Association between Iron Deficiency Anemia and Pregnancy Outcomes

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Abstract

Background: Maternal anaemia has been associated with increased risks of both maternal and neonatal adverse outcomes. This study aims to assess the relationship between iron deficiency anaemia and pregnancy outcomes. **Design:** A descriptive correlation design was utilized. The study was conducted at the antenatal outpatient clinic and the emergency department of deliveries (section 10) at El Kasr El Aini University Hospital. A purposive sample of 300 pregnant women who attended the antenatal clinics was recruited. The sample was divided into three groups, with 100 pregnant women for each. Tools: Three tools were designed and utilized for data collection; 1)Structured interviewing scheduled questionnaire, 2) Maternal follow up assessment sheet, and 3) Neonatal follow up assessment sheet were used for data collection. **Results:** On comparison between the non-anemic and anaemic groups related to the outcomes of the current pregnancy, data revealed that there were statistically significant differences between groups related to mode of delivery, the occurrence of immediate postpartum haemorrhage, the neonatal first minute Apgar scores, and their weight ($P \leq 0.05$). Although all mothers in the three groups reached term at their gestational age at delivery time, there were noticeable statistical differences between the non-anemic group and the mild and moderate anaemia groups. **Conclusion:** Multiparous women with moderate anaemia were more likely to have postpartum hemorrhage, an increased caesarean section rate, neonatal low birth weight, and be small for their gestational age. **Recommendations:** monitoring mothers' compliance to approach the antenatal clinics for regular follow-up as well as their compliance to take the prescribed supplements is an essential need for Egyptian mothers.

Key wards: Iron Deficiency Anemia, Pregnancy Outcomes, Maternal Morbidity, Neonatal Morbidity

Introduction

Fetal and maternal death and morbidity are most frequently caused by anaemia during pregnancy. Iron deficiency anaemia (IDA) during pregnancy causes 95% of anaemic pregnancies worldwide, making it a major public health issue in both developed and developing countries **(Elzeiny, Sultan, & Shetya, 2019).** Asia and Africa, whose anaemia prevalence was 60% and 52%, respectively, are the regions that are most affected. According to WHO data from 2016, the prevalence of anaemia during pregnancy was about 22.6% in Egypt **(Elzeiny et al. 2019).** According to the haemoglobin (Hb) level, anaemia in pregnancy is categorized by the **World Health Organization (2014)** as mild (Hb 10 to 10.9 g/dl), moderate (Hb 7 to 9.9 g/dl), severe (Hb fewer than 7 g/dl), and extremely severe (Hb less than 4 g/dl).

Although the causes of IDA vary, it frequently develops when the body's iron requirements are not met through iron absorption. People with IDA may not consume enough iron due to poor dietary intake, reduced iron transport or absorption, or chronic blood loss caused by secondary illnesses (**Nakade et al. 2020).** Pregnancy anaemia is linked to harmful outcomes for the mother and the foetus.

But the research's conclusions about the link between anaemia and poor pregnancy outcomes remain debatable **(Azami et al., 2019).** According to several studies, anaemia during pregnancy and newborn outcomes are directly related. The majority of research indicates that when the maternal haemoglobin (Hb) goes below 8.0 g/dL, the prenatal mortality risk increases by two to three times, and by eight to ten times when the Hb drops below 5.0 g/dL. despite the fact that iron and folate supplements are frequently recommended **(Kumari et al. 2019).** Premature birth was more common in anaemic mothers' newborns (8.9% vs. 6.5%), although no morbidities associated with prematurity were present **(Zerfu, Umeta & Baye, 2016).** In addition, babies of anaemic moms were more likely to experience respiratory difficulty and stillbirth. Additionally, congenital abnormalities, preterm birth, low birth weight, and small head circumference were observed in neonates **(Elzeiny et al. 2019).** Furthermore, **Labib, Ahmed, and Abdelmoaty (2021)** investigated the effects of moderate maternal iron deficiency anaemia on maternal outcomes and discovered that atonic postpartum haemorrhage or postpartum infections after delivery, placental abruption, chorioamnionitis, and intensive care unit admission were all more common complaints in anaemic mothers. Furthermore, maternal anaemia was observed to increase the risk of preterm delivery, preeclampsia, and the requirement for blood transfusions as well as caesarean sections (CS) **(Drukker, etal., 2015),** preterm delivery **(Ronkainen, etal. 2019),** and preeclampsia **(Young, et al. 2019; Parks, etal. 2019).** In order to change the current incidence of iron deficiency anaemia during pregnancy, healthcare providers will need to change their protocols and guidelines for antenatal follow-up in the future. This will be made possible by the assessment of mothers' haemoglobin levels during pregnancy, even though they received vitamin supplements, and their pregnancy outcomes.

