Effect of Mobile Application Assisted Nursing Intervention on Pregnant Women Regarding Iron Deficiency Anemia

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ABSTRACT

Anemia is present among 90% of women during pregnancy that is of the iron deficiency type. **Aim:** To investigate the effect of mobile application assisted nursing intervention on pregnant women regarding iron deficiency anemia. **Subjects and method: Design:** A quasi-experimental research design was used. **Setting:** The study was conducted at antenatal outpatient clinics at Mansoura and Tanta University Hospitals. **Subjects**: A purposive sample of 210 pregnant women was involved in the study from the previously selected settings. **Three Tools were used for data collection** 1) a structured interviewing questionnaire, 2) pregnant women's reported practices tool, and 3) an investigation tool used to measure hemoglobin level. **Results**: There was a statistically significant difference regarding pregnant women's level of knowledge and practice about iron deficiency anemia management and Hemoglobin (Hb) value after mobile application assisted nursing intervention. In addition, there was a statistically significant association between pregnant women's knowledge, practice regarding the management of iron deficiency anemia during pregnancy and their demographic characteristics. **Conclusion:** Mobile application-assisted nursing intervention has a positive effect on improving pregnant women's knowledge and practice regarding management of iron deficiency anemia. **Recommendations:** Mobile application-assisted nursing intervention should be used in various Maternity health care settings.

Keywords: Anemia, Assisted nursing intervention, Knowledge and practice, Mobile application, Pregnant women.

Introduction:

Anemia is considered a major nutritional problem that occurs in developing countries among pregnant women (**Hameed et al., 2018**). Anemia is considered one of the big public health challenges as population studies find that anemia prevalence is at 5.0% or higher (**WHO, 2018**). Anemia during pregnancy is defined by the Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO) as a hemoglobin concentration of less than 11 g/dl. It is considered severe when the hemoglobin concentration is less than 7.0 g/dl, moderate when hemoglobin falls between 7.0 and 9.9 g/dl, and mild when hemoglobin is from 10.0 to 10.9 g/dl (**Gebre et al., 2015**).

Anemia is present among 90% of cases of women during pregnancy that is of the iron deficiency type. It is considered a major public health problem particularly among poorer segments of the population in developing countries where 95% of the world anemic pregnant women are residing. In those cases of women who begin pregnancy with low or absent stores of iron due to heavy menstruation, a previous pregnancy, low iron intake, and increase demands of fetal to iron that leads to anemia (**National Population Commission, 2014).**

Iron is an important component of hemoglobin, the oxygen-carrying pigment in the blood. Iron is normally obtained through the food and by recycling iron from old red blood cells and during the absence of the required iron blood concentrations, blood does not carry oxygen effectively and hence normal functioning of every cell in the body will be affected. It is estimated that a median amount

that needs to be absorbed throughout the pregnancy of iron is 840-1210 mg of iron (**Huang et al., 2015**)

Anemia occurrence during pregnancy may lead to many health problems among pregnant women and their fetuses. Anemia is accompanied by the high incidence of preterm birth, low birth weights, and a small gestational age fetus (**Aboye et al., 2018**). Women with anemia in pregnancy may experience fatigue, reduced energy levels, and reduced mental performances (**Imdad et al., 2017**).

Various factors affect the incidence of anemia in pregnant women, called inadequate antenatal care, close birth spacing, and poor nutrition**.** The current high incidence of anemia may be influenced by the flow behavior of women in preventing and managing anemia, such as do not take iron supplement tablets regularly. The major factors responsible for low intake of iron-rich food are poverty, ignorance, lack of knowledge regarding the nutritive value of foods, and inadequate sanitary environment (**Singal et al., 2018**).

Obstetrics and gynecology and community health nurses play a vital role in promoting health during pregnancy through health promotion which has been shifted from a disease model to a health model (**Piper, 2009**). The most vital role is depending on teaching and providing pregnant women with information needed to help maintain health during pregnancy mainly those related to nutritional aspects. They emphasize behavioral changes to assist mothers to change their eating habits and practices that contribute to the nutritional deficit (**Nisar and White, 2013**).

Knowledge and practice among pregnant women were correlated with anemia" was conducted in numerous studies and revealed that the lower the knowledge and inadequate practice about anemia prevention and management in pregnant women increases the risk for more than five times. One of the most important responsibilities of skilled health providers is to provide detailed, concise, and appropriate information to women before, during, and after pregnancy regarding anemia

prevention and management. Anemia can be prevented and controlled in pregnant women by improving knowledge and practice regarding diet and prophylactic treatment by iron-folic acid, and improvement of diet (**WHO, 2018**)

A mobile health nursing intervention is defined as "the use of electronic information and communication to support and promote long-distance clinical healthcare, patient and professional health-related education (**Department of Health and Human Services, 2018**). Mobile is an accessible communication method used for health nursing intervention. It has several uses as it helps access care services, and improves the relationship between patients & caregivers (**Zakeri et al., 2009**).

