International Journal of TROPICAL DISEASE & Health
11(1): 1-9, 2016, Article no.IJTDH.20791
ISSN: 2278–1005, NLM ID: 101632866

SCIENCEDOMAIN *international*
www.sciencedomain.org

Anaemia in Pregnancy: Prevalence and Associated Factors in Azare, North-East Nigeria

L. M. Dattijo[1*], P. H. Daru[2] and N. I. Umar[3]

[1]Department of Obstetrics and Gynaecology, ATBU Teaching Hospital, Bauchi, Nigeria.
[2]Department of Obstetrics and Gynaecology, Jos University Teaching Hospital, Jos, Nigeria.
[3]Department of Obstetrics and Gynaecology, Federal Medical Centre, Azare Bauchi State, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Authors LMD and PHD conceived, designed the study and performed the statistical analysis. Authors LMD and NIU wrote the draft and interpreted the results. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJTDH/2016/20791
Editor(s):
(1) Anthony R. Mawson, Public Health and Director Institute of Epidemiology and Health Services Research, Jackson State University, USA.
Reviewers:
(1) Abbassia Demmouche, Djillali Liabes University, Algeria.
(2) Golam Hafiz, Bangabandhu Sheikh Mujib Medical University, Shahbag, Bangladesh.
(3) Nwosu Betrand Obi, Nnamdi Azikiwe University (UNIZIK), Nigeria.
(4) C. Aneke John, Nnamdi Azikiwe University, Nigeria.
Complete Peer review History: http://sciencedomain.org/review-history/11634

Original Research Article

Received 9th August 2015
Accepted 17th September 2015
Published 29th September 2015

ABSTRACT

Aims: Anaemia in pregnancy is a common health problem in poor-resource countries like Nigeria and is associated with both maternal and perinatal complications. It is multifactorial in origin; the relative contribution of these factors may differ from one region to the other. Anaemia is a preventable condition through interventions that are potentially feasible and cost effective. The objective of this study was to determine the magnitude of anaemia in pregnancy and its associated factors In Azare, north-eastern Nigeria.
Study Design: Cross-sectional study.
Place and Duration of Study: Department of Obstetrics and Gynaecology, Federal Medical Centre, Azare Bauchi State, between January 2010 and June 2010.
Methodology: Four hundred women who presented to the antenatal clinic for their booking visit were studied. Anaemia was defined as a haematocrit of 33%. Demographic and obstetric

**Corresponding author: Email: Lamaran2@yahoo.com;*

characteristics as well as blood, urine and stool samples were taken from the enrolled participants. Estimation of haematocrit, malaria parasite, urine microscopy and stool microscopy were done. The data was analysed with Epi info 3.3.4. (CDC Atlanta).
Results: Prevalence of anaemia was 71.3% and severe anaemia was 1.4%. The majority (79%) of the women booked in the second trimester. Multiple logistic regression model revealed malaria parasitaemia (AOR 5.45CI 2.59-11.45), low socioeconomic status (AOR 4.90 CI 2.09-11.49) and bacteriuria (AOR 4.74CI 1.99-11.32) as significant associated factors of anaemia in pregnancy.
Conclusion: The prevalence of anaemia in pregnancy in this community is high and it is an established problem at booking visit. Girl-child education, economic empowerment of women, antenatal care, treatment of infestations and provision of safe water supply should be promoted.

Keywords: Anaemia; pregnancy; prevalence; factors; Nigeria.

1. INTRODUCTION

Anaemia in pregnancy is a major public health problem in poor-resource countries [1-4]. It is responsible for an estimated 20% of maternal deaths in West Africa and contributes to still more deaths through obstetric haemorrhage [5]. Studies reveal a strong association between severe anaemia and adverse perinatal and maternal outcome [3]. Nutritional problems such as iron and folate dietary deficiencies are major causes of anaemia in pregnancy. Others include secondary effects of malaria and hookworm infestations, infections such as human immune-deficiency virus, and hemoglobinopathies [2,6,7].

It was estimated that up to 56% of all non-pregnant women living in developing countries were anaemic by WHO standard (Hb <11 g/dl), compared with 18% in industrialised countries [1,2]. Asia and Africa have the highest prevalence of anaemia where it is estimated that 60% and 52% of women, respectively, are anaemic, and between 1% and 5% are severely anaemic (Hb <7 g/dl) [5-7].

