

Effect of Nutritional Program on Anemic Status and Pregnancy outcome among Pregnant Women Suffering from Iron Deficiency Anemia

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Abstract

Background: Iron deficiency anemia (IDA) is the most common nutritional disorder during pregnancy. **The aim of this study:** was to determine the effect of nutritional program on anemic status and pregnancy outcome among pregnant women suffering from iron deficiency anemia. **Subjects and Method:** The study was carried out at antenatal inpatient units and outpatient clinics in obstetrics and gynecological department at Tanta University and El-Menshawy Hospitals and four governmental antenatal clinics in Tanta city. Convenient sample of 60 pregnant women were included in the study and fulfilling the inclusive criteria. Five tools were used: **Tool (I): A structured interview schedule** included four parts: (a) Socio-demographic data, (b) Reproductive history, menstrual history, antenatal booking and attendance of antenatal care classes regarding IDA, (c) Current health history of women included: medical, surgical and also family history (d) History of iron deficiency anemia during current pregnancy. **Tool (II): Women's knowledge assessment interview:** it included two parts: a) Women's knowledge about iron deficiency anemia and b): Assessment of pregnant women's self-care measures and nutritional habits regarding iron deficiency anemia. **Tool (III): Iron Intake Calculation Food Frequency Questionnaire** it was used to assess women's iron dietary intake. **Tool (IV): Bio-physiological measurement** included: (a) Anthropometric measurements :Body Mass Index and Mid Upper Arm Circumference (MUAC), (b) Physical examination: to assess signs of iron deficiency anemia, (c) Measurement of serum hemoglobin level on capillary blood using *one touch hemoglobin device*(d) Stool analysis: was done to exclude parasitic infestation. **Tool (V): Outcome assessment tool:** included two parts, (a) Maternal outcome assessment sheet and (b) Neonatal outcome assessment sheet. **Results:** It revealed that mean blood hemoglobin level had increased from (9.05±0.98) pre-program to (11.8±0.95) at the end of the 2nd trimester and (10.74±0.93) at the end of the 3rd trimester. **Conclusion:** Significant improvement of the level of knowledge, dietary habits, anemic status (hemoglobin level) and the maternal & neonatal outcome were found after implementation of the program. **Therefore, the study recommended:** developing antenatal educational classes for all pregnant women to increase their awareness about importance of early and regular antenatal care as well as proper screening for early diagnosis and effective management of IDA to improve their pregnancy outcome.

Keywords: Iron Deficiency Anemia during Pregnancy, Anemic Status, Maternal outcome, Neonatal outcome, and Nutritional Program

Introduction

Pregnancy is an event of a considerable importance in the life cycle of the women. Health care system should give special attention to the pregnant women health as their health directly affect the health of the fetus where mother supply all the nutrients necessary for the developing embryo and fetus so nutrition of pregnant women is an important issue. The most common nutritional deficiency during pregnancy which lead to iron deficiency anemia IDA⁽¹⁾. The World Health Organization WHO IDA during pregnancy as hemoglobin level less than 11 g/dl regardless of gestational trimester. The incidence of iron deficiency anemia during pregnancy in Egypt varied from 45%, 52.5%, 32.5% to 73.8% in 2008, 2015, 2018 and 2019 respectively⁽²⁻⁴⁾. Iron deficiency anemia may occur during pregnancy due to many causes such as; deficient intake of iron rich diet, impaired absorption of iron, increased requirement (27g/day) and deficient iron stored in the body leads to drop in the hemoglobin level. Iron is key ingredient used to make the hemoglobin, which is protein found in red blood cells, it traps oxygen from the lungs and carries it around the body. When hemoglobin reaches a low level, less oxygen can be carried in the blood. This may cause symptoms such as: general weakness, headache, dyspnea on exertion,

easy fatigability, palpitation, dizziness, pallor and also irritability⁽⁵⁻⁸⁾.

Nutritional status of pregnant woman is the most important determinant of pregnancy outcome, subsequently untreated iron deficiency anemia has adverse consequences on pregnant woman and fetus such as: increasing perinatal risks for mothers and neonates, low birth weight (LBW) and preterm birth. Also, it reduced the maternal work capacity, physical activity and productivity, increasing incidence of ante-partum, intra-partum and post-partum hemorrhage and also increasing maternal and fetal morbidity and mortality^(9,10).

Management of iron deficiency anemia during pregnancy depends on the severity and underlying cause of anemia. Mild and moderate iron deficiency anemia can be prevented and treated by dietary modification and oral iron supplementation. While, in case of severe iron deficiency anemia (less than 7g/dl), it requires treatment by parenteral iron preparations (intravenous and intramuscular) and/or blood transfusion in severe, non-responsive or emergent cases⁽¹¹⁻¹³⁾.

Nurse has a crucial role as a member of the health care team. She has an important role in promoting and maintaining women's

health through her efforts in different health care settings. The principle goals of prenatal care are to monitor both the pregnant woman and the fetus throughout pregnancy and to identify any factors that could change the outlook of the pregnancy from normal to risky. Prenatal care also focuses on providing accurate information regarding daily nutritional requirements throughout pregnancy, common complaints that may arise during pregnancy and hope to manage them through nursing nutritional education regarding IDA during pregnancy, preferably without medications to avoid its side effect^(14,15).

The primary nursing goal of nutritional education and dietary modification is improving and maintaining the iron status of pregnant women, which involves changing in behavior that lead to an increase in the selection of iron rich food (such as: meat, fish, poultry and non-animal food as legumes and green leafy vegetables). In addition, food that optimize iron absorption (such as: vitamin C which presents in fruits, juices, potatoes and some other vegetables such as green leaves, cauliflower and cabbage) should be increased. On the other hand, food that hinder iron absorption (such as calcium, very fatty foods, phytates and also tannins

that presents in tea and coffee) should be also decreased⁽¹⁶⁻¹⁸⁾.

The majority of Egyptian women had a harmful nutritional practice during pregnancy such as: increase consumption of tea which contribute to high incidence of IDA which can cause serious effect on pregnancy outcome⁽²⁾. Also, the Egyptian pregnant women had poor knowledge related to iron deficiency anemia⁽³⁾. Constant measuring hemoglobin level is used as indicator of iron status as it is a simple and inexpensive test^(19,20). So, nutritional program is a necessary step for better improvement of the anemic status and pregnancy outcome among pregnant women suffering from iron deficiency anemia.