Significance of the study:

Iron deficiency anemia among pregnant women is considered a frequent condition during pregnancy. The prevalence of anemia in pregnancy is estimated to be approximately 41.8% 4; nevertheless, the percentage of iron deficiency without anemia is unknown. Many factors lead to anemia occurrences such as lack of knowledge regarding nutritive foods and low intake of iron-rich food (**Whitehead & Seaton, 2016**).

Anemia can be managed through health education and follow-up nursing intervention. Mobile applications are important mHealth tools and tend to be easy to be acquired. Smartphone apps allow patients to access health information and healthcare services anytime and anywhere. Studies have documented the feasibility and effectiveness of mobile apps in supporting patients in healthcare and clinical practice (**Schlachta, 2015**). Therefore, the current study contributes to investigate the effect of mobile application assisted nursing intervention on pregnant women regarding iron deficiency anemia.

Aim of the study:

The study aimed to investigate the effect of mobile application assisted nursing intervention on pregnant women regarding iron deficiency anemia through:

- Evaluating the effectiveness of the mobile application-assisted nursing intervention on knowledge and practice of pregnant women regarding the management of iron deficiency anemia.

- Assessing the effectiveness of the mobile application-assisted nursing intervention on the Hemoglobin (Hb) level of pregnant women.

Research hypothesis:

- Mobile application-assisted nursing intervention has a positive effect on improving pregnant women's knowledge and practice regarding management of iron deficiency anemia**.**

- Improving pregnant women's knowledge and practice regarding management of iron deficiency anemia has direct positive effect on blood hemoglobin level

Subjects and Methods:

Research design:

A quasi-experimental research design was utilized in this study.

Setting:

The study was conducted at antenatal outpatient clinics at Mansoura and Tanta University Hospitals.

Subjects:

A purposive sample of 210 pregnant women was involved in the study that was recruited from the previously selected settings within six months from July 2018 until December 2018. Inclusion criteria included pregnant women who had mobile phones, have all mild, moderate, and iron deficiency anemia and did not receive any nursing intervention before regarding iron deficiency anemia management. Exclusion criteria included women who had learning problems.

Sample size:

Sample size was calculated based on a power analysis of $0.95(\beta=1-0.95=0.5)$ at alpha .05(one–sided) with large effect size (0.5) was used as the significance

Tools of data collection:

Three tools were used to collect the data of the study as the following:

Tool I: Structured interviewing questionnaire: it was developed by researchers based on reviewing the relevant literature and consisted of three parts as follows **(World Health Organization, 2018).**

Part (1): It included demographic data of the pregnant women such as age, educational level, occupation, and residence.

Part (2): It included the obstetrical history of pregnant women; it contained five questions about the gravida, abortion and pregnancy stage Iron supplementary use, and having anemia before.

Part (3): Pregnant women's anemia knowledge tool (pre-post tool)**:** it was designed by the researchers to identify the level of pregnant women's knowledge regarding iron deficiency anemia, it contained 20 items. Each question was answered by the pregnant women either true or wrong. The scoring system was (0) if the answer is wrong and (1) if the answer is true with a total grade of 20. The level of knowledge was determined as good (≥70%), average (51-69%), and poor level (≤50%).

Tool II: Pregnant women's reported practices tool (pre-post tool); it was composed of two elements; the first one contained ten questions to assess the pregnant women's eating practices. The second one contained eight questions to assess pregnant women cooking habits. The eighteen questions have 3 responses; always, sometimes, and never which were given the score of 3, 2, and 1point respectively. The sum of scores for all of the items was calculated, then the level of practice was classified, as adequate practices if the score is (>60%), and inadequate practices if the score was (≤60%).

Tool III: Investigation tool: Pre-post tool that assessed pregnant women's

hemoglobin level two times during the study period, at the first visit, and after two months of nursing intervention.

Tool V: Alidity and reliability:

The content validity of the tool was reviewed by five experts in the obstetrics and community health nursing field for testing clarity, comprehensiveness, and appropriateness of the tool and testing the content validity before using the tool in the study. Modifications were done according to the panel's judgment on the clarity of sentences and content appropriateness as "rephrasing and canceling". The Cronbach's α test was used to assess the reliability of the questions relating to knowledge and practice was 0. 84.

Operational Design:

The operational design for this study consisted of three phases named by; preparatory, implementation, and evaluation phase.

