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ARTICLE

Prevalence of anaemia in pregnancy and associated factors in northern Uganda: a cross-sectional study

Samson Udho[a*], Joyce Nankumbi[b], Mariam Namutebi[b], David Mukunya[c,d], Grace Ndeezi[e] and James K Tumwine[e,f]

[a]*Department of Nursing & Midwifery, Lira University, Lira, Uganda*
[b]*Department of Nursing, Makerere University, Kampala, Uganda*
[c]*Department of Research, Sanyu Africa Research Institute, Mbale, Uganda*
[d]*Department of Public Health, Busitema University, Mbale, Uganda*
[e]*Department of Pediatrics and Child Health, Makerere University, Kampala, Uganda*
[f]*Department of Pediatrics and Child Health, Kabale University, Kabale, Uganda*
**Correspondence: sudho@lirauni.ac.ug*

Background: Anaemia in pregnancy is associated with poor maternal and foetal outcomes. Nonetheless, there is a paucity of recent literature on the predictors of anaemia during pregnancy in the context of northern Uganda, a region emerging out of decades of war. A study was undertaken to determine the prevalence and factors associated with anaemia among pregnant women in northern Uganda.
Methods: In this cross-sectional study, 320 pregnant women seeking care at Lira Regional Referral Hospital were consecutively enrolled. Data were collected using a structured interviewer-administered questionnaire. Data collected included: demographic, obstetric, nutritional and dietary characteristics of study participants. Data analysis consisted of descriptive statistics, cross-tabulations and logistic regression with 95% confidence and a p-value of < 0.05 as significant using STATA version 14.
Results: The mean age of the women was 25.3 ± 5.6 years while their mean gestational age was 25.4 ± 7.8 weeks. The overall prevalence of anaemia (Hb < 11 g/dl in the first and third trimesters and less than 10.5 g/dl in the second trimester) was 24.7%. Iron deficiency was prevalent in half of the women (50%) with anaemia. Factors independently associated with anaemia included taking antimalarial prophylaxis (AOR 0.44; 95% CI 0.19, 0.99) and consumption of legumes and cereals more than twice in the previous week (AOR 0.46; 95% CI 0.24, 0.89).
Conclusion: One-quarter of pregnant women in this study population based in northern Uganda were anaemic. There is a need to strengthen interventions to control anaemia during pregnancy, particularly the intake of antimalarial prophylaxis and consumption of iron-rich locally available foods.

Keywords: anaemia, iron deficiency, pregnancy, Uganda

Introduction

Anaemia in pregnancy, defined as haemoglobin (Hb) concentration levels of less than 11 g/dl in the first and third trimesters and 10.5 g/dl in the second trimester, remains a public health problem.[1,2] The global prevalence of anaemia during pregnancy is around 38%, which translates to 32 million anaemic pregnant women.[3] The burden of anaemia during pregnancy is disproportionately higher in low- to middle-income countries with prevalence estimates of 24% to 56% compared with 22% in high-income countries.[3] A recent systematic review estimates the burden of anaemia during pregnancy in Uganda to range from 23% to 37%.[4]

According to Milman,[2] 40% of global maternal deaths are attributable to maternal anaemia while 17% of low birthweight, preterm birth and perinatal mortality in low- and middle-income countries are attributed to anaemia during pregnancy.[1] The heightened iron requirements that predispose pregnant women to anaemia are due to the expansion of maternal red cell mass, growth of the placenta and foetus development, which increases with increasing gestational age.[5,6] The increased iron demands in pregnancy are exacerbated by food taboos, poor dietary habits, parasitic infestation, infections (especially malaria) and HIV/AIDS, and pre-existing anaemia before pregnancy.[7,8]

The mainstay strategy to control and treat anaemia during pregnancy has been supplementation with iron, coupled with routine screening for anaemia during antenatal care.[9] Other broad strategies to control anaemia include prevention and control of malarial infection with intermittent preventive treatment (IPT) and use of insecticide-treated mosquito nets, treatment and control of helminth infestations, and promotion of diet diversification to increase dietary iron intake.[8,10] Despite these strategies, compliance with these interventions remains generally poor across contexts including Uganda.[11–13]

