Effect of Mobile Assisted Education Regarding Fetal Kick Monitoring on Perinatal outcomes among High-Risk Pregnant Women during COVID-19 Pandemic

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Abstract:

Background: Fetal kick monitoring (FKM), a self-screening technique, has been proposed as a primary method of fetal surveillance for all pregnancies including high-risk pregnanciesand decreasing perinatal morbidity and mortality. **Aim & design:** Quasi-experimental (study/control group)study design was conducted aiming to evaluate the effect of mobile-assisted education regarding fetal kick monitoring on perinatal outcomes among high-risk pregnant womenduring COVID-19 pandemic.**Sample:** A purposive sample of 100 pregnant women was chosen for the study. **Setting:** the study conducted at the Ain Shams University Maternity Hospital's Antenatal Clinic.**Tools:**the study utilized three tools: astructured Interviewing Questionnaire, self reported practices checklist,and maternal and fetal assessment record. **Results:** The present study revealed that there was no statistically significant difference between study and control groups regarding fetal kick monitoring in total knowledge, and practices scores pre-intervention.Meanwhile, a highly statistically significant improvement was observed in total knowledge and practices scores after using mobile-assisted education among study group as compared to control group ($p<0.001$) in addition to statistically significant improvement in perinatal outcome among study group compared to control group ($p<0.001$).Conclusion: The study concluded that application of mobile-assisted education during COVID-19 pandemic improved knowledge and practice of high-risk pregnant women regarding fetal kick monitoring that reflect on better perinatal outcomes among study group compared to control group.**Recommendations:** Applying usage of mobile apps in all available health services as a method for transferring service and replication of the research on a greater statistical sample drawn from various Egyptian regions.

Keywords: Fetal kick monitoring, perinatal outcomes, mobile-assisted education&COVID-19 Panademic

Introduction

Perinatal morbidity and mortality, particularly in high-risk pregnancies, are serious issues in low- and middle-income countries. Pregnancies with comorbid diseases such as hypertension, gestational diabetes, placental anomalies, premature labor, and post-term pregnancies are all considered high-risk from the start. To achieve the best possible outcomes in high-risk pregnancies, rigorous maternal and fetal monitoring is essential **(Yilmaz and Oskay, 2021).**

Fetal kick monitoring (FKM) is a self-screening technique that has been recommended as the primary method of fetal monitoring in all pregnancies, even those at high risk **(Poojari, Kumar, & Vasudeva, 2018).**Maternal regular perception of fetal movements has been considered an indicator of fetal well-being. FKM is also linked to

better perinatal outcomesas it permits early identification, timely evaluation, and appropriate intervention for fetuses at risk of adverse outcomes**(El-Sayed et al., 2018).**

Pregnant women begin to feel fetal movement between the ages of 16 and 20 weeks of pregnancy. As pregnancy continues, the timing and quality of fetal movements indicate fetal maturation and neurobehavioral development, and they follow typical patterns. Movement changes as pregnancy advances, reflecting increased frequency, more complex limb and trunk motions, and increased strength. Furthermore, the intensity of those kicks is constantly advancing until the 32nd week of gestational age and from then onwards remains at the same leve**(El-Sayed et al., 2018).**

Decreased fetalmovement(DFM) is linked to a variety of poor perinatal outcomes. It is the most important marker of decreased fetal activity, and it can indicate chronic fetal injury, fetal growth restriction, stillbirth, umbilical cord complications, placental dysfunction, low birth weight, and preterm birth. It is also associated with multiple pregnancy pathologies and adverse pregnancy outcomes. Perinatal problems such as maternal-fetal bleeding and emergency cesarean section are also linked to DFM **(Poojari, Kumar & Vasudeva, 2018).**

There are several methods for monitoring fetal movement during pregnancy, which can be classed as subjective (passive or unstructured) or objective (structured) (active or structured). Subjective assessment relies on the mother's perception and awareness of fetal movement (FM) rather than a formal or structured approach to FM monitoring, such as the Sadovsky method, which includes three kicks per day, one hour in the morning, one hour in the afternoon, and hours is calculated at night **(El-Sayed et al.,2018)**

objective assessment uses a variety of tools to observe and/or record FM,for example,; the Cardiff "count to ten kick chart" method is derived from Pearson and Weaver's Daily Fetal Kick Count or FM Count Chart, and more recent advanced technology methods, such as multi-sensor magnetocardiogram recording, mobile apps, and abdominal sensors. Mind-fatalness is an alternative approach to assessing FM in which women focus on FM characteristics, such as strength and frequency, rather than counting each kick **(Smith et al., 2019).**

Prenatal care is a good opportunity to assess and improve the mother's and fetus general health states, and interventions during this time are important for providing support and improving maternal and fetal health but due to the irregularity of pregnancy follow up through virtual means due to effect of precautionary measures of COVID-19 pandemic this lead to hinder the delivery of health services and these provide an opportunity to expand access to pregnancy and childbirth services and may help to mitigate adverse health outcomes for the pregnant women**(Ashour, El Bahlowan, and Shahin, 2021).**

As a result of Covid-19 pandemic grows, medical practitioners are attempting to discover innovative technologies to facilitate the administration of medical services and raise health awareness among pregnant women. As a result, there is a need to transition to technology-based solutions and use mobile-assisted education as a method of delivering health services and assessing fetal health, by self-monitoring of fetalmovements and providing knowledge and improvement of their practice which consequently had reflected upon better fetal wellbeing and pregnancy outcomes**(Daly et al., 2017).**

Overall, mobile-assisted education stratigies have the potential to improve perinatal outcomes, as pregnant women increasingly seek help from digital resources such as mobile applications ("Apps"). These