A-Preparatory phase:

It was based on the assessment data was obtained during the interviewing questionnaires, literature review, about knowledge and practices regarding iron deficiency anemia. The researchers prepared educational material (booklet) after reviewing related literature regarding iron deficiency anemia management and gave it to all study participants women. The booklet includes definitions, risk factors, symptoms, and how to prevent and manage anemia in the Arabic language. Also, the researchers prepared mobile conversations and massages after reviewing evidenced-based research and comprehensive literature about iron deficiency anemia management.

Administrative and Ethical considerations:

Administrative permission was obtained through an issued letter from the Dean of Faculty of Nursing, Mansoura, and Tanta University Hospitals to the directors of the antenatal outpatient clinics to conduct this study. The aim of the study was explained and the expected outcomes from the implementation of the study were included in this letter to obtain permission to collect the study data. The purpose of the study was explained to pregnant women. The researchers informed the participants that, the study was voluntary; they were allowed to refuse to participate in the study. Pregnant women had the right to withdraw from the study at any time, without giving any reason. Pregnant women were assured that their information would be confidential and used for research purposes only.

Pilot study

A pilot study was conducted on 10% of the studied pregnant women (21). The clarity and testing of the feasibility of the research process needed for modifications were carried out based on the results of the pilot study to develop the final form of the tools. Pregnant women involved in the pilot study were excluded from the study.

B-Implementation phase:

Before starting the study, Administrative permission was obtained from the directors of the selected settings. All pregnant women who met the inclusion criteria during the time of data collection were included in the study. The researchers introduced themselves to the pregnant women. Clear and simple explanations about the aim and nature of the study were discussed by the researchers with pregnant women. Oral informed consent was obtained from pregnant women to get their acceptance as well as to gain their cooperation. The researchers attended the antenatal outpatient clinics two days per week starting from 9.00 a.m. until 12:00 p.m.

Data collected through a period of six months from the beginning of July 2018 until the end of December 2018. The interview took approximately 20 minutes for each woman to answer and fill the questionnaire (Tool 1) to assess the knowledge and practice of pregnant women regarding the management of iron deficiency anemia and also Hb level was assessed.

All telephone numbers of participated pregnant women were collected and were participated in the Whats up group on mobile for all pregnant women. All pregnant women received mobile-based instructions.

Three online sessions and appropriate health-education mobile messages were given to pregnant women. The sessions were given through Zoom Meetings, one session per week. Each session lasted 20-30 minutes. The

first session included the definition, incidence, and clinical features of iron deficiency anemia. The second session contained the followings topics: risk factors, and diagnostic test for iron deficiency anemia; and finally, the third session included ways of management of iron deficiency anemia as education about iron-rich foods, enhancers and inhibitors of iron absorption, iron medication adherence, adequate eating practice, and cooking habits.

Teaching sessions

The intended learning outcomes of the teaching session were:

Knowledge

- Define iron deficiency anemia

- Identify incidence, clinical features, and risk factors of iron deficiency anemia

- Summarize diagnostic tests and management of iron deficiency anemia

Skills

• Demonstrate proper usage of iron medication during pregnancy.

• Demonstrate adequate eating practice and cooking habits for the management of iron deficiency anemia.