Hitherto, limited prospective studies have examined how effective these interventions have been in reducing anaemia during pregnancy in northern Uganda, partly because of the high costs associated with measuring anaemia, especially for big sample sizes.[14,15] In addition, the contextual factors responsible for the preponderance of anaemia in the area remain widely unstudied. Current information on the burden and determinants of anaemia is vital in the design and evaluation of policies and strategies aimed at reducing the burden of anaemia in pregnancy in northern Uganda. Therefore, we aimed to assess the prevalence and factors associated with anaemia among pregnant women seeking antenatal care in a public referral hospital in northern Uganda.

Material and methods

Study design and setting

We conducted an analytical cross-sectional study between December 2017 and March 2018. The study was conducted in the antenatal clinic of Lira Regional Referral Hospital (LRRH). The hospital is one of the 14 regional referral hospitals in Uganda and is located in Lira City, which is proximately 340 kilometres by road to the north of Kampala, the capital city of Uganda. LRRH is found in the Lango sub-region, one of the four sub-regions in northern Uganda. The hospital has a bed capacity of approximately 350 and serves all 8 districts in the Lango sub-region. According to the clinic register, the monthly antenatal clinic attendance averages 640 pregnant women and it is run by at least two midwives each day. The facility was chosen because of the high patient load and the fact that it had a wide catchment area which would make our findings more generalisable.

Study participants

The study was conducted among pregnant women attending the antenatal clinic at LRRH. Confirmation of pregnancy was based on the antenatal card record of the woman. All pregnant women attending the antenatal clinic at the hospital were eligible to participate in the study irrespective of gestational age, gravidity or parity. Pregnant women with known haemoglobin disorders and those who had malarial infection at the time of data collection were excluded from the study.

Sample size and sampling procedure

The sample size was calculated using a single population proportion formula[16] with a z-score (z) of 1.96, a margin of error (e) of 0.05, and a prevalence (p) for the known population of 0.291.[17] The calculated sample size was 349 plus a 10% allowance for non-response. Eligible participants were enrolled in the study using a consecutive sampling technique. The investigators enrolled the participants consecutively as the women came in for their ANC visits daily during the study period until the desired sample size was realised. This sampling technique was chosen because of time constraints given the big sample size.

Data-collection method, tool and procedures

We used a structured interviewer-administered questionnaire to collect data with the help of two trained research assistants. The questionnaire was developed from a literature review of previous studies.[8,10] The questionnaire was reviewed, pre-tested and adjusted accordingly before data collection. The questionnaire was developed in English, translated to Lango, the local language, and then back-translated to English by two different language experts who speak English and Lango fluently. The questionnaire collected information from the participants on the following: demographic characteristics, obstetric history, nutritional status and dietary patterns, and anaemia prevention-related factors (iron supplementation, deworming, intake of antimalarial prophylaxis and intake of iron-rich foods). Data collection involved administration of the questionnaire and taking blood from the study participants for assessment of Hb and serum ferritin levels. The overall process of data collection lasted for 20–30 minutes.

Sample collection and processing

A venepuncture at the antecubital fossa was done to collect 5 ml of blood in each of two vacutainer tubes for Hb and serum ferritin analysis. The tubes were clearly labelled using a code that matched the participants' completed questionnaire. Samples were maintained at +4^{0}C and transported to Mulago National Referral Hospital laboratory for analysis. Hb and serum ferritin concentrations were assessed using the Sysmex XS-1000i Automated Hematology Analyzer (Sysmex Corporation, Kobe, Japan) and Cobas 6000 automated analyser respectively (Roche Diagnostics, Indianapolis, IN, USA). Hb concentration was adjusted for altitude by subtracting 0.2 g/dl from the measured participant concentrations for defining and classifying anaemia based on the recommendation by the World Health Organization for study settings such as Lira City with altitudes between 1 000 and 1 500 metres above sea level.[18]

Study variables and measures

The outcome variable was anaemia, defined as Hb less than 11 g/dl in the first and third trimesters and less than 10.5 g/dl in the second trimester.[18] Anaemia was classified as: severe (Hb < 7.0 g/dl), moderate (Hb 7.0–9.9 g/dl) or mild (Hb 10-10.9 g/d).[18] The independent variables included: age, marital status, level of education, occupation, level of income, gravidity, number of children, birth interval, gestational age, number of ANC visits, timing of the ANC visit, serum ferritin (sF) concentration levels, mid-upper-arm circumference (MUAC), frequency of eating meat and poultry, legumes and cereals, and vegetables and fruits, iron supplementation, intake of anti-malarial prophylaxis, intake of dewormers and food avoidance.