Significance of the study

Iron deficiency anaemia during pregnancy continues to be a serious issue, even in nations where other types of malnutrition have been all but eradicated. There are numerous studies that demonstrate a link between both low and high haemoglobin concentrations and unfavourable pregnancy outcomes, but few in Egypt. The purpose of the current study is to establish a relationship between iron deficiency anaemia and pregnancy outcomes. The findings of this study may influence how health care professionals change their antenatal follow-up strategies for IDA-suffering women, and enhancing women's awareness of iron deficiency anaemia prevention strategies.

Aim of the study

The aim of the study is to assess the relationship between iron deficiency anemia and pregnancy outcomes.

Research Question

Is there a relationship between iron deficiency anemia and pregnancy outcomes?

Subjects and Methods

Research Design

A descriptive correlational research design was adopted to achieve the stated aims. Descriptive designs are helpful in gaining additional information about characteristics within a particular study area. A correlational study determines whether or not two variables are correlated. This means studying whether an increase or decrease in one variable corresponds to an increase or decrease in the other variable (**Polit & Beck, 2014**).

Setting

The study was conducted at the antenatal clinic, and the emergency department of deliveries (section 10) at El Kasr El Aini- Cairo University Hospitals. It serves 100 to 120 pregnant women from different regions every day and approximately 28000 annually (**Statistical department, 2020**). Antenatal clinic provides free healthcare to all pregnant women as well as women with any gynecological problems. The emergency

department of deliveries (section 10) provides care for women in labor and women who have abortion.

Sample

A non-probable purposive sample of 300 pregnant women who attended the antenatal clinics to receive routine antenatal care were recruited in the present study with the following inclusion criteria; pregnant women with singleton fetus, ±37weeks of gestation, primiparous and multiparous women (i.e. not more than 3 times), with normal body mass index (BMI) during pregnancy, on routine daily iron supplementation(i.e. 400 mg), diagnosed as non anemic (i.e. Hb level is more than 11 g/dL), had mild anemia (i.e. Hb level is between 10 to 10.9 g/dL), and moderate anemia (i.e. Hb. level is between 7 to 9.9 g/dl). All women with high risk pregnancy or had any other medical disorders were excluded from the study.

Sample size

The sample size was calculated according to the following statistical formula; n = Z2P (1-P) /d2 where Z = level of confidence according to the standard normal distribution (i.e. for a level of confidence of 95%, Z = 1.96), P = estimated proportion of the population that presents the characteristic (i.e. when unknown we use P= 0.5), and d is considered 0.05.The study sample was divided into three groups; non anemic, mild anemic and moderate anemic groups, 100 pregnant women for each.

Data Collection Tools

Three tools were designed after extensive revision of available literature and are utilised for data collection purposes.

1.**Structured interviewing with a scheduled questionnaire**. It includes three sections; a) socio-demographic characteristics such as age, level of education, occupation, monthly income, and residence. b) Obstetrical profile, which includes information about previous obstetrical history, such as parity, mode of previous delivery, previous pregnancy and delivery complications, current pregnancy history, and gestational age. And c) baseline assessments of mothers' body mass index (BMI) at recruitment, haemoglobin level, iron supplementation intake, and the number of mothers' antenatal follow-up visits.

