Original Research Article

Epidemiological profile of pregnant women with anemia admitted at the maternity unit of the health district hospital of Keita, Tahoua from 2018 to 2020

ABSTRACT

Aims: The objective of this study is to provide data on the epidemiological profile of pregnant women aged 15-45 years with anemia in Keita department, Tahoua regional state of Niger republic.

Methodology:A retrospective cross-sectional study was conducted from January 1st, 2018 to December 31st, 2020, on pregnant women who attended antenatal care at the maternity unit of the health district of Keita. Structured questionnaire was used to retrieve data regarding pregnancy from the medical record files which are archived at the maternity unit and entered into Epi Info version 7.2.4.0 for further analysis.

Results: Of the 1571 registered pregnant women, 310 suffered from anemia, with the prevalence of 19.7%. The prevalence of the severity of anemia was 17.7% mild, 49.0% moderate, and 33.2% severe anemia. The mean age of the pregnant women with anemia was 25.3±6.97 years and most were at third trimester (53.5%). Out of 310 patients, 244(78.7%) were either illiterate or had primary education level. Most of them 262(84.5%) are housewives and only 2(0.7%) visited hospital for antenatal care more than four times. About 249(80.3%) were multigravida. 52(16.8%) deliveries were by cesarean section with a higher recourse to blood transfusion. Major maternal complications were postpartum hemorrhage (28.4%), abortion (31.9%), malaria (15.2%) and maternal deaths (5%). Neonatal outcome was analyzed in terms of stillbirth (9%) and neonatal deaths (7%).

Conclusion: Anemia in pregnancy is a real public health problem in Niger republic and was mild in severity in the study setting of Keita, especially during the third trimester. Pregnant women who were younger, housewives, illiterates, multiparous and multigravida constitute the most vulnerable segments of the population at risk of anemia. Therefore, further strengthening of the existing health care system through awareness and education on early and regular antenatal care visits for a positive pregnancy experience should be reinforced.

Keywords: Anemia; pregnancy; epidemiology; antenatal care.

1. INTRODUCTION

Anemia among women of reproductive age, pregnant women, and adolescent girls remains a public health problem affecting both developed and developing countries such as Niger republic, a country with majority of populations living in rural settings, in poorer household and have received no formal education [1-3]. In pregnancy and even after child birth, it is

extremely common that anemia contributes to maternal morbidity and mortality [4-6]. According to the World Health Organization (WHO), anemia prevalence up to 5.0% or higher is considered to be of public health concerns and once reached 40% or more in a given population, the burden is then classified as a severe public health problem [7]. Recently, the Global Burden of Disease Study 2021 (GBD 2021) reported a global prevalence of anemia across all ages of 24.3%, corresponding to 1.92 billion prevalent cases [8]. In 2019, 30.1% of women of reproductive age were estimated to have anemia globally [9]. Global data from WHO fact sheets Anemia of May 1st 2023 highlighted an estimate of 37% of pregnant women aged 15-49 years worldwide to be affected by anemia [10] against 38.2% (32.4 million cases) global anemia prevalence for the year 2011 [11]. However, the burden of anemia during pregnancy and even after child birth was higher in low and middle-income countries than in high-income countries [1, 2]. In Niger republic, the Standardized Monitoring and Assessment of Relief and Transition (SMART) national survey on nutrition have reported a global anemia prevalence in women of reproductive age of 58.4% among which mild, moderate and severe anemia represent 26.5%, 30.37% and 1.5% respectively. At regional level, the state of Tahoua among the eight states that count the country, was found with a higher anemia prevalence in women of reproductive age of 62.1% [12]. However, and unfortunately, this large-scale national level survey did not produce any data concerning the anemia prevalence in pregnant women. Iron deficiency was among the highest-ranking conditions assumed to significantly contribute to the anemia burden during pregnancy especially in least developed countries [13, 14]. To improve pregnancy outcomes, many health and education programs for the prevention and control of maternal anemia through daily iron and folic acid supplementation have been implemented in pregnant women in most of these developing countries including Niger republic [15, 16]. Thus, in order to significantly reduce maternal morbidity and mortality at the national level, the government of Niger republic the Ministry of public health and social affairs has developed, adopted and implemented several political and strategic measures towards the strengthening of the national healthcare system through surveillance of maternal deaths, the repositioning of family planning with emphasis on young people and adolescents, emergency obstetric and neonatal care and all other initiatives aimed at reducing the costs of maternity delivery and obstetric complications [17, 18]. However, despite various and multiple health initiatives via diverse health programs, anemia in pregnancies remains a severe public health problem in Niger republic. Indeed, knowledges on the epidemiological and biological characteristics of anemic pregnant women in a given population are expected to help improve antenatal care through the development of strategies which could help fight and prevent anemia during pregnancy and even after child birth. Hence, the present study is designed to examine the epidemiological profile of pregnant women with anemia admitted at the maternity unit of the health district hospital of Keita in Tahoua state of Niger republic.