Iron deficiency (ID) as determined by sF concentration was classified as category I (sF <15 µg/l), which denotes ID that requires active intervention, category II (sF 15–29.9 µg/l), which still signifies low iron stores, and category III (sF ≥30 µg/l), which indicates a normal iron-store level.[19] Adherence to iron supplements was defined as a self-reported intake of iron pills on at least four days in the previous week. This was used as a proxy of how well the women were taking the total routine daily prescribed iron pills. Undernutrition status was defined as MUAC < 23.0 cm using an adult MUAC tape for pregnant women.[20] The food frequency questionnaire[21] was adapted to measure the frequency of consumption of iron-rich foods by participants. The frequency of intake of iron-rich foods was then defined as consumption of meat and poultry, legumes and cereals, vegetables and fruits at least twice or more than twice a week.

Data management and analysis

Every questionnaire was checked for completeness at the end of each interview. Data were entered in SPSS version 25 (IBM Corp, Armonk, NY, USA) and exported to STATA version 14 (StataCorp, College Station, TX, USA) for analysis. Data were scanned for out-of-range and missing values before commencing data analysis. Categorical variables were summarised as proportions and continuous variables as means with their standard deviations as appropriate. We used logistic regression to test for association between the dependent and independent variables at a 95% level of confidence. Based on the scientific literature and biological plausibility, we included the following factors in our multivariate logistic model (Table 3): maternal age,[22] gravity,[23] parity,[23,24] gestational age,[23,24] number of ANC visits,[25] intake of antimalarial[26] and iron supplementation,[11,27,28] deworming[29] and MUAC.[23] All the variables in the model were assessed for collinearity, which was considered present if the variables had a variance inflation factor (VIF) of > 10. In situations of collinearity, we retained the variable with greater biological plausibility.

Ethical considerations

The research protocol was reviewed and approved by the Makerere University School of Health Sciences Research and Ethics Committee (SHSREC REF: 2017-061). Administrative clearance was also obtained from the office of the District Health Officer, Lira District, and Lira Regional Referral Hospital administration. Written informed consent was obtained from participants. Pregnant women who were below 18 years of age were regarded as emancipated minors. Privacy and confidentiality were maintained throughout the study by conducting the interviews in a private place, the use of codes instead of participants' names, and password protection of entered data. Pregnant women found to have low Hb and serum ferritin concentrations were contacted and advised to seek treatment from LRRH or any other nearby health facility.

Table 1: Demographic and obstetric characteristics of study participants (*N* = 320)

