Iron deficiency among pregnant women attending an antenatal clinic in Northern Uganda: a cross-sectional study

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Research article

Keywords: Iron deficiency, Anemia, Pregnancy, and Uganda

Posted Date: September 12th, 2019

DOI: https://doi.org/10.21203/rs.2.14386/v1

Abstract

Background Iron deficiency is a leading cause of anemia among pregnant women in Uganda. However, due to the high cost of biochemical tests required to determine iron deficiency, the prevalence and factors associated with iron deficiency remain largely unstudied in our setting. Therefore, this study aimed at determining the prevalence of iron deficiency and its associated factors among pregnant women attending an antenatal clinic, Lira District-Uganda.

Methods A cross-sectional study was conducted among 320 pregnant women attending an antenatal clinic at Lira Regional Referral Hospital. Maternal serum ferritin was used as a measure of iron deficiency and was determined using a Cobas 6000 Automated Analyzer. Iron deficiency was based on serum ferritin of <30 μg/L. A semi-structured questionnaire was used to obtain the characteristics of the study participants. Binary and multivariate logistic regression were performed to identify the associated factors.

Results The prevalence of iron deficiency was 45%. Non-adherence to iron supplements (AOR: 2.05 95% CI: 1.02-4.12) & third trimester pregnancy (AOR: 1.88 95% CI: 1.20-2.94) were significantly associated with iron deficiency during pregnancy.

Conclusion Nearly 5 in 10 of the participants had iron deficiency. Iron deficiency during pregnancy was associated with non-adherence to iron supplements and being in the third trimester of pregnancy. Midwives should encourage pregnant women to adhere to iron supplements during pregnancy especially pregnant women who are in the third trimester.

Background

Pregnancy is a period of heightened iron requirement [1]. This is largely due to the expansion of maternal red cell mass and growth of the fetus and placenta [2]. The average total iron requirement during pregnancy for an average weight of 55 kilograms is 1200 mg [3]. This translates into 0.8 mg of iron per day during the first trimester rising to 7.5- 10 mg of iron per day in the third trimester [3]. Daily maternal dietary iron intake is often insufficient to meet iron requirements during pregnancy and this predisposes the woman to iron deficiency (ID) [2, 3].

Iron deficiency is the most common micronutrient deficiency in the world and the leading cause of anemia [4]. Globally, 264 million women of reproductive age are affected by "iron-amenable anemia" [5] of whom 56 million are pregnant women [6]. Worldwide, the prevalence of anemia during pregnancy is estimated at 38%; in high-income countries it is 22% while in low-income countries it is 41% [6]. In Uganda, the overall prevalence of anemia among women of childbearing age is reportedly 32% while in Lango sub-region, Northern Uganda, the burden of anemia among women aged 15–49 years was 39.4% [7]. According to Kassebaum [4], more than 60% of the anemia cases during pregnancy are due to iron deficiency.

Anemia due to iron deficiency during pregnancy has serious negative effects on the health of both the mother and the fetus such as preterm labor, low birth weight, poor Apgar score, fetal anemia, neonatal mortality, maternal fatigue, poor work productivity and even maternal mortality [8, 9]. In light of the above, control and treatment of "iron-amenable anemia" during pregnancy is a priority for all countries including Uganda [10].

The government of Uganda implements a multifaceted policy of: iron-folate supplementation, deworming, intermittent presumptive treatment against malaria, dietary diversity for complementary feeding, indoor residual spraying against mosquitos and long lasting insecticide net use as a strategy to control and treat anemia during pregnancy [11]. Scanty literature exists that documents the impact of this policy implementation. This could possibly be attributed to the high cost of biochemical tests required to assess iron deficiency and anemia. Therefore, the aim of this study was to determine the prevalence of iron deficiency and associated factors among pregnant women attending an antenatal clinic, Lira District-Uganda.

Methods

Study design and setting

This was a descriptive cross-sectional study that used quantitative methods of data collection. The study was conducted between December 2017 and March 2018 among 320 pregnant women attending the antenatal clinic at Lira Regional Referral Hospital. The hospital is one of the 13 regional referral hospitals in Uganda and is located in Lira District, Northern Uganda. Northern Uganda is divided into Lango sub-region, Acholi sub-region, Karamoja and West Nile sub-region. Lira Regional Referral Hospital is found in Lango sub-region where the majority of the people in the sub-region speak the Lango language. It has a bed capacity of 346 and it serves all the eight Districts in Lango sub-region [12]. Their antenatal clinic runs from Monday to Friday usually between 9:00 hours to 16:00 hours and has a monthly attendance of about 640 pregnant women.