2. MATERIAL AND METHODS

2.1 Study design

The study design was a retrospective cross-sectional hospital-based study was used.

2.2Studysettingsandpopulation

The study was conducted at the maternity unit of the health district hospital of Keita. The hospital is found in the department of Keita under Tahoua regional state of Niger republic which is located at 73 Km far from Tahoua regional state department. The town of Keita is situated at a latitude of 14 755 and longitude 5 775 14^{o} 45’ 18’’ North and 5^{o} 46’ 30’’ East. The health district of Keita covers an area land of 4 862 Km^{2}. According to the 2012 National census report (RGP/H/2012), Keita has a total population of about 466 556 inhabitants. Tuaregs, Hausa, Fulani are the main ethnic groups living in Keita.

The study population was anemic pregnant women attending antenatal care at the maternity unit of the health district hospital of Keita from January 1st 2018 to December 31st 2020. They were aged 15-49 years with differing gestational age and parity. Information on sociodemographic and maternal characteristics, history of previous transfusion and daily iron supplementation were collected from all subjects.

2.3 Inclusion and exclusion criteria

The inclusion criteria include all anemic pregnant women who are admitted at the maternity unit of the health district of Keita from January 1st, 2018 to December 31st, 2020. On the other hand, the exclusion criteria include: (i) anemic pregnant women with no medical dossiers, (ii) anemic pregnant women who are suffering of sickle cell disease or of thalassemia.

2.4Data collection

A pretested questionnaires which was conceived with EPI info version 7.2.4.0 was deployed to obtain data about sociodemographic, obstetric and gynecological history.

2.5Data quality assurance

To assure the quality of the data, pretesting of the pre-designed questionnaire guide was carried out at the maternity unit of the health district of Bouza, the nearest health district to Keita and with similar population characteristics (cultures, ethnic groups, etc.).

2.6Data processing and analysis

Data were entered into Epi info version 7.2.4.0 for further analysis.

3. RESULTS

3.1 Study selection

By reviewing the registration document containing all the records of daily attendance of pregnant women for antenatal care utilization from 2018 to 2020, a total of 1571 pregnant women aged 15 to 49 years were counted to visit the maternity of the health district during the study period. After application of the inclusion and exclusion criteria, 310(19.7%) anemicpregnant women were included, 1261(80.3%) pregnancies were excluded from the main analysis due to the absence of anemia in that group (Fig. 1).

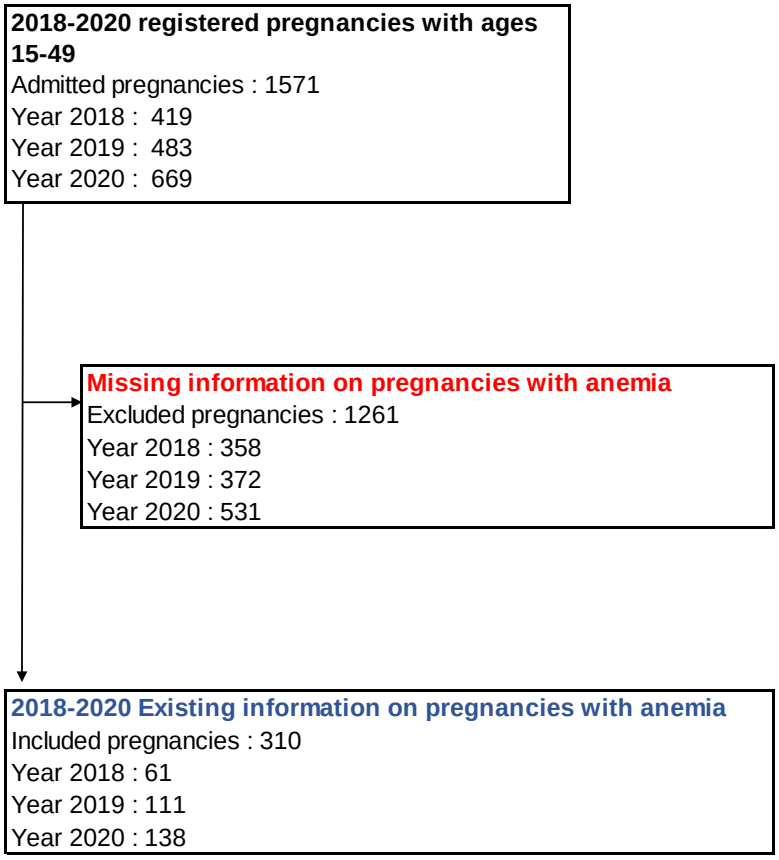

Fig. 1. Flowchart explaining the selection of samples for the determination of epidemiological profile of pregnant women with anemia admitted at the maternity unit of the health district hospital of Keita, Tahoua from 2018 to 2020.