Competence

• Value the importance of proper management of iron deficiency anemia.
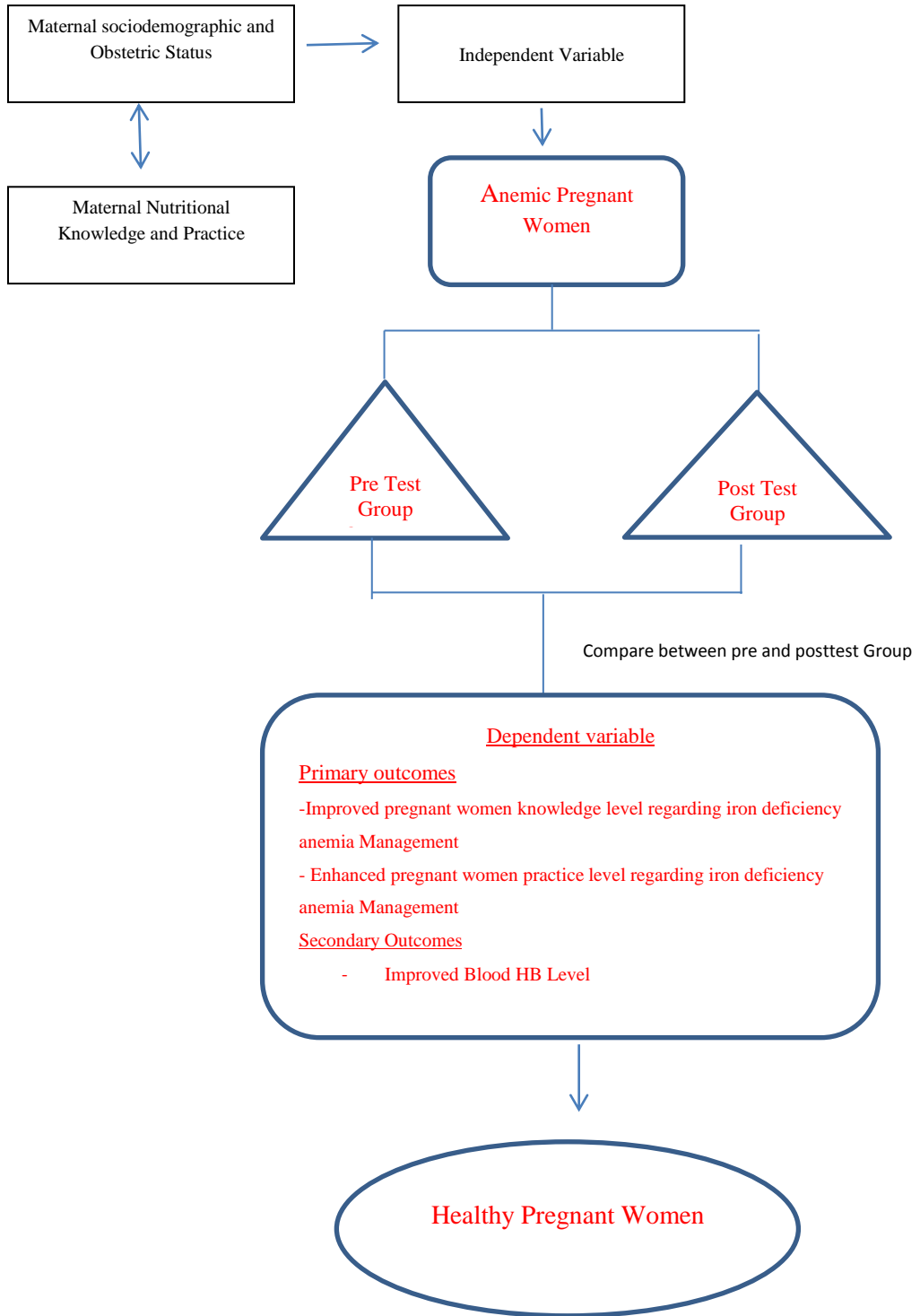
Appropriate health-education mobile messages were categorized under seven major sub-items: general messages on anemia definition, danger signs of iron deficiency anemia in pregnancy, causes of iron deficiency anemia, complications from iron deficiency anemia, reminders of antenatal care availability, health nutritional requirements, and drugs. All the health messages were also translated and available in Arabic languages and delivered in women's preferred time of the day.
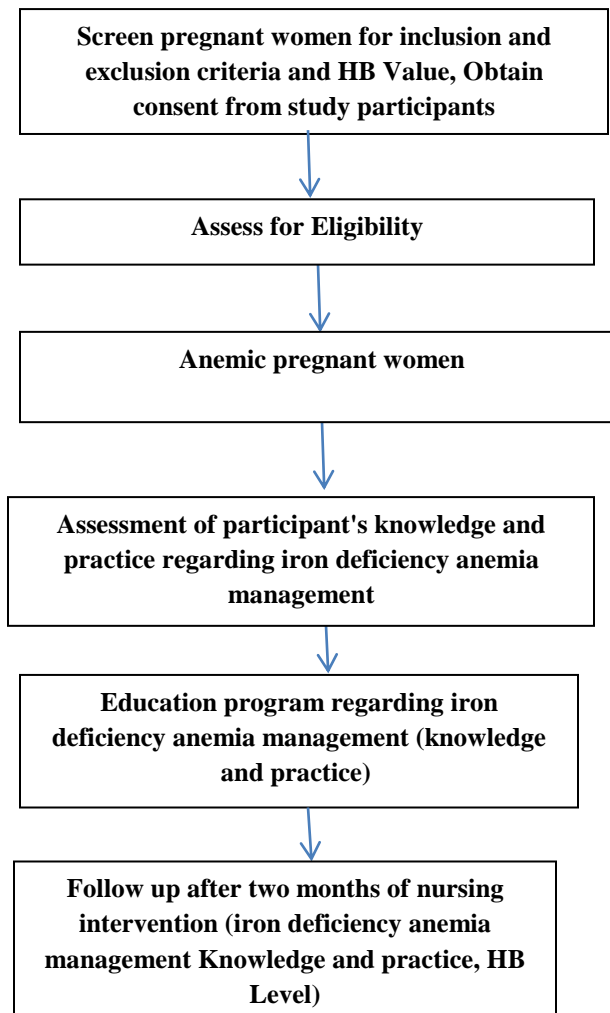
During mobile massages, researchers asked women if they had adapted the nursing intervention given previously and included giving information related to iron deficiency anemia management. Researchers allowed pregnant women to ask any questions they want. Mobile application-assisted nursing intervention was performed for about 6 weeks.