2.**Maternal follow-up assessment sheet**. It includes two sections; the first section includes data related to intrapartum assessment (i.e., gestational age at delivery, prolonged and obstructed labor, and premature rupture of membrane (PROM), foetal and maternal distress, and mode of delivery). The second section includes data related to the assessment of postpartum haemorrhage signs (i.e., vital signs, atonic uterus, and amount of blood loss).

3.**Neonatal follow-up assessment sheet**. It includes data related to the immediate newborn assessment (i.e. the first and fifth minute Apgar scores (Apgar, 1953), neonatal weight, neonatal anthropometric measurements), the neonatal gestational age assessment chart (Lubchenco, 1960), immediate newborn complications (i.e. respiratory distress, asphyxia, ect.), and the admission to the neonatal intensive care unit (NICU).

Content validity and reliability

A panel of three experts in maternity nursing examined and revised the designed tools in order to reach the best form. Modifications were carried out according to the panel's comments on the clarity of sentences and appropriateness of the content. The reliability of the tools was tested by (Cronbach's alpha =0.84), which indicated a strong significant positive correlation between the items of the tools.

Pilot study

A total of 10% of the sample was included in the pilot study in order to assess the feasibility and clarity of the tools and to determine the needed time for answering the questions. Based on its results, minimal changes were carried out. The samples included in the pilot study were excluded from the main study sample.

Ethical considerations

An ethical approval was obtained from the administrative authority at antenatal clinics in Obstetrics and Gynecological hospital affiliate to Cairo University hospital. Written consent was obtained from eligible women who met the inclusion criteria were informed about the aim of the present study and knew that their participation was voluntary. The anonymity and confidentiality of the participants were considered.

Procedure of data collection

The procedure was divided into two stages; the interviewing and monitoring phases.

1.***An interviewing phase.*** Data was collected between September 2019 and March 2020.The researchers approached the pregnant women in the antenatal clinics. All pregnant women were screened for their haemoglobin levels and their BMI in order to match the inclusion criteria. All pregnant women who wanted to participate in the study signed their written consent. Three days a week, data were gathered by interviewing each pregnant woman individually in order to collect the necessary demographic data as well as past and present obstetric history; each interview lasted approximately 15-20 minutes.

2.***Monitoring phase.*** All pregnant women had been followed up till their delivery time; the researchers attended their deliveries in order to assess the mode of deliveries and the immediate maternal complications. Further, immediate and complete newborns assessment was approached utilized the specified newborn assessment tools. In addition, postpartum assessment and follow up was conducted for the first 24 hours after delivery. Mothers were strictly observed and assessed for atonic uterus and immediate postpartum hemorrhage.

Statistical Analysis

The data was scored, tabulated, and analyzed using the Statistical Package for the Social Sciences (SPSS) version 23 program. Descriptive as well as parametric inferential statistics were utilized to analyze data pertinent to the study. The level of significance was set at $P \leq 0.05$. A bivariate correlation test was used to analyze the data.

Results

Regarding sample characteristics, data revealed that there were no statistically significant differences between mothers' characteristics in the non-anemic group as compared to mothers in the mild and moderate anaemia groups. Mothers' age in the three groups ranged between 20-30 years old (X^2 =6.16, P 0.40), with a mean of 27.43 5.25 SD in the non-anemic group compared with 27.64 5.64 SD in the mild anaemia group and 26.07 5.34 SD in the moderate anaemia group, from rural (60%) in non-anemic versus (59%) and (53%) in mild and moderate anaemia groups respectively, can read and write (34%) in the non-anemic group versus (24%) and (85%) in mild and moderate anaemia groups respectively, and with adequate income level (P0.05), (Table 1).