3.2 Epidemiological profile of anemia in pregnant women

Pregnant women coming for antenatal care at the maternity unit of the health district of Keita are subjected to laboratory test for blood, to determine the hemoglobin level (Hb: g/dl). The records concerning the results of this analysis show that of the 1571 registered pregnant women, 310 suffered anemia, with an overall prevalence of 19.73%, by reference to the norm prescribed by the WHO (hemoglobin level less than 12g/dl). From 2018 to 2020, the prevalence of anemia among pregnant women was 14.5% in 2018, 23% in 2019, and decreased to 20.6% in 2020 (Fig. 2). Of the anemic pregnant women, 103, 152, and 55 were severely (<7 g/dl), moderately (7.0 to 9.9 g/dl), and mildly (10.0 to 11.9 g/dl) anemic, respectively (Table 1).

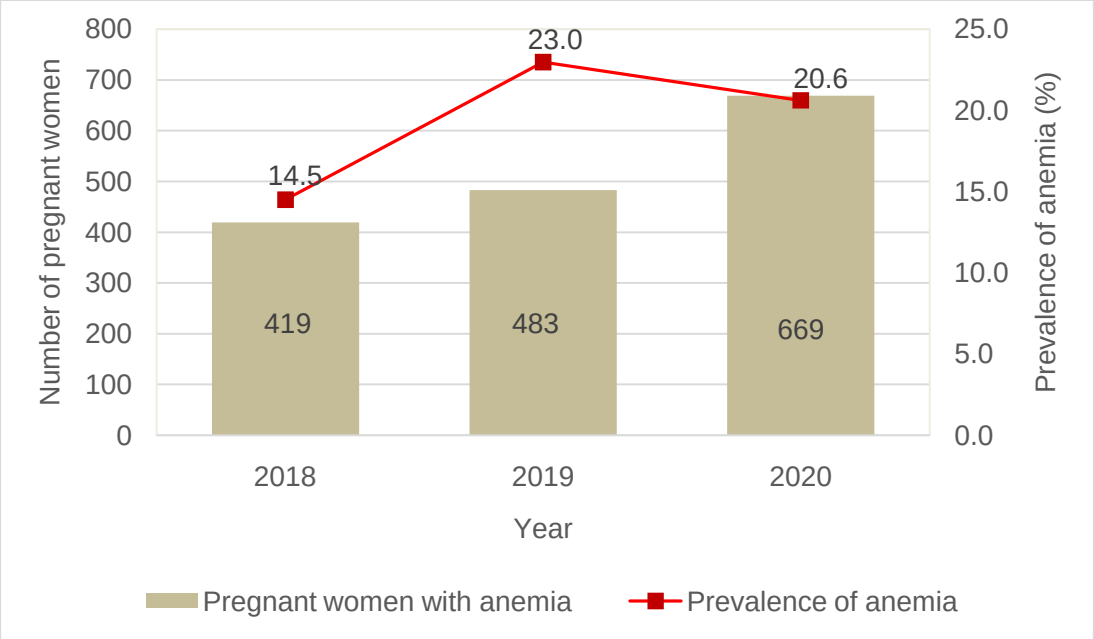

Fig. 2. Prevalence of anemia in pregnant women

Table 1. Distribution of pregnant women according to severity of anemia

Severity of anemia	Number of pregnant women	Percentage (%)
Severe anemia	103	33.23
Moderate anemia	152	49.03
Mild anemia	55	17.74
Total	**310**	**100**

3.3Sociodemographic and maternal characteristics of the anemic pregnant women (n = 310)

In this part we look for possible relationships between anemia and the following variables: residence, age, occupation, marital status, education status, antenatal care visit during pregnancy, parity, gravidity, gestational age, abortion, cesarean section, postpartum hemorrhage, and preeclampsia.

3.3.1 Sociodemographic characteristics

A total of 310 anemic pregnant women aged 15-49 year with 265(85.5%) and 45(14.5%) from rural and urban areas respectively were collected from the maternity data records. The mean age of the pregnant women with anemia was 25.3±6.97 years, extremes 15 and 46

years. Majority were housewives (84.5%, n=262) as their primary profession and married (93.9%, n=291). Concerning the level of education, 43.9% of anemic pregnant women were illiterate. For others, 56.1% had one form of formal education (Table 2).