Aim of the study

The aim of this study was to determine the effect of nutritional program on anemic status and pregnancy outcome among pregnant women suffering from iron deficiency anemia.

Research hypothesis

Nutritional program is expected to improve the anemic status and pregnancy outcome of pregnant women suffering from iron deficiency anemia.

Subjects and Method

Research design

A quasi experimental research design was used to determine effect of nutritional

program on anemic status and pregnancy outcome among pregnant women suffering from iron deficiency anemia.

Setting

The study was carried out at antenatal inpatient units and outpatient clinics in obstetric and gynecological department at *Tanta University* and *El-Menshawey Hospital* affiliated to Ministry of Health and from four governmental antenatal clinics affiliated to the different available geographical health zones in Tanta city which include: Tanta rabae at Kohafa, Medical center at Said, Tanta Khamesat El-agizy and Medical center at Sager.

Subjects

A convenient sample of 60 pregnant women was selected from previously mentioned settings. The subjects of this study were selected according to the following:

Inclusion criteria

1. Age ranged between 20-35 years.
2. Gestational weeks during their 2nd trimester of pregnancy (20th week).
3. Primi and multigravida women.
4. Women suffered only from iron deficiency anemia (Hb less than 11gm/dl).

Exclusion criteria

1. Other medical and obstetrical complications.
2. Multiple gestations.

3. Severe anemia(Hb less than 7gm/dl).

Tools of data collection

To achieve the aim of the study five tools were used for data collection:

Tool (I):A structured interview schedule was developed by the researcher after review of relevant recent literatures to collect basic data. It consisted of four parts as follows:-

Part a

Socio-demographic data of the women:It was used to collect data about; name, age, level of education, marital status, occupation, residence, family type and family income.

Part b

Reproductive history included: gravidity, parity, spacing period, number of abortion, number of still birth, number of living children, mode and place of past deliveries, and previous complications with previous pregnancies, deliveries, and puerperium (as iron deficiency anemia), previous fetal and neonatal complications. **Menstrual history:** such as age at menarche, regularity of menstruation, duration and interval of the cycle, and also the amount of menstrual blood loss. Last menstrual period (LMP) and expected date of delivery (EDD). **Antenatal booking:** included time of initial antenatal care visit, numbers of antenatal visits, follow-up visits, and attendance of antenatal care

classes especially related to iron deficiency anemia.

Part c

Current Health history referred to assessment of the following:

Medical history: such as history of parasitic infestation and history of taking medications that inhibit iron absorption,

Surgical history: referred to previous operations, intra or postoperative bleeding, and also **Family history:** presence of family history of iron deficiency anemia.

Part d

History of iron deficiency anemia during current pregnancy: It included questions related to time of diagnosis of the disease, presence of any risk factors of IDA, onset of symptoms, medical and laboratory follow-up for IDA, hemoglobin level, degree of IDA, method of treatment, presence of complications as well as the need for blood transfusion or hospitalization. In addition, hemoglobin level recorded from patient hospital record at time of hospitalization or from antenatal clinical file. Intake of iron supplementation in the last six months (dose, frequency and duration of use). Symptoms related to iron deficiency anemia as: general weakness, headache, dyspnea on exertion, easy fatigability, palpitation, dizziness, pallor, irritability and also numbness in hands or feet.

Tool (II): Women's knowledge

assessment interview: This tool was developed by the researcher after reviewing of related literature, it was included two parts:

Part (a):

Women's knowledge about iron deficiency anemia included: meaning, signs & symptoms, risk factors, sources of iron rich foods, importance of iron supplementation, inhibitors and promoters of iron absorption, complications and effects of iron deficiency anemia on maternal and fetal outcome, the score of each item was summed up and then was converted into percent score, adapted from (Ahamed et al. 2018)⁽³⁾.

The total scoring system of knowledge:

correct and complete answers were scored as (2), correct and incomplete answers were scored as (1) and incorrect answers or don't know were scored as zero (0).

The total score for knowledge was calculated as follows: good knowledge: 65-100%, fair knowledge: 50- to less than 65% and poor knowledge: 0- to less than 50%.

Part(b):

Assessment of pregnant women's self-care measures and nutritional habits regarding iron deficiency anemia: It was included questions related to:

- Self-monitoring of hemoglobin level or laboratory test regularly (not performed or performed).
- Self-monitoring of daily fetal movement, rest, sleep and fluid intake (adequate or inadequate).
- Number of regular meals per day (\leq two meals, three meals or \geq four meals per day).
- Eat iron rich food as meat, liver, fish and poultry intake (\leq one time, two times or \geq three times per week).
- Eat food rich in vitamin C as citrus fruits or tomatoes to enhance the absorption of iron (\leq one time, two times or \geq three times per week).
- Use of substances that could decrease iron absorption as drinking tea (frequency per day: 1-2 times or \geq 3 times per day, timing in relation to meal: with meal, directly after meal, 1-2hours after meal or >2hours after meal).

Tool (III): Iron Intake Calculation Food Frequency Questionnaire (IRONIC-FFQ). It was used to assess women's iron dietary intake. This tool was adapted by the researcher from (Glabskaet al.2017)⁽²¹⁾, it was translated and modified by the researcher according to the Egyptian Food Composition Table⁽¹³¹⁾ included all food products that were

characterized by iron content no lower than 0.1mg per 100g, iron intake was analyzed and calculated according to iron content in each product.

The total scoring system of IRONIC-FFQ was recorded as: Adequate iron intake \geq 27mg per day and inadequate iron intake < 27mg per day.

Tool (IV): Bio-physiological measurements:

It included four parts as follows:

Part (a):

Anthropometric measurements:

Body Mass Index (BMI) was calculated by the equation:

$$\text{BMI} = \text{Weight}/(\text{Height})^2$$

Mid upper arm circumference (MUAC):

This tool was adopted from (Muthoni, 2017)⁽²²⁾. It refers to the circumference of the left upper arm and was measured at the midpoint between the tips of the shoulder and elbow. It was used to identify risk of severe acute malnutrition and acute energy deficiency of pregnant women.

Part (b):

Physical examination: complete physical examination was performed to assess signs of iron deficiency anemia (pallor, dyspnea, tachycardia, hypotension, hair and nail brittle).

Part (c):

Measurement of serum hemoglobin level on capillary blood using one touch

hemoglobin device. The fingertips of each woman was pierced using a sterile lancet and the first drop of blood was removed with a sterile cotton swab. Drops were collected directly into a special cuvette. The apparatus converted the readings into Hb and displayed the results digitally (g/dl). Then, the concentration of Hb was recorded on the study interview sheet of each woman.