Blood samples were determined by measuring hemoglobin. Blood was collected by venipuncture and drawn into a container. Blood samples were taken from all pregnant women by an expert laboratory technician. All of these tests were performed in a private laboratory of medical analysis. Anemia was defined when hemoglobin <11 g/dL. Blood samples were taken twice; the first time before beginning the nursing intervention and the second time after two months of nursing intervention.

The evaluation phase:

The evaluation was concentrated on examining the effect of the mobile application-assisted nursing intervention on knowledge and practice of pregnant women regarding the iron deficiency anemia management after two months of mobile-assisted nursing intervention implementation by using Tool 1. The hemoglobin level of pregnant women was also assessed after two months of nursing intervention.

Maternal sociodemographic and Obstetric Status

Independent Variable

Maternal Nutritional Knowledge and Practice

Anemic Pregnant Women

Pre Test Group

Post Test Group

Compare between pre and posttest Group

Dependent variable

Primary outcomes

-Improved pregnant women knowledge level regarding iron deficiency anemia Management

- Enhanced pregnant women practice level regarding iron deficiency anemia Management

Secondary Outcomes

- Improved Blood HB Level

Healthy Pregnant Women

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┌──────────────────────────────────────┐
│  Screen pregnant women for inclusion  │
│  and exclusion criteria and HB Value, │
│   Obtain consent from study           │
│            participants               │
└──────────────────────────────────────┘
                  │
                  ▼
┌──────────────────────────────────────┐
│         Assess for Eligibility        │
└──────────────────────────────────────┘
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│        Anemic pregnant women          │
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                  ▼
┌──────────────────────────────────────┐
│  Assessment of participant's          │
│  knowledge and practice regarding     │
│  iron deficiency anemia management    │
└──────────────────────────────────────┘
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                  ▼
┌──────────────────────────────────────┐
│  Education program regarding iron     │
│  deficiency anemia management         │
│  (knowledge and practice)             │
└──────────────────────────────────────┘
                  │
                  ▼
┌──────────────────────────────────────┐
│  Follow up after two months of        │
│  nursing intervention (iron           │
│  deficiency anemia management         │
│  Knowledge and practice, HB Level)    │
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Statistical analysis:

After completion of data collection, data were revised, coded, computed, and analyzed using statistical package for social sciences (SPSS) version 23. Frequency distribution, percentages, mean and standard deviation were calculated, Chi-square and Paired sample T-test were used to describe the level of statistical significance which was considered at $p < 0.05$.

Results

Table (1) represented that 49% of pregnant women their age ranged between $22 < 26$ years and their mean age 20.10 ± 6.57. (30%) of them had secondary education,

meanwhile, (81%) of them lived at rural residence (68%).

Figure (1) pointed out that (69%) of pregnant women were housewives.

As shown in **table 2,** (50%) of the pregnant women were multigravida, 60% of them were not aborted before, and 44% were in the second trimester. Also, it was observed that 19% of them have a previous history of anemia.

Table (3) showed that 53% of pregnant women do not use iron tablets regularly, and 17% of them don't use them pre intervention which improved to be used regularly among 62.9% of pregnant women after mobile application assisted nursing intervention. Also, it observed

that 14% of pregnant women drink iron with milk pre intervention that has been improved after mobile application assisted nursing intervention to not drink iron tablets with milk.

Figure (2) pointed out that causes of refusal to use iron tablet 37% and 15% respectively of pregnant women reported causes related to forgetting and fear of having a baby with abnormalities.

It was observed from the **table (4)** that 67% of pregnant women had a poor level of knowledge regarding iron deficiency anemia management before intervention as compared to 5% after the intervention, While, 89% of them had a good level of knowledge after intervention as compared to 4% before intervention with statistically significant differences (p= 0.004).

Table (5) highlighted that 86% of pregnant women had an inadequate level of practice regarding iron deficiency anemia management before intervention as compared to 10% after the intervention, While, 90% of them had an adequate level of practice regarding iron

deficiency anemia management after intervention as compared to 14% before intervention with statistically significant differences (p= 0.000).

Table (6) showed that 29% of pregnant women have a moderate level of anemia post-intervention (second time) compared to 93% of them pre-intervention (first time). This result indicates a highly significant difference between the first and second times of measuring hemoglobin level.

Table (7) showed that there was a statistically significant relationship between pregnant women's total knowledge and their reported practice regarding iron deficiency anemia management throughout the intervention phases (**R**=.87, **P**=0.001*).