"pregnancy apps" can include health information, motivational information, fetal development monitoring, fetal movement monitoring, and changes in their bodies, provide reassurance and behavior change tools, which assist women with tools to support healthier lifestyles and strengthen informed decision-making modifying demand for quality services and enabling the provision of targeted care and addresses specific needs of women with high-risk pregnancies or pre-existing medical conditions**(Daly et al., 2017).**

Nurses play a vital role in promoting health during pregnancy through health promotion. The most vital role is depending on teaching and providing pregnant women with information needed to help maintain health during pregnancymainly those related tonew methods for assessment of fetal wellbeing such as monitoring of fetal kicks by using technology and mobile apps at home without transferring to health care service unless her status and her baby stable especially during covid 19 pandemic that hinderthe attendance of pregnant woman to antenatal clinic and receiving the care**(Abd El-Razek, 2016)**

Significance of the study

A high-risk pregnancy is linked to poor pregnancy outcomes as well as an increased risk of neonatal and maternal morbidity and mortality. adverse perinatal outcomes include preterm births, intrauterine fetal death, intrapartum stillbirth, neonatal intensive care unit admissions, early neonatal deaths, and low birth weight **(Yilmaz and Oskay, 2021).**

Fetal kick monitoring in high-risk pregnant women is a simple, inexpensive, and effective screening approach that has the potential to avert issues in unborn baby, and provides the attention of health care provider and pregnant women. The fetal movement has long been considered a sign of fetal well-being throughout pregnancy. FM that is reduced or absence could suggest prenatal compromise or mortality **(Levy et al., 2020).**

Perinatal morbidity and mortality continue to be a major global public health issue, affecting 2.64 million families worldwide and accounting for roughly 10 per 1000 live births in Egypt **(UNICEF, 2020)**,which are preceded by maternal perception of decreased fetal movement (DFM)**.**Pregnant woman had barriers to receive information from their healthcare provider about fetal movements due to consequent coronavirus disease and its adverse that reduce attending to the health care facilities. So empowering pregnant women for self-monitoring their fetal kicks daily and report DFM concerns in a timely manner in need to use other alternative methods as merging technologies such as mobile and pregnancy apps for provision of appreciate intervention for high risk pregnant women that result in a reduction of perinatal deaths and other complications of pregnancy outcome**(Kotlar et al. 2021).**Therefore, the present study aims to evaluate the effect ofmobile-assistededucation regarding fetal kick monitoring on perinatal outcomes among high-risk pregnant women during covid 19 panademic.

Aim of the study

This study aimed to evaluate the effect of mobile-assisted education regarding fetal kick monitoring on perinatal outcomes among high-risk pregnant women during COVID-19 pandemic. This aim was achieved through the following:

- Assessing the effectiveness of mobile-assisted education on high-risk pregnant women'sknowledge and practicesregarding fetal kick monitoringCOVID-19 pandemic.
- Evaluate the effectiveness of mobile-assisted education onperinatal outcomes among high-risk pregnant women duringCOVID-19 pandemic.

Research Hypotheses

- Mobile assisted education has a positive effect on enhancing pregnant women' knowledge and practices regarding fetal kick monitoring that reflect on better of perinatal outcomes during COVID-19 pandemic.

Subjects and Methods:

Research design:

A Quasi-experimental (study/control group) design was utilized in this study.

Setting:

The research was carried out at the Ain Shams University Maternity Hospital's antenatal clinic. It serves a very large sector of citizens and huge flow rate with a nominal cost. It provides many services to women such as outpatient clinics (family planning, gynecology,andantenatal clinicsin addition to breastfeeding counseling clinic), Delivery unit, early detection unit, intensive care unit, gynecological operations and inpatient units for high-risk pregnancy, post-operative care, and postnatal inpatient units.

Subjects:

Sample type:

A purposive sample with the following inclusion and exclusion criteria:

Inclusion criteria:

- Pregnant women with a gestational age of 20-37weeks, Pregnant women who had high-risk pregnancy as pregnancy-induced hypertension, gestational diabetes, and preeclampsia, Educated, and who had a smartphone with the internet.

Exclusion Criteria:

- Pregnant women who had psychological problems, chronic disease, multi-fetal pregnancy, Fetal abnormalities, and had learning problems.

Sample Size:

The current study was conducted on 100 pregnant women. According to the following formula:

Sample size Equation:

- The researchers depended on the following equation to calculate the sample size: Steven Thompson Equation **(Khuanbai&Yerkhanat, 2019).**

$$N = \frac{Z^2 (P (1-p)}{d2}$$ Where,

N =Sample size

Z: statistic for a level of confidence. (For the level of confidence of 95%, which is conventional, the Z value is 1.96).

P = the expected proportion in population-based on previous studies.

d=error percentage = (0.05). So,

$$N = \frac{(1.96)^2 (0.07 \times (1-0.07)}{.05 \times .05}$$

$$N = \frac{(1.96)^2 (0.07 \times 0.93)}{.05 \times .05}$$

$$N = \frac{4 \times 0.260}{.0025} = 106$$

Based on the above formula, the sample size required for the study was 100 pregnant women.

Sample technique:

The study sample was randomly assigned into two equal groups (study and control group.) This was accomplished by assigning each of the 100 women either number one or number two on a piece of paper. Women who choose number one were assigned to the study group, while those who chose number two were assigned to the control group. This method assisted in avoiding sample contamination and bias.

- **Control group:**(50 pregnant women) who only received routine antenatal care only. The control group was chosen first to ensure no contamination or bias in the sample of the study group.
- **Study group:**(50 pregnant women) were given an educational intervention regarding fetal kick monitoring using mobile application with routin hospital care.

