

Descriptive Study of Anemia in Pregnant Women in the Beni Mellal-Khenifra Region

Rachid Hnini^{1,2*}, Hicham Esselmani¹, Eliane Silva², Hayat Bouighajd³, Hicham Chatoui^{1,4,5}, Mohamed Merzouki^{1*}

¹ Biological Engineering Laboratory, Pathology and Functional Biology Team, Sultan Moulay Slimane University, FST, P.O. Box: 523, 23000 Beni Mellal, Morocco

² School of Medicine and Biomedical Sciences of the University of Porto (ICBAS-UP), Rua de Jorge Viterbo Ferreira, 228, 4050-313, Porto, Portugal

³ Nutritional physiopathologies, Neurosciences and Toxicology, Laboratory of Anthropogenetics Biotechnology et and Helth, Faculty of Sciences, Chouaib Doukkali University, Av des Facultés, Zip 24000, El Jadida, Morocco

⁴ Higher Institute of Nursing Professions and Health Techniques (ISPITS-M), Marrakech, Morocco.

⁵ Private University of Marrakech (UPM), Marrakech, Morocco.

ABSTRACT

Background: In low- and middle-income countries, anemia during pregnancy remains a major cause of maternal and neonatal mortality. **Purpose:** There are currently no reports on anemia among pregnant women in the Beni Mellal-Khenifra region. This study aims to assess and describe anemia in pregnant women in this area. **Methods:** The full blood count was performed using the SYSMEX XS-1000i Automated Hematology Analyzer (Sysmex Corporation, Kobe, Japan) in Whole Blood Mode. The measured indices included RBCs, WBCs, Hb, MCV, and MCHC. **Results:** In this study, 74.0% of the total sample of pregnant women were anemic. Among these anemic women, the types of anemia observed included 21.4% (micro hypo cases, n=63), 8.1% (micronormo cases, n=24), 2.0% (normo hypo cases, n=6), and 68.5% (normo normo cases, n=202). Regarding age distribution among the anemic pregnant women, 5.1% (n=15) were under 20 years old, 49.1% (n=145) were between 20 and 30 years old, and 45.8% (n=135) were over 30 years old. Hematological analysis of all studied pregnant women provided valuable information on hematological indices, such as red blood cells (RBCs), with 70.5% of anemic pregnant women having less than 4.20 million cells per mm³; hemoglobin (Hb), with 55.6% below 12 g/dl; mean corpuscular volume (MCV), with 29.2% less than 80 fL; mean corpuscular hemoglobin content (MCHC), with 22.0% below 27 pg; platelets (Pla), with 93.2% within normal levels; and blood sugar (BS), which remained relatively stable. **Conclusion:** Overall, this descriptive epidemiological study highlights the significant prevalence of anemia among pregnant women in the Beni Mellal region and the variety of anemia types present. The findings emphasize the urgent need to enhance public health efforts to improve maternal health and reduce the risks associated with anemia during pregnancy.

Keywords: Anemia in Pregnant Women, Beni Mellal, Hemoglobin, Red Blood Cells, Morocco

INTRODUCTION

Worldly anemia is one of the most important health conditions affecting people [1]. According to the World Health Organization (WHO), anemia remains a silent disease with slow progression and few physical symptoms, which can cause patients not to realize their condition until it is in an advanced stage (WHO). It is estimated that about two billion people worldwide have anemia. People with anemia have lower than normal hemoglobin levels in their blood, resulting in a decreased ability of red blood cells to carry oxygen to tissues [2]. WHO defines anemia during pregnancy as a hemoglobin (Hb) concentration of less than 11 g/dl [3, 4]. A more detailed classification is available from WHO [5]. Anemia during pregnancy is categorized by WHO as mild (10.0 - 10.9 g/dl), moderate (7.0 - 9.9 g/dl), and severe (< 7.0 g/dl), based on hemoglobin levels [6-9]. This condition can occur in any population, but young children and pregnant women are most commonly affected by this blood disorder [10]. In both developing and developed countries, anemia during pregnancy is recognized as a public health issue linked to adverse pregnancy outcomes [1, 11, 12]. The hemoglobin deficiency caused by anemia in pregnancy can lead to serious maternal and fetal complications, even maternal death [13], especially in low-resource countries [14]. Data shows that anemia contributes to over 115,000, 000 maternal and 591,000, 000 perinatal deaths annually, accounting for 20% of maternal deaths worldwide [15]. The main causes of anemia during pregnancy include poor antenatal care, inadequate nutritional status,