Table 2. Sociodemographic characteristics of the anemic pregnant women

Variable name	Number (%)
Residence	
Urban	45(14.5)
Rural	265(85.5)
Age (years)	
15-20	109(35.2)
21-25	63(20.3)
26-30	69(22.3)
31-35	45(14.5)
36-40	22(7.1)
41-49	2(0.6)
Occupation (mothers)	
Housewives	262(84.5)
Government employed	4(1.3)
Farmers	37(11.9)
Merchants	7(2.3)
Marital status	
Married	291(93.9)
Divorced	19(6.1)
Educational status	
Illiterate	136(43.9)
Primary	108(34.8)
Secondary/tertiary	66(21.3)

3.3.1 Maternal characteristics of the anemic pregnant women (n = 310)

Majority of the anemic women included in this study were married and multiparous (53.9%, n=167) with number of children falling within 2 to 3 and 31.9% of the women experienced abortions in their previous pregnancies. Very few have experienced stillbirth (9%, n=28) and almost all of the women had singleton pregnancies. For the gravidity status, most women were multigravidas (80.3%, n=249) and others primigravidae (19.7%, n=61). Concerning the gestational age, the number of weeks of amenorrhea was considered for the repartition of anemic pregnant women; most were in their third trimester (53.5%, n=249). In this study, majority of the anemic pregnant women (46.1%) had undergone their second to third antenatal visits and only 36.5% have received iron supplementation during current pregnancy. Majority of the anemic pregnant women (71.3%) had vaginal delivery. In terms of fetal and maternal complications, 99(31.9%), 52(16.8%), 88(28.4%), 21(6.7%), and 1(0.3%) had abortion, cesarean section, postpartum hemorrhage, obstructed labor, and preeclampsia respectively. Around 67% of abortions/stillbirths, and 21(7%) babies died after delivery (Table 3).

Table 3. Maternal characteristics of the anemic pregnant women

Variable name	Number (%)
Frequency of Antenatal care visit during pregnancy	
Zero visit	112(36.1)
First visit	53(17.1)
Second to third visits	143(46.1)
Forth or more visits	2(0.7)
Parity	
Nullipara	74(23.9)
Primiparous	69(22.2)
Multiparous	167(53.9)
Gravidity	
Primigravida	61(19.7)
Multigravida	249(80.3)
Gestational age	
1st trimester	93(30)
2nd trimester	45(14.5)

3rd trimester	166(53.5)
History of abortion	99(31.9)
History of cesarean section	52(16.8)
History of postpartum hemorrhage	88(28.4)
Blood transfusion	246(79.4)
Stillbirth	28(9)
Pre/eclampsia	1(0.3)
Malaria	47(15.2)

4.DISCUSSIONS

Anemia during pregnancy is one of the major public health problems especially in low-income countries [19]. Thus, the present study assessed the epidemiological characteristics that affect anemia during pregnancy at the health district level of Keita in Tahoua regional state of the Niger republic. According to national survey on nutrition conducted by the Ministry of Public Health, of Population and Social Affairs (MSP/P/AS), nearly 76.1% of women in Tahoua are anemic [12]. But the degree of prevalence of anemia is varied across local states and districts of Tahoua regional state. For the study period of 2018-2020, we found an anemia overall prevalence for pregnant women aged 15-49 years in Keita of 19.73%. This prevalence was comparable to studies conducted in Tanzania (18.0%) [20], Nigeria (17%) [21], Northwest Ethiopia (16.6%) [22], Thailand (20.1%) [23], Cameroon (22%) [24], Malaysia (18.6%) [25], and China (18.9%) [26].

However, the prevalence is significantly lower than previous reports from Democratic Republic of Congou (52.8%) [27], Northern Ghana (42.7%) [28], Maroc (41%) [29], Mauritius (49.75%) [30], Karnataka in India (85.2%) [31], Indonesia (69.8%) [32], Malaysia (42.8%) [33], Bangladesh (62.5%) [34] and China (41.98%) [35]. Geographical positions and socioeconomic characteristics could be the possible factors influencing the differences in prevalence of anemia in pregnant women across the world. In terms of severity, moderate anemia was the most prevalent. This is in line with reports from Africa and elsewhere across the world.

In this study, significant association between various socio-demographic factors and the influence of anemia in pregnant women. For instance, we found that majority of the anemic pregnant women were from rural areas, suggesting that poverty which could limit access to adequate food is more prevalent in rural than in urban area and more over it is evident that in Niger republic the degree of urbanization is very low with very limited access to health care facilities. Anemia was found to be more prominent in younger pregnant women age group compared with other age groups. Similar observations were reported by others [36-38]. Adolescent girl under 20 years of age is more predisposed to develop anemia. During the adolescent period there is high demand for iron because of the onset of menstruation and the risk for anemia increases when the adolescent girl contract pregnancy. In our study setting with its particular sociocultural exigence, 15 to 20 years old is the pointed perfect group age for early marriage, with intense sexual activities which could consequently lead to high number of pregnancies. Majority of the identified anemic pregnant women have never

gone to school (formal education) and the proportion decreases as the level of the education is increasing; suggesting the high risk of anemia among non-solarized women or analphabets. Up to 84.5% (n=262) of the anemic pregnant women were housewives, with no fixed employment. The results are close consistent with Lestari et al (2018) who found the prevalence of 87.1% of anemic women in North Sumatera in Indonesia to be housewives who do not work outside the house [39].