Study population and eligibility criteria

The study included all pregnant women attending the antenatal clinic at Lira Regional Referral Hospital who consented to participate in the study. Pregnant women who were severely ill were excluded from the study.

Sample size and sampling procedure

The Kish-Leslie formula [13] was used to calculate the sample size of the study. A29.1% prevalence of anemia during pregnancy was used to calculate a sample size of 320 participants [14]. A consecutive sampling technique was used to enroll study participants. Consecutive sampling is a process where all accessible and eligible subjects are picked to participate in a study [15]. Each day, the investigator (SU) and two other trained research assistants (a midwife and a clinician) consecutively enrolled participants as they came into the antenatal care clinic until the desired sample size was achieved.

Study variables

The outcome variable was iron deficiency during pregnancy. Iron deficiency was defined as a serum ferritin concentration level <30 μg/L [16]. Serum ferritin concentration was measured using a Cobas 6000 Automated Analyzer (Roche Diagnostics, Indianapolis, United States of America) and classified based on the World Health Organization's guidelines [16]. Category I (<15 μg/L) of ID denotes ID which requires active intervention, category II (15–29.9 μg/L) still signifies low iron stores while category III (30–150 μg/L) indicates a normal level.

The independent variables were socio-demographic characteristics (age, marital status, religion, education, occupation and average income), obstetric history (gravidity, gestational age, birth interval, and number of living children), and health service utilization related factors (number of antenatal care visit, deworming, malaria prophylactic treatment, iron supplementation, and adherence to iron supplementation). Intake of iron-folate pills for at least four days in the previous seven days as prescribed for pregnant women was used as a proxy for adherence to iron supplements during pregnancy [17].

Data collection procedure

An interviewer-administered questionnaire was used to conduct a face-to-face interview. After the interview, a venipuncture was performed at the antecubital fossa to collect about 5mls of blood in a clot activator-containing red-topped tube. The tubes were labeled using a code that matched the participants' completed questionnaires. Samples were collected and stored in the hospital refrigerator at 4^0C for five days and transported at night in a cold box lined with ice cubes to Mulago National Referral Hospital laboratory for processing.

Data analysis

Data were entered and analyzed using SPSS version 23.0. The prevalence of iron deficiency during pregnancy was determined by dividing the number of women with iron deficiency by the sample size multiplied by 100%.Univariate analysis was done to summarize characteristics of participants and results presented in a table with percentages, means and or medians and standard deviations.Bivariate and multivariate logistic regression analyses were done to determine the factors associated with iron deficiency during pregnancy. A bivariate logistic regression analysis was performed between iron deficiency and each of the independent variables and crude odds ratios (COR) with 95% confidence intervals were obtained. All variables with a *p*-value <0.2 in the bivariate logistic regression analysis were subsequently included in the multivariable logistic regression model to determine factors independently associated with iron deficiency during pregnancy. The strength of statistical association was measured by the adjusted odds ratio (AOR) and 95% confidence intervals. All tests were two-sided and a p value < 0.05 was considered statistically significant.

Results

Characteristic of the study participants

The mean age of the participants was 25.47± 5.61 years and More than one-half of the participants (52%) had primary level education. The mean gestational age of the participants was 25.37± 7.80 weeks and the mean inter-pregnancy interval was 36.0± 28.46 months (Table 1). More than one-half (53%) of the participants were not taking iron supplements, while 78% of the women started iron supplementation either in the second or the third trimester (Table 2).

Prevalence of iron deficiency among study participants

The overall prevalence of iron deficiency during pregnancy was 45%. Further analysis of the results revealed that 12.5% and 32.5% had category I and II respectively of iron deficiency.

Factors associated with iron deficiency among study participants

In the bivariate analysis, iron deficiency was associated with the first ANC visit (COR: 0.53 95% CI: 0.34–0.83; *p*-value: 0.005), iron supplementation (COR: 0.63 95% CI: 0.41−0.99; *p*-value: 0.044, and third-trimester pregnancy (COR: 1.92 95% CI: 1.23−3.00; *p*-value: 0.004). However, age, marital status, level of education, occupation, level of income, gravidity, birth interval, number of living children, deworming, non-adherence to iron supplements during pregnancy and timing of initiation of iron supplementation were not associated with iron deficiency at bivariate analysis level (Table 3). During the multivariate logistic regression analysis, non-adherence to iron supplements (AOR: 2.05 95% CI: 1.02−4.12; *p*-value: 0.043) and being in the third trimester of pregnancy (AOR: 1.88 95% CI: 1.20−2.94; *p*-value: 0.006) were the only factors statistically associated with iron deficiency during pregnancy. First ANC visit and iron supplementation were not statistically significant at multivariate analysis level (Table 4).