In Nigeria, various rates have been reported from parts of the country. In Abeokuta, south-west Nigeria, a prevalence rate of 76.5%, a high percentage of the women booked in the second trimester. The rate was higher among primigravidae than multigravidae [8]. In Enugu south-eastern Nigeria, a prevalence rate of 64.1% with 1.1% of cases being severe anaemia recorded at a University Hospital and the rate was higher among those that booked in the third trimester [9]. In a tertiary centre in north-eastern Nigeria found a prevalence rate of 72% was reported [10]. From the south of Nigeria, a prevalence of 56.1% was found at antenatal booking clinic, of which 6.7% were severely anaemic [11]. All these studies used the WHO cut-off point of the haematocrit of 33%. A study in Gombe North-eastern Nigeria recorded 51.8% with 2.1% having severe anaemia [12]. This study used haematocrit of 30% as the cut off point. Other studies using this criterion reported a prevalence of 33.3% and 35.5% in Port Harcourt and Nnewi respectively [13,14].

Availability of baseline data on this important morbidity is necessary to be able to estimate the burden and for monitoring of progress in its management. There is no existing data on this common condition in Bauchi, north-east Nigeria. It is the aim of this study to generate data on anaemia in pregnancy at booking in this area. The information on this condition and its correlates will help maternal health policy makers to apply appropriate interventions.

2. MATERIALS AND METHODS

This was a prospective study of 400 pregnant women who presented for booking at the Federal Medical Centre Azare, north-east Nigeria between January 2010 and June 2010. The hospital provides care to the population of Bauchi and its neighbouring states of Yobe and Jigawa.

Verbal consent was obtained from the pregnant women and those who give consent were consecutively enrolled into the study. Those excluded were pregnant women on follow-up visits, who had a blood transfusion in the index pregnancy, those with sickle cell disease and who decline to give consent. Ethical approval was obtained from the hospital ethics committee.

The demographic and obstetric characteristics of the participants such as age, education, occupation, gestational age, parity, inter-pregnancy interval as well as history of Pica ingestion were obtained from each participant by the interviewer. The information was entered into a data form. Socioeconomic status was determined taking cognisance of local situations

using husband occupation and educational level of the wife as done by Olusanya et al. [15].

For this study, anaemia was defined according to the WHO criteria of haematocrit below 33% [1]. Anaemia was further categorised into three levels; mild 28-32%, moderate 21-27% and severe <21%.

2.1 Laboratory Methods

The packed cell volume was determined by the microhaematocrit method. Two millilitres of blood was taken from each participant. The sample was centrifuged and then read with the haemocytometer.

Thick films were made and stained with Giemsa stain and read. Parasite densities were estimated by counting the number of trophozoites per 200 white blood cells. A thick film was considered negative if 100 microscopic fields showed no parasites.Determination of HIV status was done using two rapid tests(Determine^{R} and Unigold^{R}). It is regard as positive when two are in agreemenr. Where there is disagreement, a tie breaker is then utilised.

Mid-stream urine specimens were collected from the participants and processed by inoculation on a blood agar plate using calibrated wire loop to determine bacteriuria. Streaking on Cysteine-Lactose-Electrolyte (CLED) agar plate was done to obtain discrete colonies for identification. A gram microscopy of the discrete colonies was performed followed by biochemical identification and subsequent antimicrobial susceptibility testing.

The stool samples were examined within 24 hours of collection. They were first examined macroscopically for blood or mucus staining and the form described as formed, loose or watery. A wet preparation was then done. The 10x objective was used to examine each slide thoroughly and where ova or larvae of any parasite were suspected, the 40x objective was used to identify the parasite.

Data management and the statistical analysis was done with Epi info 3.4.3 (Centre for Disease Control and Prevention, Atlanta, GA, USA). This included univariate and multivariate analyses. Variables known to be associated with anaemia factors and those found to be significant in bivariate analysis were entered into a logistic regression model to determine predictors of anaemia. A p value of less than 0.05 was considered statistically significant.