The maternal characteristics associated with anemia in pregnant women include among others: antenatal care, parity, gravidity, gestational age, and obstetric history. Antenatal care visit during pregnancy represents an opportunity for women to receive health education which could help detect and prevent early complications. Several visits for antenatal care are needed for a woman experiencing pregnancy and according to the WHO recommendations on antenatal care, two and five visits are recommended during the first trimester and third semester respectively [40]. According to the results of our study, majority of the anemic pregnant women had undergone their second to third antenatal visits. Only few women (0.65%, n=2) have reached more than four visits during their pregnancy. The frequency of anemia was found elevated in pregnant women at first trimester of gestation (30%) compared to the prevalence of pregnant women at second trimester of gestation (14.5%). This could be due to poor or irregular intake of iron supplements by the pregnant women at first trimester of gestation compared to women at second trimester of gestation. A WHO report states that anemia in pregnancy peaks in the third trimester [41]. Several other studies on their turn found that the risk of developing anemia was higher in third and second trimester when compared with those in the first trimester [42-46]. In this study, the prevalence of anemic pregnant women was highest (53.5%, n=166) in the third trimester of gestation. This high rate may be attributed to late initiation of antenatal care which could lead to late detection and missing of opportunity to catchup the deficiency through iron supplementation and to learn other important credentials that could help improve maternity outcomes. In term of parity, many authors have proven the relationship of this factor with anemia and have reported that the risk for anemia increased with the number of children [47-49]. This is in harmony with our findings where the majority of the pregnant women with anemia were multiparous (most with up to 6 children). The rise in parity and its association with poor preconception care (family planning) could explain this situation. Gravidity is another important variable which have shown a significant link with anemia in the present study; majority of the studied population were multigravida. This finding is consistent with the findings from other studies [50-53].

Anemia during pregnancy is considered as risk factor for poor maternal and fetal outcomes [54]. In this study, from the data analysis regarding the maternal outcomes, we found that anemia significantly increases especially the risk for cesarean section, the risk of abortion, the postpartum hemorrhage and the need for blood transfusion. Our results are in part consistent with the recent findings of Adil B and Deka OM. (2023) [55] who have reported through univariate analysis, the association of maternal anemia with postpartum hemorrhage, maternal blood transfusions, and oxytocin administration. In this study, in terms of fetal outcomes only abortion, stillbirth and newborn death are reported as complications associated with anemia during pregnancy. Studies from Gambia [56], Pakistan and India [57], and China [58] have also highlighted that pregnancies of women with anemia were complicated by stillbirth, preterm birth and maternal death. Unfortunately, neonatal outcomes with complications such as preterm birth and low birthweight were not discussed in the present study.

5. CONCLUSION

This study has shown that anemia in pregnancy remains a major concern in Keita department, Tahoua. Younger maternal age group, no or very low formal education status, being housewives, late or non-regular antennal care attendance, high parity, and short

pregnancy intervals were identified as risk factors of anemia. Therefore, technical and financial supports from the local community, the government and the funding agencies should continue to arise in those localities with known localized risk factors in order to raise the degree of awareness and health education for a positive pregnancy experience.

ETHICAL APPROVAL

The study was approved by institutional review board of 'Public Health Institute (ISP)'. An acceptance letter (Rèf No 022/ISP/2023) by the Medical Director (Médecin Chef de District) of the health district hospital of Keita as permission to conduct the study was obtained. To ensure data confidentiality of participants, anonymous typing and codification were applied throughout the processes of data collection, entry and analysis.