The total scoring system (WHO, 2011)⁽²³⁾ of Iron deficiency anemia was classified according to Hb level as: mild IDA (10-10.9 g/dl), moderate IDA (7-9.9 g/dl), or severe IDA (<7 g/dl).

Part (d):

Stool analysis: was done to exclude parasitic infestation.

Tool (V): Outcome assessment tool: This tool was developed by the researcher and was used to evaluate maternal and neonatal outcome. It included two parts.

Part I:

Maternal outcome assessment sheet, it included: mode of rupture of membrane (spontaneous or artificial), mode of delivery (vaginal delivery, forceps delivery or cesarean section), occurrence of maternal distress or maternal sepsis as evidenced by: dehydration (dry mouth and lips), pyrexia, pallor, palpitation, lower abdominal pain, tachypnea, diarrhea and vomiting, in addition to arising

complications that occurred during labor and postpartum such as intra partum and early postpartum hemorrhage, early symptoms of postpartum sepsis, and uterine sub involution.

Part II:

Neonatal outcome assessment sheet, it included: viability status- alive or stillborn, full term/ preterm, need for resuscitation and oxygen administration, visible congenital anomalies, birth weight, and arising complications as neonatal respiratory distress, cyanosis and /or neonatal jaundice.

Method

The study was implemented according to the following steps:

1. Administrative approval:

An official letter clarifying the purpose of the study was obtained from the Faculty of Nursing and was submitted to the responsible authorities of the selected settings.

2. Tool development :

The tools were developed after reviewing recent relevant literature. Then, they were translated and tested for content and construct validity. All tools were tested for reliability by six women using appropriate statistical method.

3. Ethical considerations

Women who were participated in the study have been met by the researcher and the purpose of the study was explained for them. An informed consent from the participants for participation in the study was obtained from the entire sample. The researcher ensured that the nature of the study was not causing any harm and/or pain for the entire sample. Also, confidentiality and privacy have been put into consideration regarding the data collection and the participant's rights to withdraw from the study at any time.

4. Pilot study

After the development of the tool, a pilot study was carried out on 10% of the sample (6 women) from the previously mentioned setting to ascertain the feasibility and applicability of the tools. The data which was obtained was excluded from the study.

The purposes of the pilot study were to:

- Ascertain the relevance and content validity of the tool.
- Detect any problem peculiar to the statement as sequence and clarity.
- Estimate the time needed to complete the study.

5. Collection of data

The data was collected through 4 phases as follows

a. Assessment and planning phase

- The researcher had met each pregnant woman(at the beginning of their second trimester) in the previously mentioned settings, greeted her respectfully with kindness to gain her cooperation, introduced herself to the woman, explained the aim of the study, time needed for the program and took the informed consent. Then, the structured interview schedule was then conducted individually for each woman and basic data was collected using (Tool I).
- The women were assessed about their knowledge, self-care measures and nutritional habits regarding iron deficiency anemia using (Tool II).
- Iron dietary intake was assessed prior to the nutritional program using (Tool III).
- Also, anthropometric measurements as BMI and mid upper arm circumference, physical examination, hemoglobin level and stool analysis were assessed for each woman before the nutritional program\((at the beginning of their second trimester) using (Tool IV).

b. Planning phase

The nutritional program was developed by the researcher based on women's

needs and recent literature review. It included:

- Different methods of teaching as lecture, posters, power point, demonstration and re-demonstration for participants. Instructional nutritional booklet was prepared by the researcher, it included nutritional guidelines to pregnant women regarding information about meaning, causes, symptoms, risk factors, complications, diet rich in iron (as meat, fish, poultry, and green leafy vegetables), importance of iron supplementation, treatment, inhibitors (as drinking tea with meal) and also promoters of iron absorption (rich in vitamin C as citrus fruits or tomatoes).

c. Implementation phase (nutritional program sessions)

- The nutritional program was consisted of four sessions, the duration of each session, was 10- 15 minutes.
- The sessions were applied individually or in group according to the availability of cases.
- The sessions were conducted as follow:

Session (1): It included orientation and expectation.

Session (2): An overview of iron deficiency anemia. The aim of this session was to provide the women with knowledge about meaning, causes, symptoms, risk

factors, maternal and fetal effect, importance of iron supplementation and treatment of IDA.

Session (3): Referred to nutritional guidelines for iron deficiency anemia. The aim of this session was to enable the pregnant women to recognize the importance of iron, daily allowance of iron during pregnancy, forms of iron, diet rich in iron (as meat, fish, poultry and green leafy vegetables), nutritional habits that enhance iron absorption (eat food rich in vitamin C as citrus fruits or tomatoes) and nutritional hazards that inhibit iron absorption (as drinking tea with meal).

Session (4): Concerned with the self-care measures and self-assessment of hemoglobin level and symptoms of iron deficiency anemia. The aim of this session was to demonstrate and re-demonstrate of women's self-care measures such as how to assess hemoglobin level, the presence of symptoms of IDA as: general weakness, headache, dyspnea on exertion, easy fatigability, palpitation, dizziness, pallor, irritability and also numbness in hands or feet.

d. Evaluation phase

- Women's knowledge about iron deficiency anemia were assessed pre-program (at the beginning of the second trimester), immediate post-program (at the beginning of the

second trimester), at the end of the second trimester and at the end of the third trimester using (**Tool II, part a**).

Also, women's self-care measures and nutritional habits regarding IDA were assessed pre-program, post-program at the end of the second trimester and at the end of the third trimester using (**Tool II, part b**).

- Iron dietary intake of each woman was assessed pre-program, post-program at the end of the second trimester and at the end of the third trimester using (**Tool III**).
- Anthropometric measurements(it refers to the circumference of the left upper arm and was measured at the midpoint between the tips of the shoulder and elbow), physical examination was done to assess signs and symptoms of IDA and laboratory investigations as hemoglobin values were assessed for each women pre-program, post-program at the end of the second trimester and at the end of the third trimester using (**Tool IV, parts a,b&c**).
- Maternal and neonatal outcomes were recorded after delivery using (**Tool V**).
- Follow up was done during neonatal first immunization or through telephone call.

- Data collection have been conducted through one year (from April 2019 to April2020).

6. Statistical analysis

- Results were tabulated and statistical analysis was performed with the Statistical Package for Social Science (SPSS version 21). For quantitative data, the range, mean and standard deviation were calculated. For qualitative data, the difference was statically analyzed using Chi-Square test (X^2). P values of < 0.05 were considered statically significant.