3. RESULTS

A total of 400 women were studied. The mean age was 25.3±5.9 years. Their median parity was 2 with a range of 0-9. Mean gestational age at booking was 23±4.8 weeks while mean haematocrit was 30.8±3.8%.

Of the 400 women, 285 (71.3%) were anaemic using the WHO criteria. It was 46% when the haematocrit of less than 30% was used. Severe anaemia (<21%) was 1.4% while mild anaemia was 81.4% (Table 1).

Table 1. Distribution of anaemia according to severity

Severity	Anaemia (%)
Mild	232 (81.4%)
Moderate	49 (17.2%)
Severe	4 (1.4%)
Total	285 (100%)

Three hundred and two (75.5%) booked in the second trimester while 10 (2.5%) had their booking visit in the first trimester. Of the 10 that booked in the first trimester only 2 (20%) were anaemic compared to 78% of those that booked in the third trimester (p<0.001).

Multiparous women constituted 52% of the study population. Subgroup analysis revealed that anaemia was more common among women with grand-multiparity than those with parity of 4 and below (p<0.001). Women with no education constituted 29% but anaemia was found in 94% among them compared to 19% among those who had completed at least secondary education. Housewives with no occupation were 277 (69%) of the women. Anaemia was found in 84% of them compared to 28% among women who were civil servants. The distribution of anaemia by maternal characteristics is shown in Table 2.

Malaria parasitaemia was found in 145 (36.3%) of the women. It was seen more in primigravidae compared to multigravidae. Of the 37 women infested with intestinal parasites, all but one were anaemic. Hookworm was isolated in 20 (54%) Ascaris in 10 (27%) and 7 (19%) had trichuris trichuria.

Anaemia in pregnancy was significantly associated with the following variables: Malaria parasitaemia (8.41 CI 4.44-17.07), Bacteriuria

(4.74 CI 1.99-11.32) and intestinal helminths (16.55 CI 2.24-122.19) amongst others (Table 3). However, in the multivariate logistic regression model, only three factors were significantly associated with anaemia in pregnancy at booking in the studied population. These included malaria parasitaemia (5.45 CI 2.59-11.45), low socioeconomic status (4.90 CI 2.09-11.49) and bacteriuria (4.74 CI 1.99-11.32) (Table 4).

Table 2. Maternal characteristics and anaemia

Characteristics	Number	Anaemic n (%)
Age (years)		
≤19	60	57 (95)
20-24	131	93 (71)
25-29	107	63 (58.9)
30-34	66	45 (68.2)
35-39	28	4 (14.3)
40-44	8	2 (25)
Parity		
0	122	82 (67.2)
1-4	209	142 (67.9)
≥5	69	61 (88.4)
Gestational age		
1st trimester	10	2 (20)
2nd trimester	302	215 (71.2)
3rd trimester	88	68 (77.3)
Marital setting		
Monogamous	251	160 (63.70)
Polygamous	149	125 (83.9)
Socioeconomic group		
Low	261	224 (85.8)
Middle	90	54 (60)
High	49	7 (14.3)
Education		
No education	117	110 (94)
Completed primary	220	163 (74.1)
Completed secondary	63	12 (19)
Occupation		
House wives only	277	232 (83.8)
Civil servants	32	9 (28.10)
Traders	21	8 (30.1)
Students	37	10 (27)
Others	33	25 (75.8)

4. DISCUSSION

The principal finding of this study is the high prevalence of anaemia in pregnancy of 71.3% and severe anaemia of 1.4%. This revealed that anaemia in pregnancy was an important public health problem in Azare. The rate was comparable to 72% of Nguru (north-eastern Nigeria), 76.5% of Abeokuta (south-western Nigeria), 66% of Bobo-Dialasso (Burkina Faso) and 72% noted in rural Malawi [8,10,16,17]. These figures are in the upper limit of the reported range of 35-70% prevalence rate for developing countries [1]. The rates are higher than the 56.1% from Delta (southern Nigeria), 35.3% from the commercial city of Lagos, 35% from Malaysia and 15% for Singapore, a country with rate comparable to Europe and America [11,14,18]. The striking differences may be due to the different socioeconomic conditions, culture, health-seeking behaviour and availability or otherwise of maternal health services. The study area is rural in nature and is in the northeast region of Nigeria which has the worst figures in reproductive health indices and levels of education in Nigeria [19]. Hence the high rates in comparison to places like Delta and Lagos where socioeconomic condition and availability of maternal health services were better [19]. While studies from south-eastern Nigeria and South-western Nigeria had no case of severe anaemia [8,9], in this study 1.4% of the anaemic pregnant women were severely anaemic. Also, in Southern Malawi, 3.6% of anaemic pregnant women had the severe variety [17].