Tools of data collection:

I) A Structured Interviewing Questionnaire:

The researcher developed it after reviewing the recent literature **(Turner et al., 2021)** to get the necessary data related to study's aim. The interviewing questionnaire was used in Arabic language pre / post-intervention. The time consumed to fill in the questionnaire was about 15-20 minutes. It consisted of 26 questions (multiple choice & closed-ended questions); covering three parts as the following;

Part I; was intended to assess the study sample's general characteristicsas age, telephone number, marital status, level of education, occupation, and residence (6 questions).

Part II;included past and current obstetric history as gravid, para, gestational age, current pregnancy complications, and regularity of antenatal follow-up. (7 questions).

Part III; was designed to assess fetal movement count history as to whether the pregnant women have counted fetal movements, methods of fetal movement counted, and reasons for not counting the movements. (3 questions).

Part IIII; is concerned with the assessment of pregnant women's knowledge regarding fetal kick monitoring. It included 10 multiple choice questions as a definition of fetal kick, time of quickening, the appropriate gestational age for starting Fetal kick monitoring, the importance of fetal kick monitoring, different methods of fetal kick monitoring, the normal number of fetal movements, Cause of decreased or absence of FM, the appropriate time during a day to assess fetal movement, the correct position to assess fetal movement, and time for consult doctor about FM.

❖ **Scoring system:**

Correct answers was given two scores, while incorrect answers or "don't know" was given one score. The total score ranges from 0 to 20. The total knowledge value is divided into:

- Adequate ≥60% (0-11 score).
- Inadequate < 60% (12-20 score).

II) Self reported practiceschecklist

It was developed by researchers after evaluating recent literature, **(Saastad et al., 2020)**, to assess pregnant women's practice regarding fetal kick monitoring by using the kick counter mobile application. It consisted of seven items.

❖ **Scoring system:**

It was scored as two scores for a correct done, and one score for incorrect done or not done. The total score ranged from (0-14). The total practice scores were classified as the followingcategories:

- Unsatisfactory Practice (<60% 0-8).
- Satisfactory practice (≥ 60% 9-14).
-

III) Maternal and fetal assessment record:

It was developed by researchers to assess prenatal outcomes based on a review of the relevant literature **(Poojari et al., 2018).**it included two parts. ***The first part*** is concerned with maternal outcomes as time of delivery, and type of delivery. ***The second part*** focused on fetal outcomes such as living healthy baby, neonatal intensive care unit (NICU) admission, signs of fetal distress, intrauterine fetal death, APGAR score, weight, and stillbirth.

Validity and reliability:

The tool's clarity, relevance, completeness, simplicity, and applicability were all evaluated by a panel of five experts from the maternal and neonatal health nursing department and pediatric nursing field. Modifications of the tools were done according to the experts' judgmentas "rephrasing and canceling".

Reliability analysis was measured using Cronbach Alpha coefficient and was found to be 0.821 for structured interview questionnaire, 0.784 for self reported practices checklist, and 0. 79 for maternal and fetal assessment record.

Pilot Study:

It was carried out in three weeks on 10 % of the sample (10 pregnant women). The pilot study conducted to assess the validity, clarity, and comprehensiveness of the tools and to test the feasibility of the study process. According to the results of the pilot study, adjustments were done as “adding, deleting, or reformulating of some questions”to strengthen their contents or for more simplicity and clarity. the pilot was excluded from the study to avoid contamination of the sample.

Administrative design:

An official written approval letter clarifying the title, purpose, and setting of the study was obtained from the Dean of the Faculty of Nursing of Ain Shams University & director of Ain Shams Maternity University Hospital.

Ethical considerations:

Ethical approval was obtained from the Scientific Research Ethical Committee of Faculty of Nursing at Ain Shams University before starting the study. Informed consent obtained from participants after explaining the purposes of the study. No harmful methodology used with participants. Every participant has the option to leave the study at any time. Human rights were guaranteed. The information is kept private and encrypted.

Fieldwork:

The study was carried out through four phases: preparatory, assessment, implementation, and evaluation phase. These phases were carried out from the beginning of September 2020 to May 2021, covering a period of nine months. The previously mentioned setting was visited by the researchers three days per week from 9.00 am to 12.00 pm. The researchers took into consideration safety precautions against COVID19 infection followed by world health organization(WHO) guidelines (WHO, **2020**) and the Egyptian ministry of health **(Ministry of Health and Population, 2020)** as it was pandemic during the data collection period; for example, wearing masks, keeping a one-meter distance, hand washing and using the antiseptic solution (alcohol 70%), also the researchers followed the rules and regulation of the hospital for safety measure.

Preparatory phase:

It included reviewing local and international related literature on various aspects of the study problem. This phase assists the researcher to be acquainted with the magnitude and seriousnessof the problems and guided the researcher to

prepare the required data collection tools and prepare the teaching material(Arabic booklet).

The researcher developed an educational material (arabic booklet) after reviewing the relevant literature on all aspects of fetalkickmonitoring and gave it to all pregnant women in the study group to improve their knowledge and practices regarding FKMby using mobile application. It was designed using simple Arabic language and different illustrative pictures to facilitate the women's understanding of its contents. It was composed of two parts; *The first part*consisted primarily of education about fetal kick monitoring as definition, importance,different methods,description of the changing pattern of kicks as the fetus develops, normal sleep/wake cycles, factors that affect fetal kicks pattern, andmethods that can stimulate fetal kicks.*The second part* included benefits of FKMusing mobile application and how the fetal kick counter mobile application work. Additionally, researchers prepared mobile massages after reviewing evidence-based studies and comprehensive literature on FKM.