Discussion

This study determined the prevalence and factors associated with iron deficiency among pregnant women seeking antenatal care at Lira Regional Referral Hospital, Lira District-Uganda. The prevalence of iron deficiency during pregnancy was 45% while non-adherence to iron supplements and third trimester pregnancy were significant factors associated with iron deficiency.

The prevalence of iron deficiency during pregnancy in this study was substantially high. The World Health Organization [22], recommends daily iron supplementation during pregnancy as a means of controlling and treating "iron-amenable anemia", a measure which was underutilized in this study. The majority of women were either not taking iron supplements (53%) or started taking iron supplements in their second or third trimester (78%). Also among participants who were taking iron supplements, more than one-third (36%) were non-adherent to the iron supplements. In addition, the high burden of iron deficiency during pregnancy in this study could be due to the fact that, in Uganda as a whole, 32% of women of reproductive age are anemic before pregnancy [7] mainly as a result of iron deficiency.

Similar findings were also reported by studies from Central Uganda [14] and parts of Portugal [18] among first trimester pregnant women in which the prevalence of iron deficiency was 40.4% and 38.3% respectively. Results of this study were also consistent with what was reported in a systematic review done among pregnant women in Ethiopia, Kenya, Nigeria and South Africa in which the prevalence of iron deficiency ranged from 19–61% [19]. However, the prevalence of iron deficiency in this study was significantly higher than the 14% that was reported among 3,531 Nepalese pregnant women [20]. Similarly, in comparison with other low-income countries, the prevalence of iron deficiency in this study was higher than the 19% reported among 4220 Australian pregnant women [21] and 18% reported among 1171 American pregnant women [22].

The notable differences in the prevalence of iron deficiency across studies could be attributed to the trimester in which the participants were recruited, variations in the measure of iron markers (serum ferritin, soluble transferrin receptor, and total iron binding capacity), and the corresponding cut offs for diagnosing iron deficiency. For example, studies by Baingana, Enyaru [14] and Khambalia, Collins [21] included only pregnant women in the first trimester and yet iron requirement during first trimester is generally lower than in the second and third trimester [3]. In this study, iron deficiency was measured using serum ferritin concentration and the cut off for iron deficiency was 30 μg/L, while other studies [14, 18, 21] used cut offs of 12 μg/L, 15 μg/L, and 50 μg/L as a measure of iron deficiency.

In this study, pregnant women who were non-adherent to the iron supplements were two times more likely to develop iron deficiency compared to those who were adherent to iron supplements. This finding is plausible because the increased iron demand during pregnancy necessitates compensatory replacement of iron through iron supplementation [23]. Consequently, women who were non-adherent to iron supplements during pregnancy were perhaps unable to compensate for the increased demand for iron during pregnancy. Iron supplementation with optimal adherence to the iron supplements ensures consistent replenishing of the body's iron stores through daily exogenous iron [24]. Findings of this study are consistent with results of other studies in which pregnant women adherent to their iron supplements during pregnancy had higher serum ferritin concentrations compared to their counterparts [25, 26]. For example, in the study by Abioye, Aboud [26], pregnant women who were adherent to iron supplements were 1.4 times more likely to have higher serum ferritin concentrations than their counterparts who were non-adherent. However, findings of this study were different from those reported by Makhoul, Taren [20] where there was no statistical association between adherence to iron supplements and iron deficiency during pregnancy. This disparity could probably be due to variability in socio-demographic and obstetric characteristics of study participants in the two studies.

Pregnant women who were in the third trimester were two times more likely to have iron deficiency compared to those who were either in the first or second trimester. This finding is consistent with the scientific explanation by Breymann [3] that the iron requirement increases with increasing gestational age [2]. According to Breymann [3], iron requirements are known to increase 12 fold in the third trimester as a result of the growing fetus and the placenta and this predisposes the pregnant woman to iron deficiency. Results of this study are consistent with findings reported by Ahmed and Al-Sumaie [27] but contrary to that reported by Camargo, Pereira [28] possibly due to variation in the characteristics of study participants.

Study Limitations

This was a hospital-based study and so certain findings of the study may not give the true picture of iron deficiency among women in the community who do not attend the antenatal clinic. Recall bias might have affected the authenticity of the responses to the number of pills missed in the previous seven days. Thus, the findings of this study should be interpreted in light of these limitations.