This study was done on women who attend the antenatal clinic of the medical centre in Azare. An estimated 60% of women attend at least one antenatal visit in Nigeria [19]. We have no reason to believe that anaemic women in the town preferentially visit the antenatal clinics of the hospital. For this reason, the rate of prevalence may be a reasonable estimate for the population of pregnant women who visit the hospital.

Anaemia was commoner among grandmultipara compared to those with parity of 4 and below ($p<0.001$). This was similarly reported from Nnewi south-eastern Nigeria but is at variance with the Lagos study where no such difference was found [9,11]. The finding here could be due to progressive depletion of iron stores with increasing parity and the proposition that the experience of previous pregnancies may not have led to increased utilisation of antenatal care early.

Those booking in second and third trimester had more cases of anaemia than the first trimester. This was similar to the findings from Lagos and Gombe studies [11,12]. This high number may be because the majority of our women booked in the second trimester. The physiologic expansion of maternal plasma volume, increasing foetal

Table 3. Relationship of associated factors with anaemia

Factor	Number	Anaemic n	Odds ratio	p-value
Age (years)				
≤19 *	60	57		
≥20	340	228	0.11 (0.03-0.35)	0.001
Parity				
Para 4 and below*	331	224		
Grandmultiparity	69	61	3.71 (1.62-8.51)	0.002
Booking				
Early*	10	2		
Late	390	283	0.09 (0.02-0.45)	0.001
Inter-pregnancy interval				
>2years*	55	35		
≤ 2 years	221	166	1.72 (0.88-3.38)	0.08
Marital union				
Monogamous*	251	160		
Polygamous	149	125	2.94 (1.77-4.88)	<0.001
Socioeconomic group				
High*	283	175		
Low	17	110	4.02 (2.33-7.01)	<0.001
Malaria parasitaemia				
Yes	145	134		
No*	255	150	8.41 (4.44-17.07)	<0.001
Bacteriuria				
Yes	65	59	4.74 (1.99-11.32)	<0.001
No*	235	226		
Pica ingestion				
Yes	57	48	2.36 (1.12-4.99)	0.02
No*	343	237		
Intestinal helminths				
Yes	37	36	16.55 (2.24-122.20)	0.006
No*	363	248		

demand, worsening of existing iron deficiency and deficient or absent antenatal care early in pregnancy may all be contributory to the high rate of anaemia in late trimesters [20]. The results suggested that anaemia predates the pregnancy in the majority of cases. Hence, preconception care, including iron and folic acid supplementation, is advocated to reduce this problem.

Teenage pregnancy was found in 15% of the women in the study and 95% of them were anaemic. The rate of teenage pregnancy was lower than the National Demographic Health Survey (NDHS 2013) reported rate of 39% for north- east region [19]. This may reflect the low utilisation of ANC by this group. The young pregnant women are more likely to have low iron stores because of their greater iron requirements and so will remain iron-depleted during pregnancy as it is difficult to replenish the stores when pregnancy sets in [6,7]. Ninety-five percent of those 19 years and below were anaemic in the studied sample. Teenage pregnancy was found to be significantly associated with anaemia and pregnant adolescent were at risk of anaemia. This was in agreement with the findings reported in Benin, southern Nigeria [15] but the Delta and Malawi studies found that teenage pregnancy was not a risk factor [14,17].

The majority of the women in the lower socioeconomic class were anaemic. Of this group, 85% of them were anaemic and the low socioeconomic class was significantly associated with anaemia. This was similarly reported by the Lagos and Gombe studies [11,12]. Women in these classes are less likely to be educated. Educational attainment has a strong effect on health behaviour and a key determinant of life style [7]. More than two-third of the women studied did not have a basic education. These women are less likely to consume diets rich in

animal protein, vitamins and more of carbohydrates and have poor access to good health services. They are likely to commence pregnancy with the chronic iron deficit and the foetal demand may worsen it [7]. Education will lead to an increased awareness and better utilisation of antenatal care services. Educated mothers are more likely to have their children immunised so that child survival will improve and child spacing becomes feasible.