Interviewing and assessment phase:

In the outpatient waiting area, each woman was interviewed separately during this phase. The researchers greeted the woman, introduced theirself to each woman, described the goal of the study, and assured the participants that the information gathered would be kept confidential and used specifically for research purposes. The women then gave their verbal and written consent.

- Researchers started filling out questionnaires to assess pregnant women's general characteristics, past and current reproductive history, fetal movement history, and their knowledgeregardingfetal movement monitoring. The researchers next utilized tool (II) to assess pregnant women's practice regarding fetal kick monitoring by using kick counter mobile application.The average time for the completion of each woman's interview was around (20-30 minutes). Every day, the researchers interviewed two to three women. The data obtained during this phase constituted the baseline for further comparison to assess the intervention's effectiveness.

Implementation phase:

- **Control group:**

In the control group, pregnant women received only regular prenatal care in the abovementioned setting.

- **Study group:**

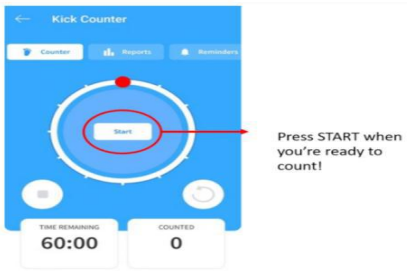
The researchers divided the study group's into five subgroups, each subgroup consisted of ten women. Each subgroup was added to a WhatsApp group on mobile after gathering their phone numbers. The researchers asked all pregnant women to download the kick counter application for assessing fetal kicks. All pregnant women received mobile-based instructions.

- The study group received three online sessions as well as suitable health education mobile messaging and illustrative videos. The sessions were given through Zoom Meetings application, one session per week. Each session lasted approximately 20 to 30 minutes.
- **The first and second sessions**focused on the definition of fetal kicks,appropriate gestational age for beginning FKM, description of the changing pattern of kicks as the fetus develops, normal sleep/wake cycles, factors that affect fetal kicks pattern, Importance of FKM, different methods of FKM, a normal number of fetal kicks per day, reasons for the absence or decreased of fetal kicks, methods that can stimulate fetal kicks, time in which the pregnant women should contact their physicians.
- **The third session;** in this sessionthe researchers provided health education to the pregnant women about the importance of FKM by using mobile applications, in addition to the instructions about how to use kick counter apps which include the followings:

1-Explore the App.

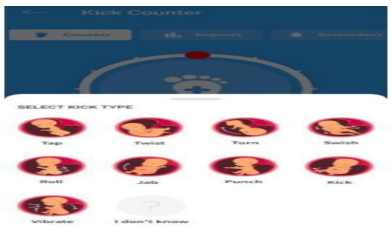
2- Once you click the tool, you will be brought to the kick counter itself

3-Once you have read the instructions; press the start button to start count kicks.

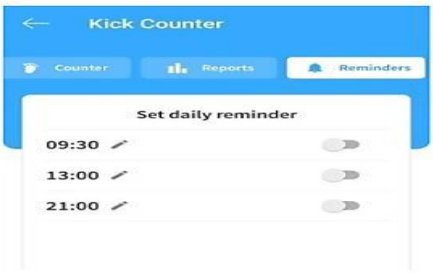


4- Continue recording the kicks for over one hour. The best time to do this is after eating as this is usually when fetuses are most active

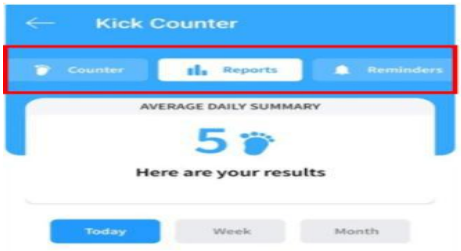
5- You can pick what kind of kick it is?



6- A set daily reminder of fetal kick counter: to make sure that you count your kicks every day



7- Get average daily summary (Report): there are daily, weekly and monthly reports of fetal movements.



- Each session ended with a summary of its contents; feedback from the pregnant women to ensure that women got the maximum benefits. The researchers used a telephone call with the pregnant for more clarification and reinforcement.The researchers used Teaching materials consisting of images, PowerPoint presentation photographs, handwritten notes, and videos that were shared during online sessions.
- Appropriate health-education mobile messages in Arabic language were categorized under seven major sub-items: general messages on FKM as definition, importance, methods, factors affecting fetal kicks, causes of decrease of fetal kicks, how to monitor fetal kicks using kick count mobile application, time for consult doctor about fetal kicks. During mobile massages, researchers asked women if they had adapted the health

education given previously and included giving information related to FKM. Researchers allowed pregnant women to ask any questions they want. Pregnant women in the control group and study group were telephoned once a week till 37 weeks of gestation to identify any problem that occurred to them.

- The researchers attended the delivery process of each pregnant woman among control group and study group to evaluate prenatal outcomes "maternal and fetal outcomes".

- **Evaluation phase:**

The effect of mobile-assisted education regarding FKMwas done through comparing between control and study groups by assessing their knowledge and practices after one month of intervention. In addition to assessing prenatal outcomes by using the pre-intervention tools.

Statistical Design:

The collected data was revised, coded, tabulated and introduced to a personal computer using Statistical Package for Social Sciences (IBM SPSS 20.0). Descriptive statistics were used to calculate percentages and frequencies for qualitative variables, mean and standard deviations for quantitative variables. The statistical tests such as chi-square test (X^2) were used to estimate the statistically significant differences. A significant level value was considered when $p < 0.05$, a highly significant level value was considered when $p < 0.01$, and no statistically significant difference when $p>0.5$.