poor diet, sociodemographic factors, genetics, abortions, infectious diseases, frequent labor, and multi-parity [7], as well as acute blood loss. According to Shams et al. [7], only iron deficiency accounts for 75% of anemia cases. Another major cause is deficiencies in micro and macronutrients [2, 16]. Poor bioavailability and insufficient intake of iron-rich foods also greatly contribute to anemia during pregnancy [2]. Additionally, individual, household, community, district, regional, or national factors may also influence anemia risk [17]. The WHO aims to reduce anemia by 50% among women of reproductive age by 2025. A key priority during pregnancy in Morocco's health sector is tackling anemia, with its prevalence among women of reproductive age serving as an indicator. However, no studies have yet been reported on anemia among pregnant women in the Beni Mellal-Khenifra region. The objective of this study was to assess and describe anemia among pregnant women in the Beni Mellal region.

MATERIALS AND METHODS

Study Design and Setting

This study was carried out at the hematology department of the medical analysis laboratory at the Regional Hospital Center (CHR) in Beni Mellal, Morocco, over a two-year period from January 23, 2023, to January 24, 2024. The Beni Mellal-Khenifra region, located in north-central Morocco, has a population of 2,525,801 residents, with

1,283,492 (50.8%) living in urban areas and 1,242,309 (49.2%) in rural areas [18]. Beni Mellal province has 580,327 inhabitants, including 350,703 in urban areas and 229,624 in rural areas (Figure 1) [18]. Beni Mellal city, the regional capital, hosts the Regional Hospital Center (CHR), which functions as a primary healthcare provider for patients from various parts of the region, including both urban and rural communities. The study involved 400 pregnant women who sought care at the hematology department during the study period. The age groups considered were pregnant women aged ≤ 20 years, between 20 and 30 years, and ≥ 30 years.

Blood Collection Equipment

The tools needed for safe and hygienic blood sample collection include sterile test tubes, needles, and tourniquets. These items are essential for performing important hematological tests to diagnose anemia.

Specimen Collection and Processing

Five milliliters (5 mL) of pregnant women's venous blood were drawn each morning (between 8:00 am and 10:00 am) for hematological analysis. About 2 mL were collected into BD vacutainers containing EDTA for hematological indices, and approximately 3 mL into BD Vacutainers with SST II Advance semi-separator gel for biochemical analysis.

Hematological Analysis

The full blood count was performed using the SYSMEX XS-1000i Automated Hematology Analyzer (Sysmex Corporation, Kobe, Japan) in Whole Blood Mode. The measured indices included RBCs, WBCs, Hb, MCV, and MCHC. Routine quality control checks were conducted on control specimens within the specified limits according to the manufacturer's instructions. Calibration of the hematology analyzer was performed following the manufacturer's guidelines whenever reagents were changed.

Statistical Analysis

Descriptive statistics were conducted using Microsoft® Excel® 2016. Categorical variables were summarized with frequencies and percentages. No inferential statistical tests were performed, as the study primarily aimed to describe the distribution of type anemia, age and their hematological indices in anemic pregnant women.

Ethical Considerations

The Institutional Research Ethics Review Committee at Sultan Mouly University drafted an official consent letter outlining the study's goals for the hospital before the study began. The acquired data were handled confidentially and were not identified by names. Patients were not harmed physically or psychologically by the trial. Respondents were treated with respect, and their right to privacy and confidentiality was maintained through anonymity. Written informed consent was obtained.