Table (8): illustrated that there was a statistically significant relationship between the age, educational level, and residence of the pregnant women and their knowledge, and practices level throughout the phases of the intervention**.**

Table (1): Distribution of studied pregnant women according to their demographic characteristics (n=210)

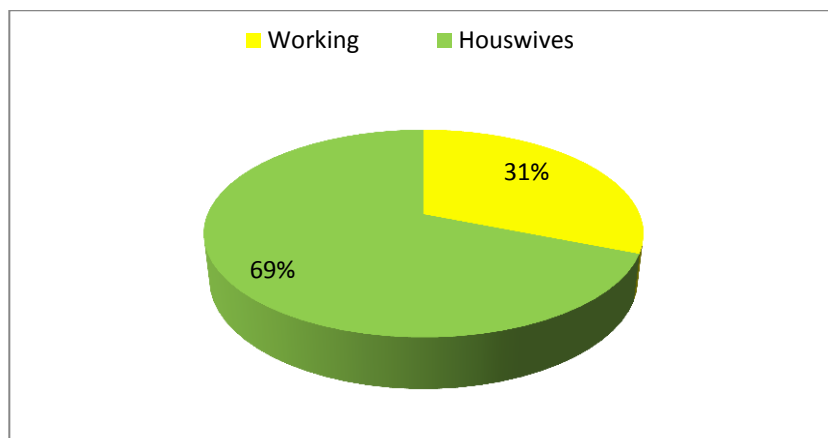| Item	Pregnant women (210)	
	No.	**%**
Women ' age in years		
18 < 21	48	23
22 < 26	103	49
27 < 30	40	19
31 < 35	19	9
Mean ±Stander deviation	20.10 ± 6.57	
- Women ' education		
- Illiterate	19	9
-Read and write	42	20
-Basic education	38	18
-Secondary education	63	30
-University education	48	23
-Residence		
-Rural	170	81
-Urban	40	19

Figure (1): Distribution of studied pregnant women according to their occupation

Table (2): Distribution of pregnant women according to their obstetrical history (n=210)

Item	Pregnant women (210)	
	No.	%
Gravida		
- Primigravida	84	40
- Multigravida	105	50
- Grand Multigravida	21	10
Abortion		
- Less than 2	67	32
- More than 2	17	8
- No abortion	126	60
Pregnancy stage		
- First Trimester	92	44.0
- Second Trimester	76	36.0
- Third Trimester	42	20
Having anemia previously		
- Yes	40	19
- No	170	81

Table (3): Distribution of pregnant women according to their use of iron supplement before and after mobile application assisted nursing intervention (no =210)

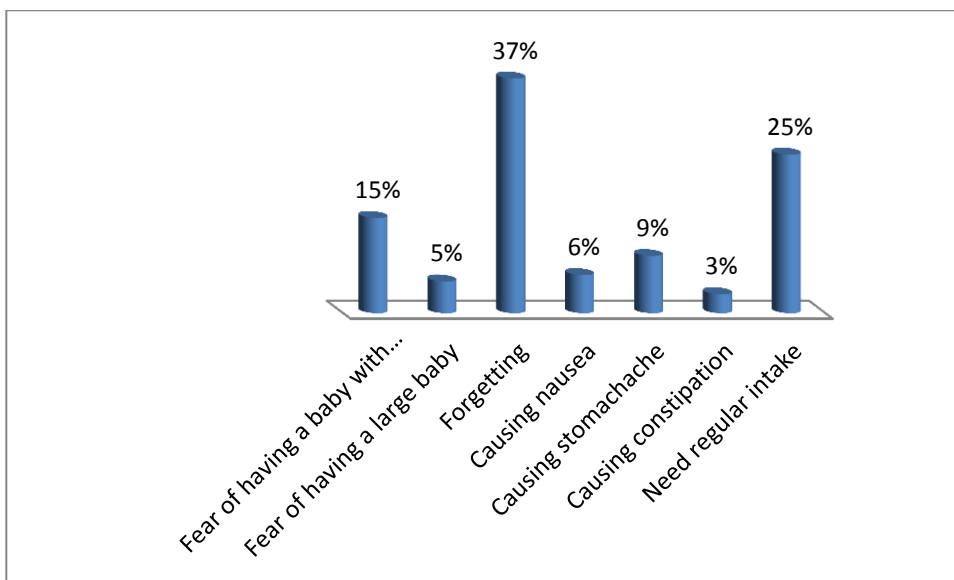| Item	Pre-intervention		Post intervention		P-value
	No	%	No	%	
Patten of using Iron					
Regular	63	30	132	62.9	<0.001*
Irregular	111	53	36	17.1	
Don't take	36	17	42	20	
Drinks took with Iron tablet					
Water	132	62.9	168	79.9	<0.001*
Milk	29	14	0	0	
Juice	13	6	36	17.1	
Don't take it	36	17.1	6	3	