Results

Figure (1): Reveals the severity of anemic status among the studied women pre-program. It was observed that nearly two third (63.3%) of women had moderate anemia compared to slightly more than one third (36.7%) who had mild anemia.

Table (1): Shows the socio-demographic characteristics of the studied women. It was observed that slightly more than half (54.5% and 52.6%, respectively) of women who had mild and moderate anemia aged more than 30 years old. It was also noticed that (63.6%) of women who had mild anemia had university education compared to (42.1%) of women who had moderate anemia were read and write only with statistically significant difference ($X^2 = 12.45$ and $p= 0.006$). It is demonstrated that the majority (95.5% and 94.7%,

respectively) of women who had mild and moderate anemia were married.

Concerning the occupation, it was found that (72.7%) of women who had mild anemia were housewives compared to (68.4%) of women who had moderate anemia were workers, there was statistically significant difference ($X^2 = 9.55$ and $p= 0.002$).

This table also clarifies that (72.7%) of women who had mild anemia were from rural areas compared to (63.2%) of women who had moderate anemia were from urban areas with statistically significant difference ($X^2 = 7.27$ and $p= 0.007$). Meanwhile, it was noticed that slightly more than half (54.5% and 52.6%, respectively) of women who suffered from mild and moderate anemia had enough family income. Moreover, it was found that (63.6%) of women who had mild anemia lived in nuclear family corresponding to (78.9%) of women who had moderate anemia lived in extended family, there was statistically significant difference ($X^2 = 10.88$ and $p= 0.001$).

Figure (2): Represents the total knowledge score level regarding iron deficiency anemia among the studied women pre and post program (immediately, at the end of the 2nd trimester and at the end of the 3rd trimester). The table clarifies that there

was highly significant statistical improvement in the total knowledge score level of the studied women pre and post program ($p=0.0001$). It was noticed that number of women who had good level of knowledge had increased from (0.0%) pre-program to (85.0%, 80% and 75.0%, respectively) post program (immediately, at the end of the 2nd trimester and at the end of the 3rd trimester).

Figure (3): Shows the daily intake of iron and its sources among the studied women pre-program (at the beginning of the second trimester) and post-program (at the end of the 2nd trimester and at the end of the 3rd trimester). It was noticed that more than half (55.0%) of women were taking inadequate daily iron (iron intake < 27mg) pre-program compared to (66.7% and 76.7%, respectively) of women were taking adequate daily iron (iron intake \geq 27mg) post-program (at the end of the 2nd trimester and at the end of the 3rd trimester) with statistically significant differences ($X^2 =13.46$, $P= 0.001$).

As regard the sources of iron intake, the table also clarifies that the mean iron intake from animal sources was increased from (7.56 \pm 1.36 mg/dl) pre-program to (8.02 \pm 1.24 mg/dl) post-program (at the end of the 2nd trimester), while it was decreased to (7.83 \pm 1.69 mg/dl) post-program (at the end of the 3rd trimester).

Meanwhile, the mean iron intake from plant sources was increased from (18.44±8.38 mg/dl) pre-program to (21.89±8.61 mg/dl) post-program (at the end of the 2nd trimester), then it was decreased to (20.99±8.55 mg/dl) post-program (at the end of the 3rd trimester). Finally, the mean total daily intake of iron was increased from (26.00±8.02 mg/dl) pre-program to (29.91±8.37 mg/dl) post-program (at the end of the 2nd trimester), then it was decreased to (28.82±8.14 mg/dl) post-program (at the end of the 3rd trimester).

Figure (4): Illustrates the blood hemoglobin level (severity of anemia) among the studied women pre and post-program (at the end of the 2nd trimester and at the end of the 3rd trimester). It was evident that none of the women relieved from anemia post-program (hemoglobin level \geq 11 g/dl) pre-program. While, this percent had increased to half (53.3% and 50.0%, respectively) post-program (at the end of the 2nd trimester and at the end of the 3rd trimester). It was noticed that more than one third (36.7%) of women had mild anemia (hemoglobin level 10-10.9 g/dl) pre-program, this percent decreased to less than one third (30.0% and 31.7%, respectively) post-program (at the end of the 2nd trimester and at the end of the 3rd trimester).

The table also portrays that less than two third (63.3%) of women had moderate anemia (hemoglobin level 7-9.9 g/dl) pre-program, this percent decreased to (16.7% and 18.3%, respectively) post-program (at the end of the 2nd trimester and at the end of the 3rd trimester). Regarding the mean blood hemoglobin level, it was increased from (9.05±0.98) pre-program to (11.8±0.95) post-program (at the end of the 2nd trimester), then decreased to (10.74±0.93) post-program (at the end of the 3rd trimester). These differences were highly statistically significant between pre and post-program (at the end of the 2nd trimester) ($X^2 = 48.73$, $P=0.0001$) as well as between pre and post-program (at the end of the 3rd trimester) ($X^2 = 45.10$, $P=0.0001$).

Table (2): Portrays the effect of anemic status of the studied women post-program on maternal outcome. It was evident that there was no statistically significant difference ($X^2 = 4.05$, $P=0.132$) between mode of delivery and anemic status of the studied women, also anemic status did not significantly affect the mode of rupture of membrane ($X^2 = 1.71$, $P=0.425$).

Regarding the complications raised during labor in relation to the iron deficiency status post-program (at the end of the 3rd trimester), it was found that almost all (96.7%) of women who have been relieved

from anemia post-program had no complications compared to (73.7%) of women who revealed mild anemia, had no complications, while (72.7%, 54.5% and 18.2%, respectively) of women who with moderate anemia, had preterm labor, premature rupture of membrane and cord prolapse, there was highly statistically significant difference ($X^2 = 37.05$, $P = 0.0001$).

Concerning the complications raised during early postpartum period in relation to the iron deficiency status post-program (at the end of the 3rd trimester), it was noticed that all (100.0%) of women who have been relieved from anemia post-program had no postpartum complications compared to (5.3% and 27.3%, respectively) of women who revealed mild and moderate anemic status, had uterine sub-involution and postpartum hemorrhage, there was statistically significant difference ($X^2 = 9.71$, $P = 0.008$).