Conclusion

The prevalence of iron deficiency among pregnant women was high, affecting almost one-half of the pregnant women who were seeking antenatal care at Lira Regional Referral Hospital in Northern Uganda. The odds of developing iron deficiency was associated with non-adherence to iron supplementation and women who were in their third trimester of pregnancy. Midwives should encourage pregnant women to adhere to iron supplements during pregnancy especially pregnant women who are in the third trimester.

List Of Abbreviations

ANCAntenatal clinic

AORAdjusted odds ratio

CORCrude odds ratio

DHODistrict health officer

IDIron deficiency

SHSRECSchool of health science research and ethics committee

WHOWorld health organization

Declarations

Ethics approval and consent to participate

The study was approved by the Makerere University School of Health Sciences Research and Ethics Committee (SHSREC) under reference number SHSREC REF: 2017–061. Administrative clearance was obtained from the District Health Officer (DHO), Lira District and Lira Regional Referral Hospital. The study participants were informed about the purpose, benefits, and risk of participating in the study and written informed consent for participating in the study was obtained. Confidentiality was maintained by using codes instead of participants' names while privacy was ensured by interviewing participants one at a time in separate rooms. Pregnant women who were below 18 years were taken as emancipated minors and consent was obtained from them. Pregnant women who were iron deficient were contacted and advised to take iron supplements and adhere to the supplements.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The author(s) declare that they have no competing interests.

Funding

Filed work data collection and laboratory analysis of samples for this study was funded by Makerere University-Swedish International Development Agency (SIDA) bilateral research programme-Project No. Sida 344.

Author's Contributions

SU conceptualized the study and was involved in the data collection, analysis, and drafting of the manuscript. JN and MN were involved in the conceptualization of the study, data analysis and drafting of the manuscript. JE made valuable input in discussion of the study results. GN & JKT were involved in conceptualization of the study and offered guidance and mentorship during the study and in writing the manuscript. All authors read and approved the final manuscript.

Acknowledgement

We would like to acknowledge all those who participated in the study. We thank the staff at Lira Regional Referral Hospital especially Ogwang Oyom George who helped during the field data collection. Our gratitude also goes to the Makerere University-Swedish International Development Agency (SIDA) bilateral research programme-Project No. Sida 344 for financial support.

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Tables

Table 1: Socio-demographic and obstetric characteristics of study participants

Variables	(n=320)	(%)	Mean ±SD
Age			
15-24	164	51.2	25.27 (±5.61)
25-29	80	25	
30+	76	23.8	
Tribe			
Lango	288	90	
Others	32	10	
Marital status			
Single/separated	29	9.1	
Married	291	90.9	
Religion			
Christian	307	95.9	
Others	13	4.1	
Level of education			
No formal education	9	2.8	
Primary	167	52.2	
Secondary	98	30.6	
Tertiary	46	14.4	
Occupation			
Housewife/unemployed	25	7.8	
Self-employed	127	39.7	
Civil servant	168	52.5	
Average monthly income (Ugx)			
≤100,0000	234	73.1	
>100,000	86	26.9	
Gravidity			
Primigravida	88	27.5	
Multigravida	232	72.5	2.68±1.59
Trimester			
First	24	7.5	
Second	140	43.8	
Third	156	48.7	
Birth interval (*n*=232)			
<2 years	68	29.3	
>2 years	164	70.7	
Number of children (*n*=232)			
Zero	21	9	
1-4	199	85.8	
≥ 5	12	5.2	

***n*=232:** Study participants who were multigravida

Table 2: Health service utilization related characteristic of study participants (n=320)

Characteristic	Frequency	Percent (%)	Mean (SD)
First ANC visit			
Yes	152	47.5	
No	168	52.5	
Number of ANC visits (n=168)			
2	61	19.1	2.04± (1.19)
3	59	18.4	
≥4	48	15	
Episodes of diagnosed malaria			
0	206	64.4	
≥1	114	35.6	
Malaria prophylaxis intake (*n*=296)			
Yes	143	48.3	
No	153	51.7	
Deworming (n=296)			
Yes	70	23.6	
No	226	76.4	
Iron supplementation			
Yes	149	46.6	
No	171	53.4	
Initiation of iron supplementation (n=149)			
First trimester	33	22.1	
Second trimester	108	72.5	
Third trimester	8	5.4	
Adherence to iron supplements (n=149)			
Non-adherent	54	36.2	
Adherent	95	63.8	

***n*=296:** Study participants in the second and third trimester
***n*=149:** Study participants who were taking iron supplement