REFERENCES

1. Ba DM, Ssentongo P, Kjerulff KH, Na M, Liu G, Gao X, Du P. Adherence to Iron Supplementation in 22 Sub-Saharan African Countries and Associated Factors among Pregnant Women: A Large Population-Based Study. Curr Dev Nutr. 2019 Oct 21;3(12): nzz120. doi: 10.1093/cdn/nzz120.
2. Stevens GA, Finucane MM, De-Regil LM, Paciorek CJ, Flaxman SR, Branca F, et al. Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data. Lancet Glob Health 2013;1(1):e16–25.
3. Kassebaum NJ, Lopez AD, Murray CJL, Lozano R. A comparison of maternal mortality estimates from GBD 2013 and WHO. The Lancet. 2014; 384:2209–2210. doi: https://doi.org/10.1016/S0140-6736(14)62421-1.
4. Ali N, Nur Kalmi Z, Sanusi NS, Ahad A, Mohd Khairuddin NA, Rosman SR, et al. Retrospective review of the prevalence and risk factors of anaemia among antenatal mothers attending health clinics in Alor Gajah, Melaka. Malays Fam Physician. 2022 Nov 25;17(3):137-143. doi: 10.51866/oa.135.
5. Herzog SA, Leikauf G, Jakse H, Siebenhofer A, Haeusler M, Berghold A. Prevalence of anemia in pregnant women in Styria, Austria-A retrospective analysis of mother-child examinations 2006–2014. PLoS ONE. 2019;14(7): e0219703. Doi: https://doi.org/10.1371/journal.pone.0219703.
6. Lopez A, Cacoub P, Macdougall IC, Peyrin-Biroulet L. Iron deficiency anaemia. Lancet. 2016;387(10021):907–16.
7. World Health Organization. Worldwide prevalence of anaemia 1993-2005: WHO global database on anaemia, 2008.
8. GBD 2021 Anaemia Collaborators. Prevalence, years lived with disability, and trends in anaemia burden by severity and cause, 1990-2021: findings from the Global Burden of Disease Study 2021. Lancet Haematol. 2023 Sep;10(9):e713-e734. doi: 10.1016/S2352-3026(23)00160-6. Epub 2023 Jul 31.
9. Kinyoki D, Osgood-Zimmerman AE, Bhattacharjee NV; Local Burden of Disease Anaemia Collaborators; Kassebaum NJ, Hay SI. Anemia prevalence in women of reproductive age in low- and middle-income countries between 2000 and 2018. Nat Med. 2021 Oct;27(10):1761-1782. doi: 10.1038/s41591-021-01498-0. Epub 2021 Oct 12. PMID: 34642490; PMCID: PMC8516651.
10. World Health Organization. Fact sheets Anemia; 2023. https://www.who.int/news-room/fact-sheets/detail/anaemia.
11. World Health Organization. The global prevalence of anaemia in 2011. World Health Organization; 2015.
12. Institut National de la Statistique. Enquête nationale de nutrition selon la méthodologie SMART, Niger ; 2020. http:// www.stat-niger.org, e-mail :ins@ins.ne.
13. World Health Organization. Guideline: Daily iron and folic acid supplementation in pregnant women. Geneva, World Health Organization, 2012.
14. United Nations System Standing Committee on Nutrition. Progress in nutrition: Sixth report on the world nutrition situation. Geneva, United Nations System Standing Committee on Nutrition Secretariat, 2010.
15. International Anemia Consultative Group. Report of the 2001 International Anemia Consultative Group Symposium. Why is iron important and what to do about it: a new perspective. Washington, DC, INACG Secretariat. 2002:1–50.
16. Peña-Rosas JP, Viteri FE. Effects and safety of preventive oral iron or iron+folic acid supplementation for women during pregnancy. Cochrane Database of Systematic Reviews. 2009; (4):CD004736.

17. Ministère de la Santé Publique : Plan Stratégique Intégré de la Santé Reproductive, Maternelle, Néonatale, Infantile, Adolescent et Jeune/ Nutrition (SRMNIAJ/Nut), 2018-2021.
18. Ministère de la Santé Publique, de la Population et des Affaires Sociales. Dossier d'investissement du Niger pour la santé reproductive, maternelle, néonatale, infantile, adolescent et la nutrition (SRMNIA-Nut), 2022-2026.
19. Kalaivani K. Prevalence & consequences of anaemia in pregnancy. Indian J Med Res. 2009 Nov;130(5):627-33. PMID: 20090119.
20. Stephen G, Mgongo M, Hussein Hashim T, Katanga J, Stray-Pedersen B, Msuya SE. Anaemia in Pregnancy: Prevalence, Risk Factors, and Adverse Perinatal Outcomes in Northern Tanzania. Anemia. 2018 May 2; 2018:1846280. doi: 10.1155/2018/1846280. PMID: 29854446; PMCID: PMC5954959.
21. Nwizu EN, Iliyasu Z, Ibrahim SA, Galadanci HS. Socio-demographic and maternal factors in anaemia in pregnancy at booking in Kano, northern Nigeria. Afr J Reprod Health. 2011 Dec;15(4):33-41. PMID: 22571103.
22. Mulugeta M, Zelalem A, Meseret A, Bamlaku E. Prevalence and Predictors of Maternal Anemia during Pregnancy in Gondar, Northwest Ethiopia: An Institutional Based Cross-Sectional Study. Anemia. 2014; ID 108593. http://dx.doi.org/10.1155/2014/108593.
23. Sukrat B, Sirichotiyakul S. The prevalence and causes of anemia during pregnancy in Maharaj Nakorn Chiang Mai Hospital. J Med Assoc Thai. 2006 Oct;89 Suppl 4:S142-6. PMID: 17725151.
24. Henri E, Valere MK, Lucas EE, Calixte PI, Ngalame CM, Grâce TT, et al. Hematological Profile and Risk Factors of Anemia in Pregnant Women: A Cross Sectional Descriptive and Analytical Study in Douala Cameroon. Open Journal of Obstetrics and Gynecology. 2019; 9:968-980. https://doi.org/10.4236/ojog.2019.97094.
25. Ali N, Nur Kalmi Z, Sanusi NS, Ahad A, Mohd Khairuddin NA, Rosman SR, et al. Retrospective review of the prevalence and risk factors of anaemia among antenatal mothers attending health clinics in Alor Gajah, Melaka. Malays Fam Physician. 2022 Nov 25;17(3):137-143. doi: 10.51866/oa.135. PMID: 36606167; PMCID: PMC9809431.
26. Yu Wu, Hanfeng Ye, Jihong Liu, Qiuyue Ma, Yanling Yuan, Qian Pang, Jue Liu, Cai Kong and Min Liu. Prevalence of anemia and sociodemographic characteristics among pregnant and non-pregnant women in southwest China: a longitudinal observational study. BMC Pregnancy and Childbirth. 2020; 20:535. https://doi.org/10.1186/s12884-020-03222-1.
27. Chola MJ, Mwembo TA, Tamubango KH, Ngwe TJ, Kakoma SZ, Kalenga MKP. Prevalence and associated factors of anemia during pregnancy in Lubumbashi, in the south of Democratic Republic of Congo: situation in 2020. PAMJ Clinical Medicine. 2021;7(19).
28. Nonterah EA, Adomolga E, Yidana A et al. Descriptive epidemiology of anaemia among pregnant women initiating antenatal care in rural Northern Ghana. Afr J Prm Health Care Fam Med. 2019;11(1). https://doi.org/10.4102/phcfm.v11i1.1892.
29. Nadia O, Kabira T, Ghizlane B, Fatim EJ. Prévalence et déterminants sociaux de l'anémie chez les femmes enceintes dans la Province d'Essaouira, Maroc. Santépublique. 2018 ;30(5).
30. Setty S, Mariem SM, Ahmed Z, Ahmed E, Abderrazzak K, Soad K, Aicha L, Rachid B. Relation Entre Les Facteurs Socio-Économiques Et L'anémie Au Cours De La Grossesse (Nouakchott – Mauritanie). ESJ. 2017; 13(36). ISSN: 1857 – 7881. Doi: 10.19044/esj. 2017.v13n36p93 URL:http://dx.doi.org/10.19044/esj.2017.v13n36p93.
31. Raj PBU, Mangasuli V. Retrospective study on prevalence of anaemia among pregnant women at booking in a health care centre in Yadwad, Dharwad, Karnataka, India. Int J Community Med Public Health 2016; 3:2762-5.
32. Fitnaningsih EC, Retno M, Dyah AU, Agus G. Retrospective study on anemia prevalence of pregnant women during third trimester pregnancy in Yogyakarta 2019. Int. Journal Health Scie. Tech. 2021;3 (2). https://doi.org/10.31101/ijhst.v3i2.2331.