Table (3): Demonstrates the effect of anemic status of the studied women post-program on neonatal outcome. It was obvious that there was highly statistically significant difference between women's anemic status and neonatal birth weight ($X^2 = 21.26$, $P = 0.0001$). Again a highly significant difference was observed between anemic status and neonatal

maturity ($X^2 = 16.63$, $P = 0.0001$). While, anemic status was not significantly affect the neonatal viability ($X^2 = 4.527$, $P = 0.104$).

In addition, it was noticed that the majority (93.3%) of women who relieved from anemia post-program had no neonatal complications compared to (84.2%) of women who revealed mild anemia had no complications, while an equal percentage (54.5%) of women who had moderate anemia reported that there neonates had signs of respiratory distress and needed resuscitation & oxygen administration. Also about (36.3% and 27.3%) of women had report complications as neonatal jaundice as well as low Apgar score, respectively with statistically significant difference ($X^2 = 12.44$, $P = 0.002$).

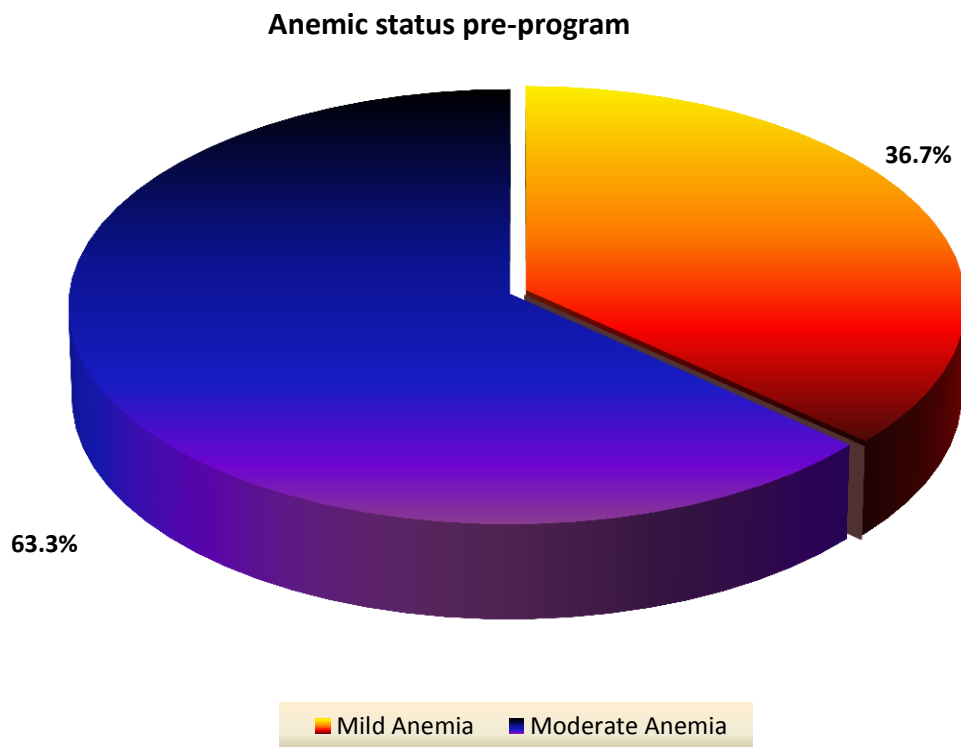


Figure (1): Percent distribution of the studied women regarding the severity of their anemic status pre-program.

Table (1): Percent distribution of the studied women regarding their socio-demographic characteristics.

Women's socio-demographic characteristics	Anemic status				Total (n=60)		X ²	P
	Mild Anemia (n=22)		Moderate Anemia (n=38)		No.	%		
	No.	%	No.	%				
Age (Years)							0.072	0.965
• < 25	4	18.2	8	21.1	12	20.0		
• 25- 30	6	27.3	10	26.3	16	26.7		
• >30	12	54.5	20	52.6	32	53.3		
Rang	23-35		23-35		23-35			
Mean±SD	29.86±4.26		29.95±4.31		29.91±4.26			
Education level							12.45	0.006*
• Read and write	0	0.0	16	42.1	16	26.7		
• Primary or preparatory	6	27.3	6	15.8	12	20.0		
• Secondary	2	9.1	2	5.3	4	6.7		
• University	14	63.6	14	36.8	28	46.7		
Marital status							0.158	0.691
• Married	21	95.5	37	94.7	58	96.7		
• Divorced	1	0.5	1	0.3	2	3.3		
Occupation							9.55	0.002*
• Housewife	16	72.7	12	31.6	28	46.7		
• Worker	6	27.3	26	68.4	32	53.3		
Residence							7.27	0.007*
• Rural	16	72.7	14	36.8	30	50.0		
• Urban	6	27.3	24	63.2	30	50.0		
Family income****							0.021	0.886
• Not enough	10	45.5	18	47.4	28	46.7		
• Enough only	12	54.5	20	52.6	32	53.3		
Family type:							10.88	0.001*
• Nuclear family	14	63.6	8	21.1	22	36.7		
• Extended family	8	36.4	30	78.9	38	63.3		