Characteristics	Total (*N* = 320) *n* (%)	Anaemia *n* = 79 (%)	No anaemia *n* = 241 (%)
Age (years):			
15–24	164 (51.2)	41 (25)	123 (75)
25–29	80 (25)	16 (20)	64 (80)
≥ 30	76 (23.8)	22 (28.9)	54 (71.1)
Marital status:			
Single	29 (9.1)	11 (37.9)	18 (62.1)
Married	291 (90.9)	68 (23.4)	223 (76.6)
Highest level of education:			
No formal education	9 (2.8)	1 (11.1)	8 (88.9)
Completed primary	167 (52.2)	41 (24.6)	126 (75.4)
Completed secondary	98 (30.6)	23 (23.5)	75 (76.5)
Completed tertiary	46 (14.4)	14 (30.4)	32 (69.6)
Occupation:			
Housewife/ unemployed	25 (7.8)	41 (24.4)	127 (75.6)
Self-employed	127 (39.7)	32 (25.2)	95 (74.8)
Civil servant	168 (52.5)	6 (24)	19 (76)
Income:			
≤ 100 000 UGX (28.6 USD)	234 (73.1)	54 (23.1)	180 (76.9)
> 100 000 UGX (28.6 USD)	86 (26.9)	25 (29.1)	61 (70.9)
Gravidity:			
Primigravida	88 (27.5)	24 (23.1)	64 (72.7)
Multigravida	232 (72.5)	55 (29.1)	177 (76.3)
Number of children (*n* = 232):			
0	21 (9)	6 (28.6)	15 (71.4)
1–4	199 (85.8)	44 (22.1)	155 (77.9)
≥ 5	12 (5.2)	5 (41.7)	7 (58.3)
Birth interval (*n* = 232):			
< 2 years	68 (29.3)	6 (20.7)	23 (79.3)
≥ 2 years	164 (70.7)	49 (24.1)	154 (75.9)
Gestational age:			
First trimester	24 (7.5)	6 (25)	18 (75)
Second trimester	140 (43.8)	35 (25)	105 (75)
Third trimester	156 (48.7)	38 (24.4)	118 (75.6)
Number of ANC visits:			
1	152 (47.5)	42 (27.7)	110 (72.4)
≥ 1	168 (52.5)	37 (22.0)	131 (78.0)
Timing of first ANC visit (*n* = 168):			
≤ 12 weeks	34 (20.1)	10 (29.4)	24 (70.6)
13–27 weeks	125 (74.4)	27 (21.6)	98 (78.4)
≥ 28 weeks	9 (5.3)	0 (0)	9 (100)

Ugx: Uganda shillings; *n = 232*: study participants who were multigravida; *n = 168*: study participants coming for at least the second ANC visit.

Results

Out of the 349 participants approached, 320 accepted to take part in the study, giving a response rate of 91.7%.

Demographic and obstetric characteristics of study participants

The mean age of the study participants was 25.3 ± 5.6 years of age while the mean gestational age of the study participants was 25.4 ± 7.8 weeks. The majority of the study participants (51.2%) were young adults and had completed a primary level of education (52%) (Table 1). Most of the participants were multigravida (72.5%) and in either the second or third trimester (92.5%) (Table 1).

Prevalence of anaemia among study participants

The prevalence of anaemia in pregnancy (defined as Hb < 11 g/dl in the first and third trimester and 10.5 g/dl in the

Table 2: Nutritional and dietary characteristics of study participants (*N* = 320)

Variables	Total (*N* = 320) *n* (%)	Anaemia *n* = 79 (%)	No anaemia *n* = 241 (%)
MUAC:			
< 23 cm	9 (2.8)	1 (11.1)	8 (88.9)
≥ 23 cm	311 (97.2)	78 (25.1)	233 (74.9)
Serum ferritin concentration:			
< 15 µg/l	40 (12.5)	17 (42.5)	23 (57.5)
15–29.9 µg/l	104 (32.5)	23 (22.1)	81 (77.9)
≥ 30 µg/l	176 (55)	39 (22.2)	137 (77.8)
Antimalarial prophylaxis (*n* = 296):			
Yes	143 (48.3)	30 (20.8)	114 (79.2)
No	153 (51.7)	49 (27.8)	127 (72.2)
Iron supplementation:			
Yes	149 (46.6)	34 (22.8)	115 (77.2)
No	171 (53.4)	45 (26.3)	126 (73.7)
Deworming:			
Yes	70 (21.9)	17 (24.3)	53 (75.7)
No	250 (78.1)	62 (24.8)	188 (75.2)
Consumption of meat, fish and poultry:			
≤ 2 times/week	153 (47.8)	30 (19.6)	123 (80.4)
> 2 times/week	167 (52.2)	49 (29.3)	118 (70.7)
Consumption of legumes and cereals:			
≤ 2 times/week	53 (16.6)	20 (37.7)	33 (62.3)
> 2 times/week	267 (83.4)	59 (22.1)	208 (77.9)
Consumption of vegetables and fruits:			
≤ 2 times/week	19 (5.9)	4 (21.1)	15 (78.9)
> 2 times/week	301 (94.1)	75 (24.9)	226 (75.1)
Food avoidance:			
Yes	145 (45.3)	34 (23.4)	111 (76.6)
No	175 (54.7)	45 (25.7)	130 (74.3)

n = 296: study participants in the second and third trimester; MUAC: mid-upper arm circumference second trimester) was 24.7% (79/320; 95% CI 20.1, 29.8). Among women with anaemia, 40/79 (50.6%) had sF < 30 µg/l and 17/79 (21.5%) had sF < 15 µg/l. Overall, 144/320 (45%; 95% CI 39.5%, 50.6%) had sF <30 µg/l.