The majority of the women had inter-pregnancy interval less than 2 years. This is illustrative of the low contraceptive usage in this community. The Nigeria Demographic Health Survey (NDHS 2013) reported a national contraceptive prevalence rate of 15% with 3.0% for the north-east region [19]. There was no significant difference in anaemia prevalence between those with an interval of fewer than 2 years and those with more than 2 years (p=0.08).

All the women studied were married. In this community, pregnancy out of wedlock is highly stigmatised and may have legal implications for the mother hence such women may not present to the health facility. Women in polygamous marriages had more cases of anaemia than that in monogamous ones. This was also noted in the Gombe study [12]. However, this was not found to be significant in multivariate analysis.

The majority (69%) of the women were housewives with no paid employment. This is in keeping with the cultural norm in this area. This is in contrast to the profile of the women studied in Abeokuta south-west Nigeria where the majority were traders and civil servants [8]. The high frequency of anaemia in the housewives compared to the civil servants in this study may be due to the economic empowerment enjoyed by those with paid employment.

Table 4. Multivariate analysis of associated factors for anaemia

Factor	Number	Anaemic	OR	Adjusted OR
Age (years)				
≤19 *	60	57	1	
≥20	340	228	0.11 (0.03-0.35)	**0.18 (0.05-0.66)**
Parity				
Para 4 and below*	331	224	1	
Grandmultiparity	69	61	3.71 (1.62-8.51)	2.72 (0.85-8.69)
Booking				
Early*	390	283	1	
Late	10	2	0.09 (0.02-0.45)	2.72 (0.23-12.66)
Marital setting				
Monogamous*	251	160	1	
Polygamous	149	125	2.94 (1.77-4.88)	2.08 (0.96-4.51)
Socioeconomic group				
High*	283	175	1	
Low	117	110	5.50 (2.42-12.49)	**4.90 (2.09-11.49)**
Malaria parasitaemia				
Yes	145	134	8.45 (4.34-16.40)	**5.45 (2.59-11.45)**
No*	255	150	1	
Bacteriuria				
Yes	65	59	4.74 (1.99-11.32)	**3.74 (1.39-10.05)**
No*	235	226	1	
Pica ingestion				
Yes	57	48	2.36 (1.11-4.99)	1.48 (0.46-4.74)
No*	343	237	1	
Intestinal helminths				
Yes	37	36	16.55 (2.24-122.19)	7.28 (0.75-11.10)
No*	363	248	1	

**Reference group; OR-Odds Ratio*

Parasitic infestation during pregnancy is a recognised cause of anaemia in Africa [7,21]. Factors responsible for the transmission of human parasites vary according to geographical location. In this study, malaria parasitaemia was seen in 31.3% with higher frequency in the primigravida women. A similar observation was seen in western Kenya but the Nguru study found higher frequency among multipara [10,22]. The increased risk of malaria among primigravidae has been well described [5,21]. The studies utilised peripheral blood to determine parasitaemia. Malaria parasitaemia was significantly associated with anaemia in this study. This is not an unexpected finding, malaria being an endemic disease in this area. Malaria parasitaemia can directly cause haemolysis and elaboration of inflammatory cytokines that may lead to decrease release of iron from bone marrow, decrease red cell survival and inadequate response to erythropoietin response to anaemia [21].

Infestation with intestinal parasites was found in 9.8% of the women. This was higher than 0.6% reported from Nguru but lower than 38.8% reported among 2000 near-term pregnant women studied in three Nigerian towns over a year and 15.64% reported from Northern Ghana [10,23,24]. The disparity could be as a result of the sampled population, period of the study and geography. The occurrence of helminthic infestation among pregnant women is indicative of faecal contamination of soil and domestic water supply [23]. The Nigeria Demographic Health Survey (NDHS) reported that 32% of households have no toilet facilities and improved source of water supply was available to less than half (49%) of rural dwellers [19]. Lack of these amenities makes control of these parasites difficult. Anaemia prevention can be improved when malaria and intestinal parasites are adequately addressed.