Regarding baseline assessment of mothers among the three groups, data revealed that there were no statistically significant differences between both groups related to their gravidity, BMI at study recruitment, and the numbers of antenatal follow-up visits. More than half of the sample was multi-gravida (75%) in the non-anemic group versus (77%) and (74%) in mild and moderate anaemia groups respectively, with mean gestational age of 37.04 ± 0.10 in the non-anemic group versus 37.11 ±0.31 and 37.01± 0.10 in mild and moderate anaemia groups respectively, and had antenatal follow-up visits between 1-4 times throughout the antenatal period (85%) in the non-anemic group versus (75%) and (81%) in mild and moderate anaemia groups respectively (P 0.05), (Table 2).

On comparison between the non-anemic and anaemic groups related to the outcomes of the present pregnancy, data revealed that there were statistically significant differences between groups related to mode of delivery, the

occurrence of immediate postpartum haemorrhage, the neonatal first minute Apgar scores, and neonatal weight (P ≤ 0.05). Although all mothers in the three groups reached term at their gestational age at delivery time, there were noticeable statistical differences between the non-anemic group and the mild and moderate anaemia groups. While there were no statistically significant differences in Apgar score at five minutes and ICU admission between non-anemic mothers and anaemic mothers (P > 0.05), (Table 3).

Regarding predictors that may affect the occurrence of anaemia during pregnancy, binary liner regression analysis demonstrated that there was no statistically significant relationship between the occurrence of anaemia and mothers' educational levels, residence & occupation. On the other hand, there was a significant positive relationship between mothers' parity and levels of anemia as well as the level of monthly family income (P ≤ 0.005) (Table, 4).

Table 1. Distribution of Sample Regarding their Demographic Characteristics (n=300)

Items	Non-Anemic group (n=100)	Anemic group (n=200) Mild (n= 100)	Moderate (n= 100)	Test	P-value
Maternal age [a]					
<20	14(14)	10 (10)	22 (22)	6.16[b]	0.40
20-25	29(29)	33 (33)	30 (30)		
26-30	28(28)	28 (28)	24(24)		
≥30	29(29)	29 (29)	24(24)		
Mean age	27.43± 5.25	27.64± 5.64	26.07± 5.34	2.47	0.08
Residence a					
Urban	40(40)	41(41)	47(47)	4.23[b]	0.12
Rural	60(60)	59(59)	53(53)		
Educational level a					
Can't read &write	7 (7)	7 (7)	9 (9)	1.63[b]	0.99
Read &Write	25(25)	24(24)	25(25)		
Primary level	8(8)	11 (11)	11 (11)		
Preparatory level	27(27)	29 (29)	26(26)		
Secondary level	23(23)	20 (20)	19 (19)		
University level	10(10)	9(9)	10 (10)		
Occupational level a					
House wife	85(85)	84 (84)	87 (87)	0.37[b]	0.83
Working	15(15)	16(16)	13 (13)		
Income level a					
Inadequate	40(40)	42 (42)	40 (40)		
Adequate	44(44)	43 (43)	43(43)		0.99
Adequate & can save from it	16(16)	15 (15)	17 (17)	0.21	

Level of significance at P ≤0.05,[a]Data presented as *n* (%),[b]Chi-square test.

Table 2. Distribution of the Study Sample Regarding their Antenatal Baseline Data (n=300)

Items	Non- Anemic group (n=100)	Anemic group (n=200)		Test	P-value
		Mild level (n= 100)	Moderate level (n= 100)		
Gravidity [a]					
Primigravida	25(25)	23 (23)	26 (26)	0.25[b]	0.88
Multigravida	75(75)	77 (77)	74(74)		
BMI in Kg/m2 at study recruitment					
Mean ±SD	22.32 ±3.21	21.97± 3.02	21.53± 3.11	1.60	0.20
Number of antenatal follow-up visits[a]					
1-4 times	85(85)	75 (75)	81 (81)	3.20 [b]	0.20
≥ 4 times	15(15)	25(25)	19(19)		

*Level of significance at P ≤0.05,[a]Data presented as *n* (%),[b]Chi-square test ,[c]Data presented as mean±SD, [d]*ANOVA test*