Figure (2): Distribution of studied pregnant women according to the causes of refusal using iron tablet

Table (4): Distribution of the studied pregnant women regarding their levels of Knowledge before and after mobile application assisted nursing intervention (no =210)

Items	Pregnant women s' scores knowledge			
	Pre-intervention		Post-intervention	
	No	%	No	%
Poor level (≤ 50%)	141	67	10	5
Average (60- %)	61	29	13	6
Good (≥ 70%)	8	4	187	89
X2= 15.52, p-value=0.004				

Table (5): Distribution of the studied pregnant women regarding their levels of practice before and after mobile application assisted nursing intervention (no =210)

Items	Pregnant women s' scores eating practices			
	Pre-intervention		Post-intervention	
	No	%	No	%
Inadequate	181	86	21	10
Adequate	29	14	189	90
X2= 8.233, p-value=0.000				

Table (6): Distribution of the studied pregnant women regarding their hemoglobin level before and after mobile application assisted nursing intervention (no =210)

Items	Pregnant women' hemoglobin level			
	Pre-intervention		Post-intervention	
	No	%	No	%
≥11	0	0%	47	22.4
Mild (10.0 to 10.9 g/dl)	13	6	102	48.6
Moderate (7.0 and 9.9 g/dl)	195	93	61	29
Severe (less than 7.0 g/dl)	2	1	0	0
X2= 11.813 , p-value=0.001				

Table (7): Correlation between pregnant women' total knowledge and their total reported practice score

Knowledge	Pregnant women' practice			
	Pre		Post	
	R	P	R	P
Pre	.42	.047*	-	-
Post	-	-	.87	0.001*

Table (8): Correlations between pregnant women's knowledge and practices toward anemia and their demographic characteristics (n=280).

Items	Knowledge	Practices
Pre-intervention		
Age	-.132	.065
Education	.135	.185
Residence	-.103	-.152
Occupation	.061	-.066
Post-intervention		
Age	-.204	-.253*
Education	.307**	.349**
Residence	.302**	.352**
Occupation	.086	-.005

(*) Statistically significant at p<0.05

Discussion:

Lack of nutritional knowledge and consequently improper practice considered one of the most important reasons for a nutritional problem which can cause complications such as malnutrition and non-contagious diseases. Anemia affected more than two billion people worldwide. Also, The World Health Organization mentioned that 58% of pregnant women in developing countries are anemic. However, having knowledge about iron deficiency anemia prevention and management and following through with proper practice can completely prevent and control anemia during pregnancy **(Tanay et al., 2014).** This study aimed at evaluating the effectiveness of the mobile application-assisted nursing intervention on knowledge and practice of pregnant women regarding the management of iron deficiency anemia**.**

The current study findings reported that pregnant women's age ranged between twenty two to twenty six years. This result is compatible with the results of **the Palestinian Central Bureau of Statistics, (2014)** that

indicates the age of pregnant women in his study was in the same range.

The study findings indicated that more than two-thirds of pregnant women were housewives. These results were consistent with **Amer et al., (2010)** who stated that more than two-thirds of pregnant women in the study group are housewives.

The findings of the present study indicated that half of the pregnant women were multigravida, these results are reliable with the finding of **Amer et al., (2010)** who studied " Effect of nutritional intervention on anemic pregnant women's health using health promotion" and indicated that about half in the study group got pregnant for 1-3 times.

The present study findings indicated that about one-fifth of pregnant women have a previous history of anemia. This result is matched with a report of **World Health Organization, (2011)** which indicated that a high proportion of women enter pregnancy with anemia.

The findings of the present study revealed that more than half of pregnant women don't use iron regularly. Regarding causes of refusal to use iron; forgetting and

fear of having a baby with abnormalities were reported by nearly one-third of pregnant women. These findings are supported by **Winichagoon, (2012**) in a study about developing a strategy to combat anemia in Thailand, who reported that "fear of having a large fetus, forgetfulness and side effects were important reasons for low compliance with iron supplementation. In contrast, **Yeketa (2008**) reported that "high intake of iron supplementation, reached the majority among pregnant women.

The findings of the present study revealed that there was an improvement to use iron tablets regularly among about two thirds of pregnant woman after mobile application assisted nursing intervention. This is reflected the importance and positive effect of the mobile application assisted nursing intervention was introduced to woman.