Nutritional and dietary characteristics of study participants

The mean MUAC measurement of the study participants was 28.1 ± 3.6 cm based on the adult MUAC tape for pregnant women. Nearly half of the participants (45%) had iron deficiency (sF < 30 µg/l). The majority of the participants (53.4%) were not on the iron supplementation programme while more than three-quarters of the eligible participants (78.1%) had never taken deworming medicine. Most of the participants consumed meat and poultry (52.2%), legumes and cereals (83.4%), and vegetables and fruits (94.1%) more than twice a week (Table 2).

Factors associated with anaemia among pregnant women in northern Uganda

Pregnant women who were taking antimalarial prophylaxis were 56% less likely to be anaemic compared with pregnant women who were not taking antimalarial prophylaxis (AOR 0.44; 95% CI 0.19, 0.99). Pregnant women who consumed legumes and cereals more than twice in the previous week were 54% less likely to have anaemia compared with those who consumed legumes and cereals less than twice in the previous week (AOR 0.46; 95% CI 0.24, 0.89), as indicated in Table 3.

Discussion

In this study, we assessed the prevalence and of anaemia and associated factors among pregnant women seeking antenatal care in Lira City, northern Uganda. We found that one in four pregnant women seeking antenatal care was anaemic, with the taking of antimalarial prophylaxis and consumption of legumes and cereals as the predictors. These findings suggest gaps in the implementation of interventions to control and treat anaemia among pregnant women and the role of diet in preventing anaemia during pregnancy.

The prevalence of anaemia in our study was comparable to the 30% reported by a systematic review conducted among

Table 3: Multivariate analysis of factors associated with anaemia among pregnant women in Lira City, northern Uganda

Variables	COR	*p*-value	AOR (95%CI)	*p*-value
Age in years:				
< 24	1		1	
25–29	0.75 (0.39, 1.44)	0.387	0.73 (0.35, 1.56)	0.421
≥ 30	1.22 (0.66, 2.25)	0.518	1.22 (0.58, 2.55)	0.595
Education:				
≤ 7 years	1		1	
≥ 8 years	1.10 (0.66, 1.84)	0.706	1.07 (0.58, 1.97)	0.831
Income:				
≤ 100 000 UGX (USD 28.6)	1		1	
> 100 000 UGX (USD 28.6)	1.37 (0.78, 2.38)	0.271	1.32 (0.69, 2.51)	0.401
Number of pregnancies:				
1	1		1	
≥ 2	0.83 (0.47, 1.45)	0.509	0.95 (0.47, 1.95)	0.897
Gestational age:				
First trimester	1		1	
Second trimester	1.00 (0.37, 2.72)	1.000	1.00 (0.35, 2.83)	0.998
Third trimester	0.97 (0.36, 2.61)	0.946	1.51 (0.48, 4.81)	0.481
Timing of first ANC:				
Other trimester	1		1	
First trimester	1.31 (0.60, 2.88)	0.500	1.65 (0.70, 3.87)	0.248
Antimalarial prophylaxis:				
No	1		1	
Yes	0.68 (0.41, 1.15)	0.149	0.44 (0.19, 0.99)	0.048*
Deworming:				
Yes	1		1	
No	1.03 (0.55, 1.91)	0.930	0.88 (0.43, 1.83)	0.740
Meat consumption (meat, chicken, fish)				
≤ 2 times/week	1		1	
> 2 times/week	1.59 (0.94, 2.70)	0.086	1.44 (0.83, 2.51)	0.199
Consumption of legumes and cereals:				
≤ 2 years	1			
> 2 times/week	0.47 (0.25, 0.88)	0.017	0.46 (0.24, 0.89)	0.020*
Consumption of vegetables and fruits:				
≤ 2 years	1		1	
> 2 times/week	1.24 (0.40, 3.87)	0.705	1.27 (0.39, 4.12)	0.688