33. Mooi ZJ, Tan JH, Nurul ABCA, Ooi SM, Kavitha N, Nazimah I. Prevalence of iron deficiency anemia in pregnancy and its therapeutic response to treatment: a retrospective audit in a tertiary hospital. Int J Adv Med. 2022;9:1090-5.
34. Sabina Azhar B, Islam MS, Karim MR. Prevalence of anemia and associated risk factors among pregnant women attending antenatal care in Bangladesh: a cross-sectional study. Prim Health Care Res Dev. 2021 Nov 3;22:e61. doi: 10.1017/S146342362100061X. PMID: 34727999; PMCID: PMC8569827.
35. Huanqing Hu, Aiqun Huang, Qi Yang, Wei Zhao, Yu Ma, Jiangli Di. Prevalence and Risk Factors of Anemia of Pregnant Women — 6 Provinces in China, 2014−2018. China CDC Weekly. 2020; 2(14): 225-229. doi: 10.46234/ccdcw2020.058.
36. Fage SG, Egata G, Dessie Y, Kumsa FA, Mizana BA. Anemia among School Adolescents in Haramaya Town, Eastern Ethiopia: Cross-Sectional Study. NutrMetab Insights. 2020 Aug 28;13:1178638820953131. doi: 10.1177/1178638820953131. PMID: 32922031; PMCID: PMC7457681.
37. Aboussaleh Y, Farsi, M, El Hioui M, Ahami, A. Transition nutritionnelle au Maroc : Coexistence de l'anémie et de l'obésité chez les femmes au Nord-Ouest marocain. Antropo. 2009;19, 67-74. www.didac.ehu.es/antropo.
38. Michael AW, Jessica A, Divine E. A Review of the Risk Factors for Iron Deficiency Anaemia among Adolescents in Developing Countries. Anemia. 2023; ID 6406286:11. https://doi.org/10.1155/2023/6406286.
39. Lestari S, Fujiati II, Keumalasari D, Daulay M, Martina SJ, Syarifah S. The prevalence of anemia in pregnant women and its associated risk factors in North Sumatera, Indonesia. IOP Conf. Series: Earth and Environmental Science 125. 2018; 012195. doi:10.1088/1755-1315/125/1/012195.
40. World Health Organization. WHO recommendations on antenatal care for a positive pregnancy experience. Geneva, Switzerland: World Health Organization, 2016.
41. World Health Organization. Iron deficiency anemia: assessment, prevention and control-a guide for programme managers, WHO, Geneva, 2012.
42. Onyeneho NG, I'Aronu N, Chukwu N, Agbawodikeizu UP, Chalupowski M, Subramanian SV. Factors associated with compliance to recommended micronutrients uptake for prevention of anemia during pregnancy in urban, peri-urban, and rural communities in Southeast Nigeria. J Health PopulNutr. 2016 Nov 2;35(1):35. doi: 10.1186/s41043-016-0068-7. PMID: 27806723; PMCID: PMC5090877.
43. Kefyalew AA and Abdulahi MD. Prevalence of Anemia and Associated Factors among Pregnant Women in an Urban Area of Eastern Ethiopia. Anemia. 2014; ID 561567:7. http://dx.doi.org/10.1155/2014/561567.
44. Khalafallah AA, Dennis AE. Iron deficiency anaemia in pregnancy and postpartum: pathophysiology and effect of oral versus intravenous iron therapy. J Pregnancy. 2012; 2012:630519. doi: 10.1155/2012/630519. Epub 2012 Jun 26. PMID: 22792466; PMCID: PMC3389687.
45. Enawgaw B, Birhanie M, Terefe B, Asrie F. Prevalence of Anemia and Iron Deficiency Among Pregnant Women Attending Antenatal Care Service at University of Gondar Hospital, Northwest Ethiopia. Clin Lab. 2019 Apr 1;65(4). doi: 10.7754/Clin.Lab.2018.180822. PMID: 30969067.
46. Makhoul Z, Taren D, Duncan B et al., "Risk factors associated with anemia, iron deficiency and iron deficiency anemia in rural Nepali pregnant women." Southeast Asian Journal of Tropical Medicine and Public Health. 2012;43(3):735–745.
47. Adinma JB-D, Ikechebelu JI, Onyejimbe U, Amilo G. AdinmaEJTJoO, Gynaecology. Influence of antenatal care on the haematocrit value of pregnant Nigerian Igbo women. Trop J ObstetGynaecol. 2002; 19:68–70.
48. Banjari I, Kenjerić D, Mandić ML. What Is the Real Public Health Significance of Iron Deficiency and Iron Deficiency Anaemia in Croatia? A Population-Based Observational