*Significant: P <0.05**** According to woman's view

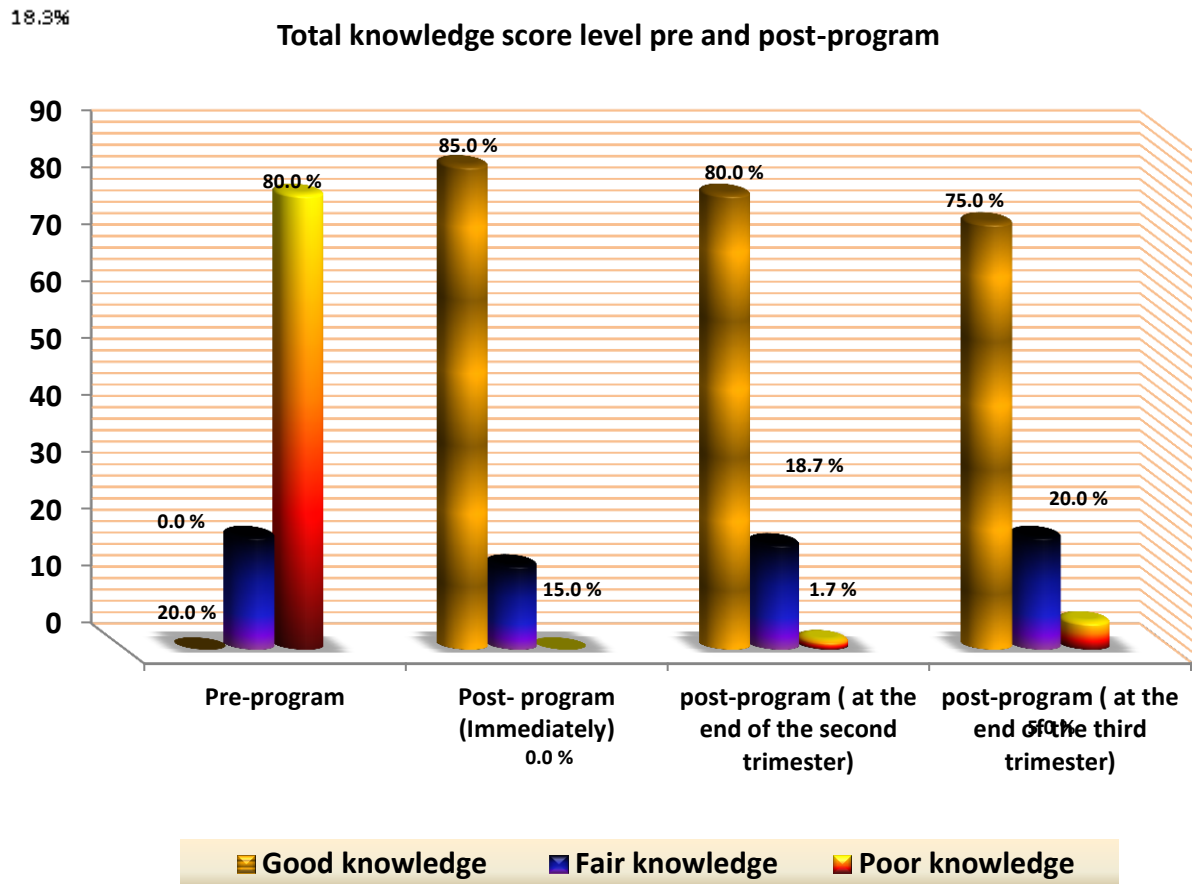


Figure (2): Total knowledge score level regarding iron deficiency anemia among the studied women pre and post program (immediately, at the end of the 2nd trimester and at the end of the 3rd trimester).

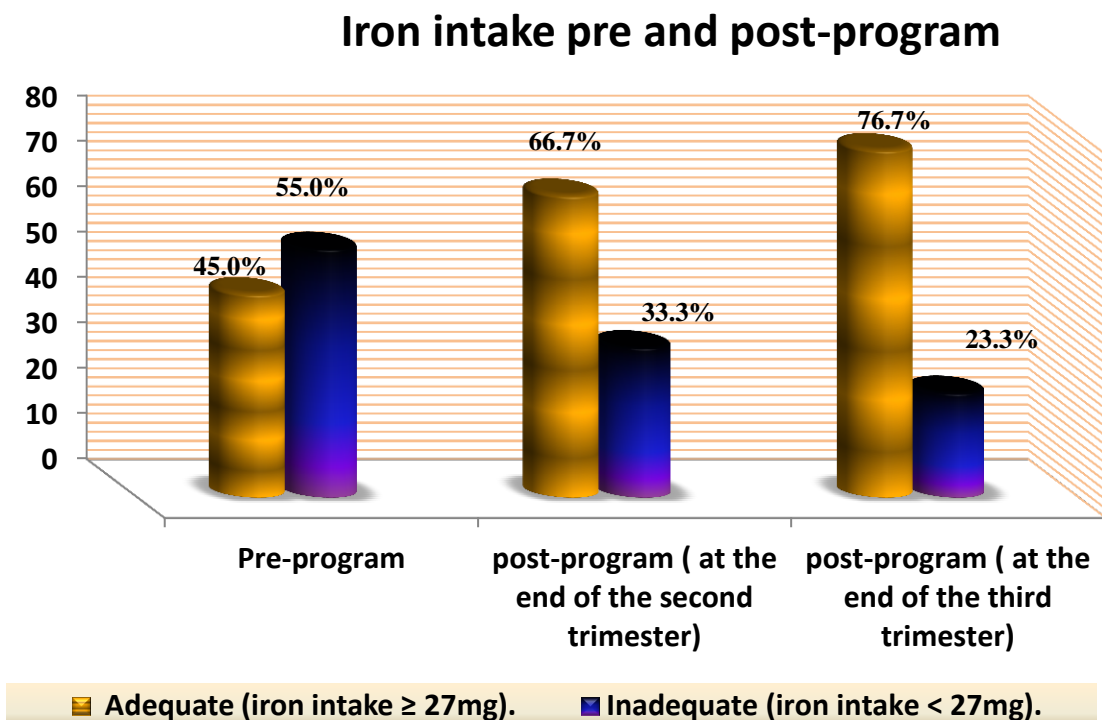


Figure (3):Percent distribution of the studied women regarding their daily intake of iron pre and post-program (at the end of the 2nd trimester and at the end of the 3rd trimester).