Table 3: Bivariate logistic regression analysis of selected factors associated with iron deficiency among study participants (n=320)

Variable	ID (Yes) n=144(%)	ID (No) n=176(%)	OR(95% CI)	*p*-value
Age				
≤24	72 (43.9)	92 (56.1)	0.91 (0.59-1.42)	0.686
≥25	72 (46.2)	84 (53.8)	1.00	
Marital status				
Single	11 (37.9)	18 (62.1)	0.73 (0.33-1.59)	0.424
Married	133 (45.7)	158 (54.3)	1.00	
Level of education				
≤Primary	75 (42.6)	101 (57.4)	0.81 (0.52-1.26)	0.343
≥Secondary	69 (47.9)	75 (52.1)	1.00	
Occupation				
Employed	70 (46.1)	82 (53.9)	1.08 (0.70-1.69)	0.719
Unemployed	74 (44.0)	94 (56.0)	1.00	
Average monthly income (Ugx)				
≤100,0000	106 (45.3)	128 (54.7)	1.05 (0.64-1.72)	0.859
>100,000	38 (44.2)	48 (55.8)	1.00	
Gravidity				
Multigravida	110 (47.4)	122 (52.6)	1.43 (0.87-2.36)	**0.16**
Primigravida	34 (38.6)	54 (48.4)	1.00	
Trimester				
≥28 weeks	83 (53.2)	73 (46.8)	1.92 (1.23-3.00)	**0.004**
≤27 weeks	61 (37.2)	103 (62.8)	1.00	
Birth interval (*n*=232)				
<2 years	14 (48.3)	15 (51.7)	1.04 (0.48-2.27)	0.921
≥2 years	96 (47.3)	107 (52.7)	1.00	
Number of living children (*n*=232)				
≤1	56 (51.9)	52 (48.1)	1.06 (0.63-1.77)	0.834
≥2	66 (53.2)	58 (46.8)	1.00	
First ANC visit				
Yes	96 (63.2)	56 (36.8)	0.53 (0.34-0.83)	**0.005**
No	80 (47.6)	88 (52.4)	1.00	
Deworming				
Yes	32 (45.7)	38 (54.3)	1.04 (0.61-1.77)	0.892
No	112 (44.8)	138 (55.2)	1.00	
Iron supplementation				
Yes	76 (51.0)	73 (49.0)	0.63 (0.41-0.99)	**0.044**
No	68 (39.8)	103 (60.2)	1.00	
Initiation of iron supplementation				
First or second trimester	73 (51.8)	68 (48.2)	1.79 (0.41-7.77)	0.438
Third trimester	3 (37.5)	5 (62.5)		
Adherence to iron supplements				
Non-adherent	33 (61.1)	21 (38.9)	1.90 (0.96-3.75)	**0.064**
Adherent	43 (45.3)	52 (54.7)	1.00	

***n*=232:** Study participants who were multigravida; ***n*=149:** Study participants who were taking iron supplements

Table 4: Multivariate logistic regression analysis of the factors associated with iron deficiency among study participants (n=320)

Variable	ID (Yes) n=144(%)	ID (No) n=176(%)	COR (95% CI)	AOR (95% CI)	P-value
Gravidity					
Multigravida	110 (47.4)	122 (52.6)	1.43 (0.87-2.36)	1.33 (0.27-1.33)	0.267
Primigravida	34 (38.6)	54 (48.4)	1.00	1.00	
Trimester					
≥28 weeks	83 (53.2)	73 (46.8)	1.92 (1.23-3.00)	1.88 (1.20-2.94)	**0.006***
≤27 weeks	61 (37.2)	103 (62.8)	1.00	1.00	
First ANC visit					
Yes	96 (63.2)	56 (36.8)	0.53 (0.34-0.83)	0.72 (1.39-1.35)	0.307
No	80 (47.6)	88 (52.4)	1.00	1.00	
Iron supplementation					
Yes	76 (51.0)	73 (49)	0.63 (0.41-0.99)	0.90 (0.46-1.79)	0.772
No	68 (39.8)	103 (60.2)	1.00	1.00	
Adherence to iron supplements (n=149)					
Non-adherent	33 (61.1)	21 (38.9)	1.90 (0.96 -3.75)	2.05 (1.02-4.12)	**0.043***
Adherent	43 (45.3)	52 (54.7)	1.00	1.00	

*Statistically significant variables at *p*-value <0.05; **1.00:** Reference group; **COR:** Crude Odds Ratio; **AOR:** Adjusted Odds Ratio; ***n*=149:** Study participants who were taking iron supplements