Result:

Table (1): Displays that 82% of the study group their age ranged from 25-35 years compared with 88% of the control group. As regard place of residence, 68% of the study group was from urban area compared to 72% in the control group. Concerning marital status 98% of the study group was married versus 90% of the control group. Regarding educational level, 48% of the study group had secondary education compared with 54% of the control group. In addition, 56% of the study group and 70% of the control group were housewives. There was no statistically significant difference between the study and control groups regarding their general characteristics ($P > 0.05$).

Table (2): points out that, (76% &80%) of the study and control groups, respectively were multigravida. The mean gestation age of the study group was (24.72±1.01) compared with (24.64±1.08%) of the control group. Concerning compilations of the current pregnancy, (38%, 32%, and 30%) of the study group had pregnancy-induced hypertension, gestational diabetes, and pre-eclampsia respectively compared to (36%, 30%, and 34%) of the control group. Also, (70%) of the study group had an irregular follow-up versus (74%) of the control group. There was no statistically significant difference between the study and control groups regarding their obstetric history (P-value > 0.05).

Table (3): reveals that 80% of the study group did not count fetal movement compared to 86% of the control group, 77.5% of the study group, compared to 73.5% of the control group, reported that they did not know how to perform fetal movement count, and this was the reason why they were not counting their fetal movements. In addition to 80% of the study group used manual palpation as a method of fetal kick count compared to 70% of the control group. There were no statistically significant differences between the study and control group regarding fetal kick count history($P> 0.05$).

Table (4): indicates that, there was no statistically significant difference between the study and control groups in terms of all aspects of knowledge regarding fetal kick monitoring at pre-intervention ($p>0.05$). While a highly statistically significant difference ($p<0.001$) was observed between them post-intervention.

Figure (1): shows that (90%& 86%) of the control and study group had indequatetotal knowledge score regarding fetal kick monitoring pre-intervention respectively. While post-intervention 84% of the study group had adequate totalknowledge score compared to 12% of the control group.

Table (5): illustrates that there was a highly statistically significant difference between the study and control group regarding total practices score regarding fetal kick monitoringusing mobile kick counter application post-intervention (P<0.001), while there was no statistically significant difference between them pre-intervention.(P>0.05). As 96% &94% of the study group had unsatisfactory total practice scores respectively pre-intervention. While post-intervention, 90% of the study group had a satisfactory total practice score compared to 8% of the control group.

Table (6): shows perinatal outcomes after delivery. regarding maternal outcomes, it reveals that (88%) of the study group had term delivery compared to (70%) of the control group, in addition to (36%) of the study group delivered normal vaginal delivery compared to (26%) of the control group. Concerning fetal outcomes, it displays that the study group had fewer complications than the control group in terms of NICU admission (8%) in the study group compared to (28%) in the control group, (4%) of the study group had signs of fetal distress versus (20%) of the control group, (84%) of the study group had normal Apgar score compared to (40%) of the control group, and (88%) of study group their weight were more than 2500 gm compared to(56 %) of control.

Table (1): Frequency and percentage distribution of the studied sample according to their general characteristic.

Items	**Study group (n = 50)**		**Control group (n = 50)**			
	No	**%**	**No**	**%**	**X^2**	**p-value**
Age: (years)						
< 25years	5	10.0	6	12.0		
25-35 years	41	82.0	44	88.0	4.2	0.123
>35 years	4	8.0	0	0.0		
Mean ± SD	**29.38±4.3**		**28.9±3.99**			
Residence:						
Rural	16	32.0	14	28.0	0.190	0.663
Urban	34	68.0	36	72.0		
Marital status:						
Married	49	98.0	45	90.0	3.5	0.173
Divorced	0	0.0	3	6.0		
Widow	1	2.0	2	4.0		
Level of education:						
Basic education	8	16.0	10	20.0	4.27	0.813
Secondary education	24	48.0	27	54.0		
University	18	36.0	13	26.0		
Work:						
working	22	44.0	15	30.0	2.1	0.147
Housewife	28	56.0	35	70.0		

Table (2): Frequency and percentage distribution the studied sample according to their obstetric history.

Obstetric data	Study group (n = 50)		Control group (n = 50)			
	No	%	No	%	X^2	p-value
Gravidity						
Primigravida	12	24.0	10	20.0	2.54	0.719
Multigravida	38	76.0	40	80.0		
Current weeks of gestation					T-test	
Mean ± SD	24.72±1.01		24.64±1.08		1.14	0.641
Current pregnancy complications:						
Pregnancy induced hypertension	19	38.0	18	36.0		
Gestational diabetes	16	32.0	15	30.0	1.95	0.835
Pre-eclampsia	15	30.0	17	34.0		
Regularity of antenatal follow up :						
Regular	15	30.0	13	26.0	2.81	0.683
Irregular	35	70.0	37	74.0		

Table (3): Frequency and percentage distribution of the studied sample according to their fetal kick count history.

Item	Study group		Control group		X^2
	No	%	No	%	p-value
Did you count your fetal movements?					
-No	40	80.0	43	86.0	1.28
-Yes	10	20.0	7	14.0	0.259
If not, what are the reasons that make you not count it? (n=40)					
It is time-consuming	4	10.0	5	12.5	2.03
I did not know how to perform it	31	77.5	29	73.5	0.381
I never hear about it	5	12.5	6	15.0	
Did you count FM regularly? (n=10)					
-No	5	50.0	4	57.1	0.757
-Yes	5	50.0	3	52.9	0.384
If yes, what is the method of FM count that you used it? (n=10)					
-Manual palpation	8	80.0	7	70.0	1.95
-App method	2	20.0	3	30.0	0.472

Table (4): Frequency and Distribution of studiedsample according to their knowledge regarding fetal kick monitoring (pre-post intervention).