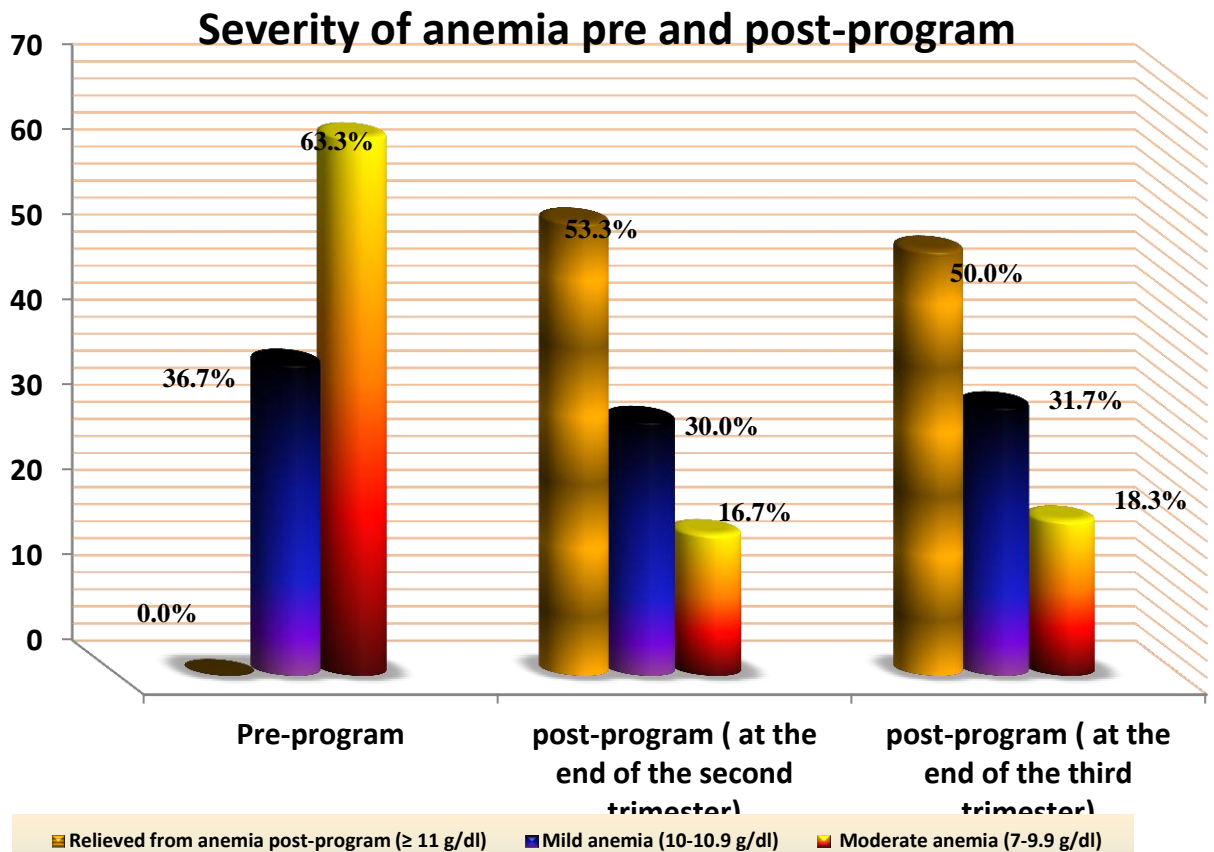


Figure (4): Percent distribution of the studied women according to their blood hemoglobin level (Severity of anemia) among pre and post-program (at the end of the 2nd trimester and at the end of the 3rd trimester).

Table (2): Effect of anemic status of the studied women post-program (at the end of the

Maternal outcome	Women's anemic status post-program (at the end of the 3 rd trimester)						Total	X ²	P
	Relieved from anemia post-program (n=30)		Mild anemia (n=19)		Moderate anemia (n=11)				
	No.	%	No.	%	No.	%			
Mode of delivery									
• Vaginal delivery.	13	43.3	10	52.6	0	0.0	23	4.05	0.132
• Cesarean section.	17	56.7	9	47.4	11	100.0	37		
Mode of rupture of membrane									
• Spontaneous.	15	50.0	8	42.1	3	27.3	26	1.71	0.425
• Artificial.	15	50.0	11	57.9	8	72.7	34		
Complications raised during labor**									
• Non.	29	96.7	14	73.7	0	0.0	43	37.0	0.0001
• Cord prolapse.	1	3.3	2	10.5	2	18.2	5		
• Intrapartum hemorrhage.	0	0.0	0	0.0	1	9.1	1		
• Preterm labor.	0	0.0	4	21.1	8	72.7	12		
• Premature rupture of membranes.	0	0.0	1	5.3	6	54.5	7		
• Maternal distress	0	0.0	0	0.0	1	9.1	1		
4- Complications raised during early postpartum period**									
• Non.	30	100.0	18	94.0	8	72.7	56	9.71	0.008*
• Hemorrhage.	0	0.0	1	5.3	3	27.3	4		
• Uterine sub-involution.	0	0.0	1	5.3	3	27.3	4		

3rd trimester) on maternal outcome.

*Significant: P <0.05** More than one answer

Table (3): Effect of anemic status of the studied women post-program (at the end of the 3rd trimester) on neonatal outcome.

Neonatal outcome	Women's anemic status post-program (at the end of the 3 rd trimester)						Total (n=60)	X ²	P
	Relieved from anemia post-program (n=30)		Mild anemia (n=19)		Moderate anemia (n=11)				
	No.	%	No.	%	No.	%			
Neonatal birth weight (kgs)									
• ≥ 2.5 kgs	28	93.3	16	84.2	3	27.3	47	21.26	0.0001**
• < 2.5 kgs	2	6.7	3	15.8	8	72.7	13		
Neonatal Maturity									
• Full term.	28	93.3	16	84.2	4	36.4	48	16.63	0.0002**
• Preterm.	2	6.7	3	15.8	7	63.6	12		
Neonatal Viability									
• Alive.	30	100.0	19	100.0	10	90.9	59	4.527	0.104
• Stillborn.	0	0.0	0	0.0	1	9.1	1		
Neonatal arised complications***									
• Non.	28	93.3	16	84.2	5	45.5	49	12.44	0.002*
• Need for resuscitation and oxygen administration.	1	3.3	3	15.8	6	54.5	10		
• Presence of any signs of respiratory distress syndrome	1	3.3	3	15.8	6	54.5	10		
• Neonatal jaundice	1	3.3	2	10.5	4	36.4	7		
• Low Apgar score.	0	0.0	2	10.5	3	27.3	5		

* Significant: P < 0.05 ** Highly significant: P < 0.001 *** More than one answer

Discussion

Nutritional status of pregnant woman is an important determinant of pregnancy outcome while the most prevalent nutritional deficiency during pregnancy is iron deficiency anemia (IDA). It can result into serious problems for mother and fetus as well as the neonate. In spite of the fact that most Ministries of Health in developing countries have policies to tackle this main problem, maternal anemia prevalence remains persistently high^(24,25). Thus this study has shed lights on the effect of nutritional program on anemic status and pregnancy outcome among pregnant women suffering from iron deficiency anemia.

Concerning the severity of anemia, the present study revealed that nearly two third of women had moderate anemia and the rest had mild anemia. This finding was relatively in agreement with **Mohamed et al. (2010)**⁽²⁶⁾, who reported that majority of anemic pregnant women had moderate anemia and the rest had mild anemia. In addition, **Hawana (2013)**⁽²⁷⁾, pointed out that more than half of pregnant women had moderate anemia and less than half had mild anemia. The findings of study disagreed with **Melku and Agmas (2015)**⁽²⁸⁾ and **Sunuwar et al. (2019)**⁽²⁹⁾, who declared that predominant type of

anemia during pregnancy was mild type followed by moderate type.