Table 3.Distribution of the Study Sample toward Current Pregnancy (N=300)

Items	Non-Anemic group (n=100)	Anemic group (n=200) Mild level (n= 100)	Moderate level (n= 100)	Test	P-value
Mean gestational age at delivery	38.46 ±1.85	38.18 ±0.88[c]	37.94± 1.17[c]	3.63[d]	0.02*
Mode of delivery					
Normal vaginal delivery[a]	43(43)	30 (30)	11(11)		0.001*
Vaginal delivery with episiotomy[a]	29(29)	28 (28)	18(18)	42.46 [b]	
Elective cesarean section[a]	17(17)	28 (28)	49(49)		
Emergency cesarean section[a]	11(11)	14 (14)	22(22)		
Occurrence of Immediate postpartum hemorrhage [a]					
No	98(98)	95(95)	90(10)	6.11[b]	0.04*
Yes	2(2)	5(5)	10(10)		
Neonatal assessment					
Apgar score at first minutes	6.59 ±1.10	6.18 ±0.93	5.06 ±1.01	60.36	0.001*
Apgar score at fifth minutes	8.42± 1.15	8.10± 1.22	8.22 ±0.88	2.16[d]	0.12
Baby weight at delivery (Kg)	2948.00±554.32	2806.50 ±475.86[c]	1800.50± 291.59[c]	189.80[d]	0.001*
Neonatal Gestational Age Assessment chart a					
SGA	4(4)	11(11)	52(52)	77.52[b]	0.001*
AGA	96(96)	89(89)	48(48)		
Admission to ICU [a]	1(1)	3 (3)	6(6)	3.93[b]	0.14

*Level of significance at P ≤0.05,[a]Data presented as *n* (%),[b]Chi-square test ,[c]Data presented as mean±SD,[d] ANOVA test

Table 4. Predictors for levels of anemia during pregnancyamong the two anemia groups (n =200).

Variable	Un standardized Coefficient		Standardized Coefficient		
	B	*SE*	*B*	*t*	*p*
Educational level	0.008	0.06	0.11	1.45	0.14
Residence	0.21	0.17	0.10	1.26	0.20
Occupation	0.32	0.25	0.11	1.26	0.20
Parity	0.13	0.22	0.05	3.60	0.004*
Income	0.50	0.10	0.36	4.64	0.001*

*Level of significance at P ≤0.05

Discussion

Obstetricians around the world frequently encounter maternal anaemia, particularly in developing nations. The results of the current study are discussed within the following frame of references; predictors of anaemia in relation to study sample characteristics and responses to the research question.

Findings of the present study demonstrated that the majority of the study sample's age ranged between 20 and 30 years, lived in rural areas, and had an adequate level of income. Furthermore, more than two-thirds of them were multiparous with normal BMI. These results are in line with a sizable retrospective observational research cohort that found multiparity to be a risk factor for anaemia during pregnancy. And concurred with **Wahabi (2022) & Mahmoud et al. (2019),** who found that younger primiparous and multiparous women experienced higher anaemia during pregnancy. And in line with **Asghari et al. (2020),** who reported that substantial inverse relationships between Hb concentrations and the number of pregnancies, children, and family members were discovered.

Additionally, according to **Melku, Addis, Alem, and Enawgaw's (2014),** the majority of the anaemia cases in their study sample were mild type anaemia, which had a high incidence throughout the third trimester. Anemia was independently predicted by low family income and a large family size. While **Geta, Gebremedhin, and Omigbodun (2022)** discovered in their systematic review and meta-analysis that nearly one in four Ethiopian pregnant women had anaemia, they also discovered that a small family size, adequate birth spacing, and a varied diet are all associated with a lower risk of anaemia in pregnancy. On the other hand, no correlation between anaemia and parity was found in other research. They discovered that mothers who did not receive regular prenatal care or their iron supplements were more likely to become anaemic during their pregnancies **(Wahabi, 2022; Akowuah, Owusu-Addo, Opun, 2022; Mahmood, etal. 2019). Further, Chu, Shao, Lo, Hsieh & Hung (2020)** discovered that mothers who were older than 34, had a history of caesarean birth, and gained less weight throughout their pregnancies were all predictors for anaemia during pregnancy.