Results

Prevalence of Anemia

The findings from this study showed that out of 400 pregnant women, 295 cases were anemia, accounting for 74% of the total sample, while 105 women were within the normal range, representing 26% of the sample (Table 1). The distribution of anemia types indicates that most cases are classified as "normo normo," meaning the cells are normal in size and hemoglobin concentration but are insufficient in number.

Type of Anemia

The types of anemia observed among anemic women include 63 cases of micro hypo, representing 21.4%. This type of anemia is characterized by small, poorly hemoglobinized RBCs, often linked to iron deficiency. There are 24 cases of micronormo, accounting for 8.1%, indicating RBCs that are normal in size but insufficient in number. Additionally, 6 cases of normo hypo, making up 2.0%, involve cells that are normal in size but low in Hb. Lastly, there are 202 cases of normo normo, comprising 68.5%, where RBCs are normal in size and Hb concentration but are insufficient in number. This could suggest anemia caused by nutritional deficiencies or other causes not related to abnormalities in RBCs (Table 1).

Age Distribution Among Anemic Pregnant Women

Regarding the age distribution among anemic pregnant women, this study reports 15 cases under 20, representing 5.1%; 145 women aged 20 to 30, making up 49.1%; and 135 women over 30, accounting for 45.8%. This suggests that anemia notably affects pregnant women aged 20 to 30 and over 30 years old (Table 1).

Table 1: Prevalence, Types of Anemia, and Age Distribution among Pregnant Women with Anemia.

Prevalence		Anemic Pregnant Women	
		Samples (n)	Percentage (%)
Anemia Types	Normo normo	295	74.0 %
	Normo hypo	202	68.5 %
	Micro normo	06	2.0 %
	Micro ypo	24	8.1 %
	Total	63	21.4 %
Age Distribution	<20	295	100 %
	20-30	15	5.1 %
	>30	144	49.1 %
	Total	136	45.8 %
		295	100 %

Hematological Data

The analysis of Table 2 reveals important information about the hematological indices of 400 pregnant women, out of whom 295 (74%) have anemia. Comparing the entire group to the subset of women with anemia helps highlight the specific features related to anemia.

Platelets (Pla)

In the overall sample, the vast majority of women, or 95%, have platelet levels within the normal range, which is between 150,000 and 400,000 per mm³. However, among women with anemia, while most, or 93.2%, also remain within this normal range, the percentage of women with platelet counts below 150,000 per mm³ has slightly

increased compared to the overall sample, rising to 5.4% (Table 2). This may suggest a tendency toward thrombocytopenia in women with anemia, although the change is relatively small.

Red Blood Cells (RBCs)

Regarding RBCs, the gap is more noticeable. While in the entire sample, 52% of women have an RBC count below 4.20 million per mm³, this percentage rises to 70.5% among anemic women. This confirms that a lower red blood cell count is a key indicator of anemia in this population. Conversely, the percentage of women with counts in the normal range of 4.2 to 5.55 million per mm³ decreases significantly in anemic women, from 47.5% to only 28.8% (Table 2).

Hemoglobin (Hb)

For Hb, 55.6% of women in the total sample have levels below 12 g/dL, indicating anemia. This same proportion of 55.6% is found among anemic women.

The group with normal hemoglobin levels, ranging from 12 to 16 g/dL, accounts for 58.8% of the total sample but drops to 44.1% among

anemic women, reinforcing the link between low Hb and anemia (Table 2).

Mean Corpuscular Volume (MCV)

The MCV also shows a difference, with 21.5% of women in the total sample having an MCV less than 80 fL, compared to 29.2% of anemic women. This parameter indicates the average size of RBCs, and a rise in cases of microcytosis among anemic women could suggest specific types of anemia, such as iron-deficiency anemia (Table 2).