HIV infection was found in 2.6% of the women; this is lower than the national seroprevalence rate of 4.8% and no association with anaemia ($p=0.96$) was noted. HIV infection is known to predispose to anaemia; it is associated with lower serum folate and serum ferritin in pregnancy so also the antiretroviral drugs used by HIV-infected patients [17,25]. This effect was not seen in this study probably due to the low number of infected women in the sample.

Bacteriuria was found in 16% of the pregnant women. Urinary tract infection has been associated with anaemia [7]. Endotoxin-induced haemolysis of red cells is one of the ways the infection predisposes to anaemia. A significant association with anaemia was seen in this study.

Odd eating habits were elicited in 14.3% of the women. Of these, 84% were anaemic compared to 69% of those without a history of pica ingestion. This figure is lower than that reported from Islamabad (32.5%) where pica ingestion was identified as a risk factor for anaemia in pregnancy [26]. This may be applicable to the study area where a type of clay of the kaolinite group (called "*farar kasa"* in Hausa language) is easily accessible in the markets, and some pregnant women crave it. Further studies are required to explain this craving and its effect on patients' nutrition and anaemia in pregnancy. It was not found to be a significant factor in this study. Items taken may include mud, back of trees and kaolin. The mud and kaolin may be a source of geo-helminths infestation.

The factors associated with anaemia, particularly during pregnancy, are multiple and complex and their relative contributions vary by geographic areas and seasons [7,21]. Significant factors identified in the population studied include low socioeconomic status, malaria parasitaemia and bacteriuria.

This study was done mainly during the dry season with extension into the early part of the rainy season. The observed finding may perhaps vary if it were done during the rainy season. A study with enrolment throughout the year will be needed. Another is its cross-sectional design that does not allow for follow-up of the patients to see the outcome of the care given to the women. Issues of recall bias of information, especially last menstrual period was a challenge due to the low level of education of the participants.

Areas for further research include the causes of late booking as antenatal care is the cornerstone in improving the maternal foetal outcome of pregnancy. A well designed longitudinal cohort study on the aetiology and outcome of pregnancy is needed to look at the causes and effects of anaemia in this population.

5. CONCLUSION

Anaemia in pregnancy is high and is found in 7 out of every 10 women studied. It is a well-established problem at the time of first antenatal visit in Azare north-eastern Nigeria. While it has been established that in the context of developing countries, nutritional iron deficiency is

the main cause of anaemia in pregnancy, it is however related to several social, demographic and obstetrics factors. In this study, malaria parasitaemia, low socioeconomic status and bacteriuria are the risk factors identified in this community. Strategies to improve girl-child education, economic empowerment of women, antenatal care, prevention and treatment of infestations are needed in the study area.