According to **Chu, Shao, Lo, Hsieh, and Hung (2020),** women with mild anaemia have a risk of unfavourable perinatal outcomes that is 1.5 to 2 times higher than that of women with a Hb level of 10.8 g/dL, and moderately anaemic women have a risk that is 2.0 to 2.5 times higher. The findings of the present study demonstrated that there were statistically significant differences between the non-anemic and two anaemic groups (i.e., mild & moderate anemia) related to mode of delivery (i.e., increased the frequency of caesarean section), occurrence of immediate postpartum hemorrhage, the neonatal gestational age, first minute Apgar scores, and the neonatal weight at birth, even though the mothers received the routine recommended iron supplementations

and even though they received the antenatal follow-up as they reported. These results may be related to many interrelated factors such as mothers' incompliance with receiving the iron supplements on a regular basis, the nature of their nutritional habits and behavior, as well as the degree of their awareness about the iron-rich foods. As a result, these factors had an impact on the modes of delivery, immediate postpartum complications, and neonatal outcomes.

According to **Chu, Shao, Lo, Hsieh & Hung (2020),** who assessed the impact of anaemia and reported that caesarean birth was a negative pregnancy outcome, the current findings were consistent with their findings. The same correlation between anaemia and a reduced risk of spontaneous vaginal birth was discovered by **Baradwan, Alyousef, and Turkistani (2018), Youssry, Radwan, Gebreel, Patel (2018), and Labib, Ahmed, and Abdelmoaty (2021).** In addition, **Nair et al. (2019), Youssry, Radwan, Gebreel, & Patel (2018), Labib, Ahmed & Abdelmoaty (2021),** and others reported that anaemic women had a nine times higher risk of postpartum haemorrhage (PPH) and that low birth weight (LBW) and small for gestational age (SGA) were adverse neonatal outcomes associated with anaemia **(Parks, et al., 2019; Bora et al., 2014).** In addition, **Wahabi (2022), Chu, Shao, Lo, Hsieh & Hung (2020) and Lin, et al., (2018)** added that anaemia during pregnancy was linked to low Apgar scores and low birth weight (LBW), preterm deliveries and small for gestational age (SGA), **(Räisänen et al., 2014).** In addition, **Mahmood et al., (2019)** examined anaemic and non-anemic women, and they came to the conclusion that anaemic women had significantly higher rates of postpartum haemorrhage, prolonged/obstructed labour, urgent induction of labour, and urgent caesarean section (CS) than non-anemic women. Negative neonatal outcomes included preterm delivery, small-for-gestational-age (SGA), and low birth weight (LBW). Furthermore**, Shi, Chen, and Wang, et al. (2022)** verified in their cohort research of 18 948 pregnant women that the degree of anaemia during pregnancy was linked to an increased risk of preterm birth, severe postpartum haemorrhage, and foetal growth limitation. These risks were higher for expectant women with moderate to severe anaemia and lower for those with mild anaemia.

Conclusion

Maternal anaemia is associated with adverse maternal and neonatal outcomes. Multiparous women with moderate anaemia were more likely to have postpartum hemorrhage, an increased caesarean section rate, neonatal low birth weight, and be small for their gestational age.

Recommendations

It is important to identify pregnant women at risk and ensure that sufficient and timely care is provided. Awareness campaigns must be conducted in order to increase women's awareness of healthy nutritional diets and habits. Further, monitoring mothers' compliance to approach the antenatal clinics for regular follow-up as well as their compliance to take the prescribed supplements is an essential need for Egyptian mothers.

Conflicts of interest

There is no conflict of interest.

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