Item	Pre-intervention					Post-intervention				
	Study group		Control group		X^2 p-value	Study group		Control group		X^2 p-value
	No	%	No	%		No	%	No	%	
Definition of fetal Kick (FK)										
Correct answer	**20**	40.0	18	36.0		41	82.0	20	40.0	**31.6**
Incorrect answer	**17**	34.0	15	30.0	**1.52**	5	10.0	16	32.0	**0.002****
Don't know	**13**	26.0	17	34.0	**0.428**	4	8.0	14	28.0	
Time of quickening										
Correct answer										
Incorrect answer	17	34.0	15	30.0	**0.97**	48	96.0	15	30.0	**47.22**
Don't know	12	24.0	15	30.0		2	4.0	15	30.0	
	21	42.0	20	40.0	**0.617**	0	0.0	20	40.0	**0.001****
Importance of FKM										
Correct answer										**61.21**
Incorrect answer	5	10.0	6	12.0	**0.20**	49	**98.0**	**6**	**12.0**	
	45	90.0	44	88.0	**0.651**	1	**2.0**	**44**	**88.0**	**0.001****
Methodsof FKM										
Correct answer	9	18.0	8	16.0	**0.78**	43	86.0	9	18.0	
Incorrect answer	24	48.0	22	44.0		6	12.0	24	48.0	**47.3**
Don't know	17	34.0	20	40.0	**0.677**	1	2.0	17	34.0	
										0.001**
Number of FK/ day										
Correct answer										
Incorrect answer	16	32.0	14	28.0	**1.30**	44	**88.0**	16	**32.0**	**33.3**
Don't know	14	28.0	12	24.0		4	8.0	14	28.0	
	20	40.0	24	48.0	**0.522**	2	4.0	20	40.0	**0.002****
Causes of increased FK										
Correct answer	17	34.0	15	30.0	**0.44**	41	82.0	17	34.0	**24.2**
Incorrect answer	13	26.0	13	26.0		5	10.0	13	26.0	
Don't know	20	40.0	22	44.0	**0.802**	4	8.0	20	40.0	**0.002****
Appropriate gestational age for starting FKM										**13.8**
Correct answer	22	44.0	19	38.0	**1.42**	40	80.0	22	44.0	
Incorrect answer	12	24.0	11	22.0		4	8.0	12	24.0	**0.003****
Don't know	16	32.0	20	40.0	**0.493**	6	12.0	16	32.0	
Cause of decreased or absence of Fk										
Correct answer										**11.3**
Incorrect answer	**17**	**34.0**	**19**	**38.0**	**0.43**	45	90.0	31	62.0	
Don't know	**13**	**26.0**	**13**	**26.0**		3	6.0	7	14.0	**0.003****
	20	**40.0**	**18**	**36.0**	**0.805**	2	4.0	12	24.0	
Time to consult a doctor about Fk										
Correct answer	6	12.0	5	10.0	**2.02**	43	86.0	8	16.0	**52.1**
Incorrect answer	22	44.0	18	36.0		4	8.0	22	44.0	
Don't know	22	44.0	27	54.0	**0.367**	3	6.0	20	40.0	**0.001****

(**) a highly statistically significant difference

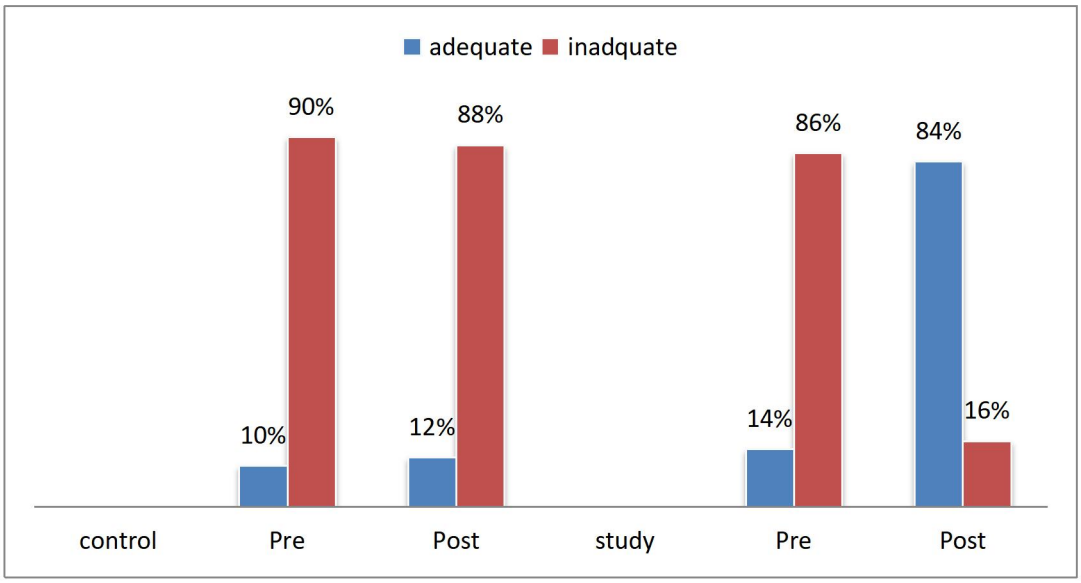


Figure (1): Percentage distribution of the study group and control group according to their total knowledge score regardingfetal kick monitoringpre and post-intervention.

Table (5): Frequency and Percentage distribution of the studied sample total practice score regarding fetal kickmonitoring using mobile kick counter application (pre & post-intervention).