Study on Pregnant Women at Early Pregnancy from Eastern Croatia. Cent Eur J Public Health. 2015;23(2):122- 7.
49. Harvey T, Zkik A, Auges M, Clavel T. Assessment of Iron Deficiency and Anemia in Pregnant Women: An Observational French Study. Womens Health. 2016;12(1):95- 102.
50. Beucher G, Grossetti E, Simonet T, Leporrier M, Dreyfus M. Anémie par carence martiale et grossesse. Prévention et traitement. Rev Sage-Femme. 2011;10(4):152- 67.
51. Marine P. Prévalence de l'anémie au premier trimestre de grossesse : étude transversale au sein d'une cohorte de 648 femmes suivies dans une maternité de type 3. Médecinehumaine et pathologie. 2017 ; dumas-01698323.
52. Charlotte NT, Eveline NDT, Arlette GN, Théophile NN, Gregory HE, Eugene BP. Prévalence et facteurs associés à l'anémie en grossesse à l'Hôpital Général de Douala. Pan African Medical Journal. 2016; 25:133. doi:10.11604/pamj.2016.25.133.10610.
53. Elzahrani SS. "Prevalence of iron deficiency anemia amongpregnant women attending antenatal clinics at Al-Hada Hospital." Canadian Journal on Medicine. 2012;3(1):10–14.
54. Dudhe M, Vaishnao LS. Impact of anemia over maternal and fetal outcome in tertiary care centre. Indian J ObstetGynecol Res. 2022;9(3):369-374.
55. Adil B and Deka OM. The association of maternal anaemia with adverse maternal and foetal outcomes in Somali women: a prospective study. BMC Women's Health. 2023;23:193. https://doi.org/10.1186/s12905-023-02382-4.
56. Camara B, Oluwalana C, Miyahara R, Lush A, Kampmann B, Manneh K, et al. Stillbirths, Neonatal Morbidity, and Mortality in Health-Facility Deliveries in Urban Gambia. Front Pediatr. 2021 Feb 15;9:579922. doi: 10.3389/fped.2021.579922. PMID: 33659227; PMCID: PMC7917219.
57. Parks S, Hoffman MK, Goudar SS, Patel A, Saleem S, Ali SA, et al. Maternal anaemia and maternal, fetal, and neonatal outcomes in a prospective cohort study in India and Pakistan. BJOG. 2019 May;126(6):737-743. doi: 10.1111/1471-0528.15585. Epub 2019 Jan 24. PMID: 30554474; PMCID: PMC6459713.
58. Shi H, Chen L, Wang Y, Sun M, Guo Y, Ma S, et al. Severity of Anemia During Pregnancy and Adverse Maternal and Fetal Outcomes. JAMA Netw Open. 2022 Feb 1;5(2):e2147046. doi: 10.1001/jamanetworkopen.2021.47046. PMID: 35113162; PMCID: PMC8814908.