Regarding socio-demographic

characteristics, there were a sizable proportion of women who had moderate anemia aged more than 30 years old were read and write, married, worker, lived in urban area, hadn't enough family income and also lived in extended family. These findings were in agreement with **Al-Mehaisen et al. (2011)**⁽³⁰⁾, who demonstrated that anemia was more relevant among pregnant women who aged more than 30 years old, low educated, worker, hadn't enough family income and lives with more than five family members. Also this results were matching with **Amr et al. (2012)**⁽³¹⁾, who reported that moderate anemia was among women who aged more than 35 years old, less educated and also were workers. The findings of the present study were partially inline with **Melku and Agmas (2015)**⁽²⁸⁾, who reported that anemia was common among pregnant women aged 31-35 years old and lived in rural area. Also, **Rezk et al. (2015)**⁽³²⁾, mentioned that majority of anemic pregnant women aged more than 30 years old, educated and worker women.

Concerning women's total knowledge score level regarding iron deficiency anemia pre and post-program. The present

study revealed highly significant improvement in total knowledge score level of the studied women pre and post program (immediately, at the end of the 2nd trimester and at the end of the 3rd trimester). These findings were consistent with **Amr et al. (2012)**⁽³¹⁾ and **Hawana (2013)**⁽²⁷⁾, who reported that there was significant increase in knowledge regarding anemia among the studied women from pre-test to immediate post-test and retention test after three months. Again, the finding of the present study was inline with **Adam (2015)**⁽³³⁾, **Abujilban et al. (2018)**⁽³⁴⁾, and **Sunuwar et al. (2019)**⁽²⁹⁾, who demonstrated that there was significant improvement of nutritional knowledge among pregnant women from base line test to end line test after the educational program.

As regard the daily intake of iron and its sources among the studied women pre and post-program (at the end of the 2nd trimester and at the end of the 3rd trimester). The findings of the present study revealed that adequate total dietary iron intake as well as mean dietary intake of plant source of iron (non-heme-iron) significantly improved post-program. Despite, there was an increase in mean dietary intake of animal source of iron (heme-iron) post-program. However this

increase was not significant. This may be due to economic factors.

The present study findings were consistent with **El-Lassy (2009)**⁽³⁵⁾, **Adam (2015)**⁽³³⁾, and **Nahrish et al. (2019)**⁽³⁶⁾, who reported that there was significant improvement in dietary iron intake post educational program than pre-program. The present findings were disagreed with **Elsaied (2015)**⁽³⁷⁾, who demonstrated that there was no significant difference regarding dietary iron intake neither from plant sources nor from animal sources pre and post intervention among anemic elderly persons. This discrepancy may be due to the different characteristics of the studied sample.

Regarding the blood hemoglobin level to assess severity of anemia among the studied women pre and post-program (at the end of the 2nd trimester and at the end of the 3rd trimester). The results of the present study illustrated that the mean blood hemoglobin level had increased from (9.05±0.98) pre-program to (11.8±0.95) post-program (at the end of the 2nd trimester) and (10.74±0.93) post-program (at the end of the 3rd trimester). These differences were highly statistically significant post-program (at the end of the 2nd trimester) ($X^2 = 48.73$, $P=0.0001$) as well as between pre and post-program (at

the end of the 3rd trimester) ($X^2 = 45.10$, $P = 0.0001$).

The present study finding was in accordance with **Al-Tell et al. (2010)**⁽³⁸⁾, **Hawana (2013)**⁽²⁷⁾, **Abd-El Mageed et al. (2017)**⁽³⁹⁾, and **Sunuwar et al. (2019)**⁽²⁹⁾, who stated that the mean hemoglobin level of pregnant women had increased significantly post-nutritional intervention than pre-intervention. Again, **Amr et al. (2012)**⁽³¹⁾, reported that there was very highly statistically significant difference among post-partum women regarding their anemic status pre-nutritional educational intervention and post-intervention. Also, **Khaton (2012)**⁽⁴⁰⁾ and **Ibrahim (2013)**⁽⁴¹⁾ demonstrated that there was significant increase in mean hemoglobin level of anemic students from pre-nutritional program to post-program.

Regarding the effect of anemic status of the studied women post-program on maternal outcome. It was obvious that severity of anemic status significantly increase labor complications as preterm labor, premature rupture of membrane and cord prolapse as well as increased complication during post-partum as postpartum hemorrhage and uterine sub-involution.

These findings were supported by **Marti et al. (2001)**⁽⁴²⁾, who stated that optimal maternal hemoglobin level protects against

poor pregnancy outcome. In agreement of the current study findings **Bencaiova and Breymann (2014)**⁽⁴³⁾, demonstrated that lower hemoglobin level was associated with increased risk of post-partum hemorrhage and sub-involution of the uterus. Again, in accordance with the study findings **El-Zeiny et al. (2019)**⁽⁴⁾, reported that anemia during pregnancy increase the risk of perinatal maternal hemorrhage and infection.

As regard the effect of anemic status of the studied women post-program on neonatal outcome. The findings of the present revealed that anemia during pregnancy was significantly associated with low birth weight and premature birth as well as greater neonatal complications as respiratory distress with the need for resuscitation & oxygen administration, in addition to neonatal jaundice and low Apgar score.

Moreover, **Laflamme (2010)**⁽⁴⁴⁾, reported that clear relation was seen between maternal hemoglobin level and pregnancy outcome, they also revealed that maternal anemia was associated with preterm birth and lower infant Apgar score. The present study finding was inline with **Bencaiova and Breymann, (2014)**⁽⁴³⁾, who noted that maternal anemia was associated with adverse outcomes, namely, preterm birth, low birth weight and low Apgar score. In

the same line, **Srouf et al. (2018)**⁽⁴⁵⁾, **Kumari et al. (2019)**⁽⁴⁶⁾ and **Oaks et al. (2019)**⁽⁴⁷⁾, reported that anemia in pregnancy was strongly associated with preterm birth and lower birth weight.

Conclusion

Based on the findings of the present study, it can be concluded that significant improvement of the level of knowledge as well as the dietary habits regarding iron deficiency was found among the studied anemic pregnant women after the implementation of the nutritional educational program consequently the anemic status of women was changed and positively affected as well the maternal and neonatal outcome.

Recommendations

- Plan and develop antenatal health educational classes for all pregnant women to increase their awareness about importance of early and regular antenatal care as well as proper screening for early diagnosis and effective management of iron deficiency anemia to improve their pregnancy outcome.
- Provide in-service training programs especially for newly appointed nurses to improve their level of knowledge and practices regarding early screening and diagnosis of iron deficiency

anemia during pregnancy and its related maternal and fetal complications.

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