)	11(19.03)	
Wanted pregnancy	**N (%)**	**N (%)**	
Yes	52(89.65)	46(80.70)	0.080 **
No	6(10.35)	11(19.3)	
Prenatal Care number	**N (%)**	**N (%)**	
0	40(69)	35(61.4)	
1	13(22.4)	15(26.3)	0.670 ***
≥2	5(8.6)	7(12.3)	
The reason for not going to the health center to receive prenatal care	**N (%)**	**N (%)**	
Fear of COVID-19	32(80)	29(82.85)	
long distance	5(12.19)	4(11.42)	0.451 ***
Costs	3(7.5)	2(5.73)	

* Independent- samles T- test. ** Chi-square *** Fisher's exact test

The mean score of self-care behaviors in the intervention group increased in T2 and T3 compared to the control group (p<0.001). Intergroup comparison showed that in the intervention group the mean score of the self-care behaviors significantly increased at 8 (T2) and 12 (T3) weeks after the intervention compared to the baseline (T1) (P<0.001); however, this difference was not significant in T2 and T3 (P=0.316) but the mean score of self-care behaviors - was not significantly changed in the control group in three times (T1, T2, T3) (P=0.287) (Table 3).

Table 3. Comparison of the mean of the awareness, perceived severity and self-care behaviors before, 8 and 12 weeks after intervention in the two groups

Variable	Mean±SD			P-Value**	Pvalue***			Group		Time×Group	
	T1	T2	T3	(1-2-3)	1,2	1,3	2,3	F	P****	F	P*****
Awareness											
Intervention	18.68±3.35	20.70±2.98	21.08±3.09	<0.001	<0.001	<0.001	0.058				
control	18.40±2.90	18.13±3.02	18.21±3.11	0.442	0.651	1	1	12.76	0.001	38.30	<0.001
P value	0.622*	<0.001******	<0.001******								
Perceived severity											
Intervention	45.13±6.22	42.76±5.91	42.05±6.11	<0.001	0.001	<0.001	0.268				
control	44.81±6.96	45.55±6.62	46.07±6.45	<0.001	0.012	<0.001	<0.001	0.115	0.736	20.09	<0.001
P value	0.061*	0.044******	0.045******								
Self care											
Intervention	33.20±4.97	40.35±5.56	40.68±5.66	<0.001	<0.001	<0.001	0.316				
control	31.96±6.40	31.28±5.90	31.25±5.93	0.287	0.228	1	0.662	46.04	<0.001	66.97	<0.001
P value	0.075*	<0.001******	<0.001******								

T1: before intervention; T2: 8 weeks after interventio; T3: 12 weeks after intervention; * Independent- samles T- test;** Repeated Measure ANOVA; *** Bonferroni test; ****Test of effect Group; ***** test of interaction effects time and group (Sphericity Assumed), ****** ANCOVA

Discussion

The findings of the present study showed that smartphone Covid 19 self-care training over time significantly increased self-care and awareness and decreased the perceived severity of coronavirus in the intervention group compared to the control group. The study conducted in 2021 showed that distance health education positively affects the knowledge of pregnant mothers and their mental health after delivery (40). Another study conducted in 2022 on 181 people with type 2 diabetes - during the COVID-19 pandemic indicated that health education through smartphones significantly increased the awareness and self-care scores in the intervention group compared to the control group (41). These results are consistent with those of the current study. Such communication channels between the medical staff and patients can increase disease monitoring in certain critical situations. In addition, it allows pregnant women to become more aware of their condition and improve their health (42-43). Education and awareness play a key role in maintaining health, and lack of awareness can lead to irresponsibility towards healthcare issues (44).

The study by Luo et al. (2021) concluded that education using smartphones reduced the perceived severity of the disease in the intervention group. Perceived severity is a key factor in disease prevention, and education plays an essential role (45). According to the study conducted in 2022, people with less perceived severity of the disease show higher preventive behaviors (46), which was in line with the present study. On the other hand, some studies showed that a higher understanding of the risk of contracting the disease increases the probability of performing self-care behaviors against the disease (44-45, 47). Demographic characteristics, gender, and target group, different cognitive appraisals are influencing factors, which can cause inconsistency in the results in different studies. The high perceived severity of the disease and the feeling of lack of control can sometimes cause an incorrect understanding of the situation, which contributes to the adoption of ineffective strategies and measures and affects self-care (48). In the current study, women with a higher understanding of the severity of the disease had a lower mean self-care score. This result was evident in the control group because the spread of disease during sampling can be the reason for the increase in the perceived severity score and the decrease in the mean self-care score. In this case, perceived severity can be considered as a double-edged sword, being both risk and asset, in the encounter of a medical catastrophe (37). In the present research, after training on the importance of perinatal care, especially in high-risk pregnant women, training about how to safely attend health centers and how to take care of health to prevent infection, it was tried to improve self-care and perinatal care by controlling the fear of illness. According to the findings of the current study, the mean score of self-care improved after the intervention, while no change in this case was observed in the control group. The study by Lau et al. (2014) showed that such perinatal training by increasing mothers' knowledge and understanding of their conditions significantly encourages them to regularly visit doctors and health providers and follow up perinatal care (49). In addition, the smartphone educational intervention was effective in improving self-care behavior scores and improving health (50) which was consistent with the results of the present study. However, the results of another study on students during COVID-19 showed that students' participation in self-care methods was not significant and satisfactory (51). The time-consuming and psychological nature of online classes, Internet limitation at the time of connection, and the target group of the above study, teenagers, could be the reason for these contradictions. Also, Adolescents' perception of the seriousness of risk is not the same as that of adults, because they do not take the illness seriously, so adopting self-care behaviors in adolescents may not be as important as in adults (52). The present study showed pregnant women at risk of preterm birth could benefit from distance learning. Of course, this training can never be completely replaced by face-to-face visits during the perinatal period, especially for high risk people who need more care.

One of the strength of the present study was that this type of training can be used during natural crises, when fear and anxiety of the disease prevent attendance to receive care. In addition, increasing the level of knowledge and perception of the mother allows her to identify danger signs and prevent possible complications by on-time visiting. Among the notable limitations of this study, we can refer to available sampling and non-random allocation of subjects, which can be effective in generalizing the results. Also, the questionnaires were completed by self-report, which can affect the accuracy of the data. The other limitation of this study was the selection of sample from centers covered by universities, and women under the supervision of private centers such as doctors' offices were not evaluated.

Conclusion

The findings of the present study indicated the effectiveness of smartphones-based education in increasing self-care, awareness and reducing the perceived severity of the disease in pregnant women at risk of premature birth during COVID-19 pandemic. Therefore, it is beneficial to use such method for this group of pregnant women, especially in critical situations in the area with few facilities. It is suggested to conduct more studies on the effectiveness of prenatal care using smartphones in other pregnant women at

risk of gestational hypertension and diabetes, especially in areas which have the least referrals to receive care.

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Conflicts of interest

Authors declared no conflicts of interest.

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