Items	Study group n=50		Control group n=50		X^2	p-value
	N	%	N	%		
Pre-intervention						
Satisfactory	2	4.0	3	6.0	2.53	0.726
Unsatisfactory	48	96.0	47	94.0		
Post-intervention						
Satisfactory	45	90.0	4	8%	28.63	0.001**
Unsatisfactory	5	10.0	46	92%		

Table (6): Frequency and percentage distribution of studied sample according to Perinatal outcomes among study and control group.

Items	Study group (n= 50)		Control group (n= 50)		X^2	p-value
	No	%	No	%		
Maternal outcomes						
Time of delivery:						
Preterm delivery	4	8.0	12	24.0		
Term delivery	44	88.0	35	70.0	24.27	0.007**
Post term	2	4.0	3	6.0		
Type of delivery:						
Normal vaginal delivery	18	36.0	13	26.0		
Emergency cesarean section	15	30.0	35	70.0	36.53	0.008**
Elective cesarean section	17	34.0	2	4.0		
Fetal outcomes						
Living healthy baby	42	84.0	20	40		
NICU admission	4	8.0	14	28.0		
Fetal distress	2	4.0	10	20.0	38.59	0.001**
Intrauterine fetal death	1	2.0	2	4.0		
Still birth	1	2.0	4	8.0		
Apgar score at delivery						
Normal	42	85.7	20	40.0	36.82	0.008**
Abnormal	7	14.3	30	60.0		
Baby weight:						
Less than 2500gm	6	12.0	22	44.0	39.06	0.001**
More than 2500gm	44	88.0	28	56.0		

(**) a highly statistically significant difference

Discussion

Fetal kick monitoring has long been used as an indicator of fetal well-being. Assessment of fetal movement is an accepted method for early detection of adverse perinatal outcomes **(Stanger et al., 2017).**

Regarding the general characteristics of the studied sample, the current study findings revealed that around the majority of the bothcontrol and study groups their age ranged from 25-35 and, most of them were married, more than two third of control and study groupwere from urban area, and around half of them had secondary education. In addition, more than half of study group and less than three quarter of the control group were housewives.

The findings of current study in accordance with**El-Sayed et al., (2018)** studied "Effect of Women Self Monitoring of Fetal Kicks on Enhancing Their General Health Status " and found that more than two third of studied sample aged 25 to 35, more than half of them had a secondary education, and nearly two-thirds of the studied group did not work. The consistency of the outcomes of the two study findings can be traced to the fact that the samples in both studies had similar general characteristics.

Disagree with **Cawley et al., (2020)** conducted a retrospective cohort study evaluating the effect of healthcare system-sponsored mobile apps on perinatal health behaviors, finding that almost half of the study group were over the age 35 yearsand pointed that increase number of this age group due to

this group, their pregnancy is risky that make them flock to antenatal clinic even under the circumstances of covid 19.

In terms of obstetric history, the current study found that about three-quarters of the study and control groups were multigravida, with mean gestation age of study group was (24.72±1.01) compared with (24.64±1.08%) of control group.Concerning with current pregnancies complications, gestational hypertension was found in more than one-third of the study and control groups, followed by gestational diabetes and preeclampsia. Furthermore, somewhat less than three-quarters of both the study and control groups had an irregular antenatal follow up. This may be due to restriction and precautionary measures of covid pandemic during this time that hinder the regularity of follow up.

In accordance with **Ashour , El bahlowan, and Shahin, (2021)** who conducted a study at Maternal and Child Health Centers (Quibli and Bahari) at Shebin El-Kom in Menoufia Governorate on 120 Primigravida to evaluate the effect of nursing intervention using kick counter mobile application on improving pregnancy outcomes among primigravida during COVID-19 pandemic, and found that more than two third of studied sample had irregular antenatal follow.Similar to**Hall et al., (2020) and Riley et al., (2020),** stated that access to reproductive health and antenatal healthcare services decreased, and many undesirable complications emerged.This could be due to pregnant women's might be anxious about receiving face-to-face prenatal care and unwilling to go to health facilities during the COVID-19 pandemic for fear of becoming infected.

Concerning fetal kickmonitoring history, the current study findings revealed that, majority of study and control group did not count fetal kicks, around three quarter of control and study group reported that they did not know how to perform FKM, and this was the reason why they were not counting their fetal kicks. Also, majority of study group used manual palpation as a method of FKM compared to more than two third of control group and the minority both groups used mobile app to assess fetal movement.

These findings are in line with those of **Belal and Elkazeh, (2017)** who carried out a study on Maternal Perception and Antenatal Advice regarding Fetal Movements in Al-Gharbyia Governorate, Egypt, and found that two-thirds of the women investigated did not measure fetal movements and that more than half did not know how to do so. This indicates that pregnant women require additional information, guidance, and education regarding the importance and methods of fetal kick monitoring.

Concerning to total knowledge score about fetal kick monitoring,the current study findings pointed out that There was no statistically significant difference between the study and control groups before the intervention as the majority of them had in adequate knowledge. Meanwhile the study group's overall knowledge scores improved significantly following the intervention as compared to the control groupin the form ofimportance of FKM, time of quickening, reasons for fetal kicksreduction or absence, and the number of fetal kicks per day, and methods of FKM. This approvedthatthe importance of mobile-assisted education for delivering pregnancy information, as well as fetalkick monitoring, in situations where in-person communication with health care providers is difficult owing to the Covid-19 panademic.

This finding supported by Liu et al., (2020) who reported that almost all pregnant women had their study stated that using mobile applications was beneficial in improving their knowledge.This finding was matching with **Ashour , El- bahlowan, and Shahin,(2021)**who found that the majority of the study group had good total knowledge score regarding fetal movement after

applying of nursing intervention using kick counter mobile application.