The findings of the present study revealed that more than two-thirds of pregnant women were taken iron tablets with water. This result is similar to **Amer et al., (2010)** who reported the same result. This could explain why women do not benefit from an iron supplement. **Hillary, (2012)** in a study conducted in Peru regard improving dietary intake to prevent anemia in girls, indicated that total iron absorption from the meal is preferred with using juice and sources of vitamin C with iron supplement and food. In addition to **Schumann, (2007) and Waweru, (2009),** who stated that the absorption rates of iron could rise significantly from less than five percent to more than fifteen percent when taking iron using vitamin c source. This is reflected in the poor practices of pregnant women regarding iron supplement use.

Regarding pregnant women's knowledge level about the management of iron deficiency anemia, the current study findings indicated that about two-thirds of pregnant women had a poor level of knowledge before the intervention; meanwhile, the majority of them had a good level of knowledge after the intervention. This is attributed to the positive effect of the intervention. This result is supported by **Abujilban et al., (2019)** who studied the impact of a planned health educational program on the compliance and knowledge of Jordanian pregnant women with anemia and found that pregnant women had higher scores of

knowledge about iron deficiency anemia management after nursing intervention

About pregnant women practice level regarding the management of iron deficiency anemia, the findings of the present study indicated that the majority of pregnant women had inadequate level of practice before the intervention; meanwhile, the majority of them had an adequate level of practice after the intervention. This is reflected the important role of the intervention in improving pregnant women's practice regarding management of iron deficiency anemia. This result is supported by **Abd ElHameed et al (2012)** who studied the effect of nutritional educational guideline among pregnant women with iron deficiency anemia at rural areas in Kalyobia governorate and found that nutritional educational guideline can bring about an improvement in knowledge and practice of pregnant women toward Iron deficiency anemia. In addition to **Nahrisah et al., (2019)** who studied the effect of integrated pictorial handbook education and counseling on improving anemia status, knowledge, food intake, and iron tablet compliance among anemic pregnant women in indonesia and showed enhancement of iron-rich food intake in diversity, weight of food (portion) and frequency of intake among pregnant women after intervention

Regarding pregnant women's Hb value before and after the nursing intervention, the findings of the present study indicated that nearly one-third of pregnant women had moderate anemia after nursing intervention (second time) compared to ninety-three percent of pregnant women before intervention (first time). This result indicates a high significance difference and improvement between the first and second time of measuring hemoglobin level before and after intervention which explained the effect of the intervention on the improvement of hemoglobin level in the study group, post-intervention. These findings were in line with a study by **World Health Organization, (2018)** that mentioned that "many pregnant women enter pregnancy with the low iron store. While post-intervention, the study showed improvement in hemoglobin level.

These results also were in the same line with a study done by **Irbihat, et al., (2011)** that

showed improvement in hemoglobin level post-education in their study among Indian pregnant women and reported significant improvement in the hemoglobin level among the interventional group compared to the non-interventional group.

The findings of the present study revealed that there was a statistically significant relationship between pregnant women's total knowledge and their reported practice throughout the intervention phases. This association is explained by improvement in knowledge which reflected on improvement in pregnant women practice regarding iron deficiency anemia management. This result is supported by **Hershko and Camaschella, (2014)** who conducted a study about how I treat unexplained refractory iron deficiency anemia and found that the subjects' knowledge about management and prevention of iron deficiency anemia during pregnancy was significantly associated with their practice.

The findings of the present study revealed that there was a statistically significant relationship between the age, educational level, and residence of the pregnant women and knowledge, and practices throughout the phases of the intervention**.** This result may be related to the fact that pregnant women's knowledge and practice are integrated and was affected with sociodemographic factors; from the researcher's point of view, there is a positive association between pregnant women's knowledge and their practice.

Conclusion:

From the results of the current study, it was concluded that two-thirds of pregnant women had a poor level of knowledge before the intervention, while, majority of them had a good level of knowledge regarding iron deficiency anemia management after the intervention. The majority of pregnant women had inadequate level of practice before the intervention, while, most of them had an adequate level of practice regarding iron deficiency anemia management after the intervention. Mobile application-assisted nursing intervention proved positive changes and improving the knowledge and practice among pregnant women regarding the management of iron deficiency anemia during

pregnancy. Blood Hemoglobin level of pregnant women who received the mobile application assisted nursing intervention during pregnancy about iron deficiency anemia management has been improved after intervention than before. There is a significant statistical relationship between the demographic characteristics of the studied pregnant women and their level of knowledge and practice about iron deficiency anemia management.

Recommendations:

Mobile application-assisted nursing intervention should be used in various Maternity health care settings**.** Health educational programs should be provided for pregnant women about iron deficiency anemia management. The educational booklet should be disturbed to pregnant women about iron deficiency anemia prevention and management. Further research should be done about effect of using new technology among pregnant women on awareness regarding most common problems during pregnancy.

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