*Statistically significant variables at $p < 0.05$; 1: reference group; COR: crude odds ratio; AOR: adjusted odds ratio.

pregnant women in Uganda[4] and another study done in Ethiopia.[30] However, our prevalence was lower than the 53% and 59% reported among pregnant women in Sudan[31] and India,[32] but higher than the 5% and 16% reported among pregnant Iranian women in the first and third trimesters respectively.[33] The differences in the reported prevalence across studies could be attributed to the differences in the cut-off for Hb level, methods of measuring maternal Hb across the studies and gestational age of study participants. For example, the Indian study[32] defined anaemia as Hb < 11 g/dl across trimesters while we set our cut-off for anaemia at 11 g/dl for the first and third trimesters and Hb < 10.5 g/dl for the second trimester. Additionally, most of our study participants (48.7%) were in the third trimester, a trimester when iron stores are transferred to the foetus and maternal serum ferritin concentrations fall.[34] The result of our study indicates that anaemia in pregnancy is still a moderate public health problem in our setting, based on the World Health Organization's classification of the public health significance of anaemia.[18]

Pregnant women who consumed legumes and cereals more than twice in the previous week had 54% lower odds of having anaemia in pregnancy compared with those who consumed legumes and cereals less than twice in the previous week. Cereals and legumes such as beans, millet (*kalo*), and sorghum (*abir*) are good sources of non-heme iron[35] although less bioavailable at 1% to 10% than the heme-iron sources at 20% to 30%.[36] Fortunately, these kinds of foodstuffs are part of the staple foods in northern Uganda. The association of anaemia and consumption of legumes and cereals in this study is consistent with a finding from rural Ethiopia[37] but contrary to findings from rural parts of Ghana[25] and urban areas of Ethiopia.[38] Discrepancies in results across studies could be attributed to variations in demographic and dietary characteristics of study participants. The results of this study serve to reinforce the need to emphasise the consumption of locally available iron-rich foods, which are usually affordable and readily available for most pregnant women.

The odds of anaemia among pregnant women taking antimalarial prophylaxis were 56% less than the odds of anaemia among pregnant women who were not taking antimalarial prophylaxis. Malaria is endemic in Uganda and the relationship between malarial infestation and anaemia is well documented in a previous study.[39] Malarial infestation causes rupture of red blood cells, which lowers the number of red blood cells thus predisposing the individual to anaemia; thus the intake of antimalarial prophylaxis ameliorates this effect. Our finding is similar to that reported in other parts of Uganda, Malawi and Nigeria.[26,40,41] Therefore, all pregnant women should be advised to take the full dose of antimalarial intermittent presumptive therapy (IPT) to prevent anaemia in pregnancy.

This study had some limitations. One of these is that we did not correct ferritin for inflammation or verify the serum ferritin results by doing a transferrin saturation test. Serum ferritin is an acute-phase protein that is affected by infections. Recall bias might have affected responses on food consumption frequency. Finally, the results of this study may not be generalisable to women in the community who do not attend antenatal clinics, as this was a hospital-based study. Therefore, the findings of this study should be interpreted within these limitations.

Conclusions

Anaemia in pregnancy is a moderate public health problem in our study population from northern Uganda and is associated with the taking of antimalarial prophylaxis and consumption of legumes and cereals less than twice in the previous week. The results of this study give insight into the impact of interventions to control anaemia during pregnancy and the targeted areas of emphasis during maternal nutrition education. We recommend a community-based study to expand data on the burden of anaemia in pregnancy in northern Uganda. More studies are needed to unravel the optimal strategies to improve the compliance of pregnant women with interventions to control anaemia during pregnancy.

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ORCID

Samson Udho http://orcid.org/0000-0001-6723-5048
Joyce Nankumbi http://orcid.org/0000-0001-9147-4559

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