Similar to these findings, a study conducted by **Hemavathy, Sarathy, and Christina. (2019)**who conducted a study at Sree Balaji Medical College and Hospital' to assess the effectiveness of structured teaching programme on knowledge regarding self-assessment of daily fetal movement count among normal and high risk primigravida mothers and found that nulliparous women at high risk had a pre-test mean of 32.2 16.1 improved to mean of 82.6 6.3 at post-test.

Also the findings supported by **El sayed et al., (2018)** who aimed to investigate the effect of women self-monitoring of fetal kicks on enhancing their general health status and showed a significant improvement ofknowledge at 37 weeks of gestation which was reflected upon their positive general health status and stress on the importance of burshore about self monitor of fetal kick to be distributed among all pregnant women during their 1st attending visit to enhance their general health.

In relation to total practice score about fetal movement monitoring by using mobile kick count applicationthe current study demonstrated that, majority of study and control group had unsatisfactory total practice score pre-intervention. While post intervention majority of study group had satisfactory total practice score compared to control group with a highly statistical significant difference between them. This demonstrates the effect and importance of mobile applications, as well as the convenience of accessing the same services from home without having to transfereto a health care service.

These results were consistent with **Ashour , El- bahlowan, and Shahin, (2021)**who found that nearly all pregnant women in the study group had adequate practice regarding fetal movement countpost-intervention compared to two percent before the intervention. This could be because of the nursing intervention, which significantly enhanced the study group's ability to observe fetal kicks using the kick counter approach.

This finding was in agreement with O'Higgins et al., (2014) who studied the use of digital media by women using the maternity services in a developed country and stated that recent studies have found that the pregnant women are seeking mobile apps to monitor the fetal development and to provide reassurance. In similar to **Samutri, and Endriyani (2021),** who revealed thatthe compliance in performing fetal movement counting was high and pointed that high compliance in this study was consequence of several factors, including the intervention packages were given was attractive enough, WhatsApp reminder was sent every 2 days, and women awareness of the importance of fetal movement monitoring.

Regarding perinatal outcomes, in the term of maternal outcomes,the current study's findings demonstrate that the majority of the study group had term births, compared to almost two-thirds of the control group, and that more than one-third of the study group had normal vaginal births, compared to less than one-third of the control group. Concerning fetal outcomes, the study group had fewer complications than the control group, a minority of the study group had signs of fetal distress, and the control group's NICU admission rate was around one-third, while most of the study group had no NICU admissions, the majority of study group had normal Apgar score with their weight were more than 2500 gm compared to more than one third and about half of the control group respectively. This study supports the beneficial effects of mobility-assisted education on fetal movement monitoring knowledge and practice in high-risk pregnant women during COVID-19 panademic, resulting in better perinatal outcomes.

This finding in accordance with **Ashour, Elbahlowan, and Shahin, (2021)** discovered that less than a quarter of pregnant women in the research encountered maternal

and newborn problems, whereas more than half of the control group did. In agreement with**Alotaibi et al., (2018)**, investigated smart mobile pregnancy management and awareness system in Saudi Arabia and discovered that mobile health increased the percentage of safe deliveries and decreased the ratio of maternal to neonatal complications, with mobile health being the Changes in fetal movement throughout pregnancy, according to **Bradford et al., (2019)**stated that the fetal movement changes throughout pregnancy can indicate normal or abnormal development.Therefore, it is important to provide prenatal care and counseling through telehealth tools, including mobile health applications, to reduce the negative effects of the COVID-19 pandemic on the healthcare services before, during, and after delivery is though.

These findings are similar to those of **El Sayed et al., (2018)** who found that a significant improvements in maternal self-monitoring of fetal kicking at 28 and 37 weeks of pregnancy post intervention. Furthermore, at 37 weeks of pregnancy, women in the intervention group demonstrated a significant improvements in general health in all domain when compared to the control group.

Disagreement to these study findings, **Cowley et al., (2020)** used a retrospective cohort study to investigate the effect of healthcare system-sponsored mobile applications on perinatal health behaviors,and this study showed that use of the app was not associated with differences in clinical health outcomes such as premature births, cesarean births, low birth weight babies, and neonatal intensive care unit stays. He articulated that studies successfully demonstrate the effectiveness of prenatal apps in improving health behavior often fail to find statistically significant differences in neonatal outcomes, delivery, or pregnancy complications may be due to small study populations.

Finally, the results of this study showed that women's knowledge and practice of self-monitoring of fetal movement improved significantly after the intervention through the use of mobile-assisted educationso the present study findings directed our attention towards the importance of self monitoring of fetal kicks through using mobile apps which consequently had reflected upon better fetal wellbeing and pregnancy outcomes.

Limitation of the study

lack of widespread network coverage and availability of mobile devices that halt the development of mobile health regarding the pregnancy

Conclusion:

The study concluded that application of mobile-assisted education during COVID-19 pandemic improved knowledge and practice of high-risk pregnant women regarding fetal movement monitoring that reflect on better perinatal outcomes among study group compared to control group.The findings of the current study supported the research hypotheses.

Recommendations

In the light of the findings of the study, the following recommendations were suggested:

- In-service training programs are needed for nurses regardingthe usage of mobile apps as a method for contact with a pregnant woman to improve, update, and refresh their knowledge and practices regarding fetal kicks as a method of assessment of fetal well-being.
- Applying usage of mobile apps as in all available health services a method for transferring service especially in special circumstances.
- Replication of the research on a greater statistical sample drawn from various Egyptian regions and long-term follow-up is recommended to obtain more generalizable results
- Further studies are needed to investigate the effect of new technologyon perinatal

outcomes among high risk pregnant women

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