ETHICAL APPROVAL

All authors hereby declare that the work has been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. World Health Organization. The prevalence of anaemia in women: A tabulation of available information. Geneva, WHO; 1992; WHO/MCH/MSM/ 92.2;119-12.
2. World Health Organization, United Nations Children's Fund, United Nation University. Iron deficiency anaemia: Assessment, prevention and control. A guide for programme managers. Geneva: WHO; 2001. WHO/NHD/01.3.
3. Van den Broek NR. Anaemia and micro nutrient deficiencies. British Medical Bulletin. 2003;67:149-160.
4. Ogunbode O. Anaemia in pregnancy. In: Okonofua F, Odunsi K, editors. Contemporary obstetrics and gynaecology for developing countries. Benin City, Nigeria. Women's Health and Action Research Center. 2003;514–529.
5. Brabin BJ, Hakimi M, Pelletier D. An analysis of anaemia and pregnancy-related maternal mortality. J Nutr. 2001;131(2S-2):604S-615S.
6. Abou Zahr C, Royston E. Maternal mortality: A global fact book. Geneva: World Health Organization; 1991.
7. Harrison KA. Anaemia in pregnancy. In Lawson JB, Harrison KA, Bergstrom S. Maternity care in developing countries. London: RCOG Press. 2001;112-128.
8. Idowu OA, Mafiana CF, Sotiloye D. Anaemia in pregnancy: A survey of pregnant women in Abeokuta, Nigeria. Afr Health Sci. 2005;5(4):295–299.
9. Ezugwu EC, Mbah BO, Chigbu CO, Onah HE. Anaemia in pregnancy: A public health Problem in Enugu South-east Nigeria. J Obstet Gynaecol. 2013;33:451-454.
10. Kagu MB, Kawuwa MB, Gadzama GB. Anaemia in pregnancy: A cross-sectional study of pregnant women in a Sahelian tertiary hospital in North-eastern Nigeria. J Obstet Gynaecol. 2007;27(7):676-679.
11. Anorlu RI ,Oluwole AA, Abudu OO. Sociodemographic factors in anaemia in pregnancy at booking in Lagos, Nigeria. J Obstet Gynaecol. 2006;26(8):773-776.
12. Bukar M, Audu BM, Yahaya UR, Melah GS. Anaemia in pregnancy at booking in Gombe, North-eastern Nigeria. J Obstet Gynaecol. 2008;28(8):775-778.
13. Omietimi JE, Allagoa DO, Anya SE, John CT. The prevalence of anaemia in pregnancy at the University of Port-Harcourt Teaching Hospital (UPTH). Trop J Obstet Gynaecol. 2003;20(1):12.
14. Oboro VO, Tabowei TO, Jemikalajah J. Prevalence and risk factors for anaemia in pregnancy in Southern Nigeria. J Obstet Gynaecol. 2002;22(6):610-613.
15. Olusanya O, Okpere EE, Ezimokhai M. The importance of social class in voluntary fertility control in a developing country. West Afr J Med.1985;4:205-212.
16. Ogbeide O, Wagbatsoma V, Orhue A. Anaemia in pregnancy. East Afr Med J. 1994;71:671-673.
17. Meda N, Madelbrot L, Cartoux M, Dao B, Ouangre A, Dabis F. Anaemia during pregnancy in Burkina Faso, West Africa, 1995–96: Prevalence and associated factors. Bull World Health Organ. 1999;77: 916–922.
18. Jamaiyah H, Das A, Lim TO, Chen WS, Noraihan MN , Sanjay R, et al. Anaemia in pregnancy in Malaysia: A cross-sectional survey. Asia Pac J Clin Nutr. 2007;16(3):527-536.
19. National Population Commission (NPC) [Nigeria] and ICF Macro. Nigeria demographic and health survey 2013. Abuja, Nigeria and Rockville, Maryland USA: NPC and ICF International; 2014.

20. Munasinghe S, van den Broek N. Anaemia in pregnancy In Malawi-A review. Malawi Medical Journal. 2006;18(4):160-174.
21. Van den Broek NR, Rogerson SJ, Mhango CG, Kambala B, White SA, Molyneux ME. Anaemia and pregnancy in southern Malawi: Prevalence and risk factors. Brit J Obstet and Gynaecol. 2000;107(4):445-451.
22. Ouma P, van Eijk AM, Hamel MJ, Parise M, Ayisi JG, Otieno K, et al. Malaria and anaemia among pregnant women at first antenatal clinic visit in Kisumu, western Kenya. Trop Med Int Health. 2007;12(12): 1515-1523.
23. Egwunyenga AO, Ajayi JA, Nmorsi OPG, Duhlinska-Popova DD. Plasmodium/ intestinal Helminth co-infections among pregnant Nigerian Women. Mem Inst Oswaldo Cruz. 2001;96(8):1055-1059.
24. Fuseini G, Edoh D, Kalifa BG, Knight D. Plasmodium and intestinal helminths distribution among pregnant women in the Kassena-Nankana district of Northern Ghana. J Entomol Nematol. 2009;1(2):19-24.
25. Levine AM, Berhane K, Masri-Lavine L, Sanchez M, Young M, Augenbraun M, et al. Prevalence and correlates of anaemia in a large cohort of HIV-infected women: Women's interagency HIV study. J Acq Immun Def Synd. 2001;26:28–35.
26. Ayub R, Tariq N, Adil MM, Iqbal M, Jaferry T, Rais SR. Low haemoglobin levels, its determinants and associated features among pregnant women in Islamabad and surrounding region. J Pak Med Ass. 2009;59(2):86-88.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/11634