Mean Corpuscular Hemoglobin Content (MCHC)

The mean corpuscular hemoglobin content, which reflects the average Hb amount per RBC, is below 27 pg in 16.3% of the entire sample and in 22% of women with anemia, further emphasizing the prevalence of hypochromic anemia in this group (Table 2).

Blood Sugar (BS)

Finally, BS, which remains relatively stable, shows minimal differences between the two groups, indicating that blood sugar is not directly influenced by anemia in this population (Table 2).

Table 2: Comparison of the Hematological Data between the Entire Sample and Anemic Women.

	Total Sample		Anemic Women	
	Samples (n)	Percentage (%)	Sample (n)	Percentage (%)
	Platelets (Pla): 150 000 - 400 000 /mm ³			
<150 000/mm ³	16	4.0	16	5.4
150 000 - 400 000 /mm ³	380	95.0	275	93.2
>400 000 /mm ³	4	1.0	4	1.4
Total	400	100	295	100
	Red Blood Cells (RBCs): 4.20 - 5.55 millions/mm ³			
<4.20 M/mm ³	208	52.0	208	70.5
4.2- 5.55 M/mm ³	190	47.5	85	28.8
>5.55 M/mm ³	2	0.5	2	0.7
Total	400	100	295	100
	Hemoglobin (Hb): 12.0 - 16.0 g/dL			
<12 g/dL	164	41.0	164	55.6
12 -16 g/dL	235	58.8	130	44.1
>16/mm ³	1	0.3	1	0.3
Total	400	100	295	100
	Mean Corpuscular Volume (MCV): 80.0 - 100.0 fL			
<80 fL	86	21.5	86	29.2
80 -100 fL	314	78.5	209	70.8
>100 fL	0	0.0	0	0.0
Total	400	100	295	100
	Mean Corpuscular Hemoglobin Content (MCHC): 27.0 - 32.0 pg			
<27 pg	65	16.3	65	22.0
27 -32 pg	311	77.8	206	69.8
>32 pg	24	6.0	24	8.1
Total	400	100	295	100
	Blood Sugar (BS) : 0.70 - 1.10 g/L			
<0.7 g/L	6	1.5	6	2.0
0.7 -1.10 g/L	386	96.5	283	95.9
> 1.10 g/L	8	2.0	6	2.0
Total	400	100	295	100

Discussion

In low- and middle- income countries, anemia during pregnancy remains a leading cause of maternal and neonatal death [19]. It happens when hemoglobin levels drop below normal, leading to insufficient oxygen delivery to meet the body's physiological needs. Symptoms include weakness, dizziness, fatigue, difficulty concentrating, and shortness of breath [20]. The recorded anemia rate in her case (74%) shows it is a major public health issue in Beni Mellal province. This rate surpasses those reported in other Moroccan regions. For example, studies report a prevalence of 41% in Essaouira [21], 30%

in Marrakech [22], 16. 8% in Temara [23], and 14. 4% in Casablanca [24]. According to Ouzennou et al. [21], regional differences within Morocco can be partly explained by disparities in living standards, particularly between urban areas and rural provinces like Essaouira and the Marrakech- Safi region [21]. The high anemia prevalence is probably linked to the region's difficult living conditions, which affect health. Notably, the Beni Mellal- Khenifra region has some of the highest poverty and vulnerability rates nationally, at 9. 8% and 9%, respectively. These conditions contribute to nutritional deficiencies and related diseases, emphasizing the need for focused efforts on pregnancy- related anemia in the area. These findings could also apply

to the entire Moroccan population facing similar socioeconomic challenges, especially in rural areas. Globally, prevalence differences may stem from variations in sample size and study regions [25]. Several studies report prevalence rates of 16.8%, 22.1%, 24.4%, 32.8%, 41.3%, 41.6%, 43.2%, 43.4%, and 45.4% in Iran, Uganda, Great Britain, Ethiopia, Cape Verde, Turkey, Cameroon, Algeria, and Egypt, respectively [26–30]. These rates are still lower than the 74% reported among pregnant women in Beni Mellal. However, they are similar to Nepal's rate of 73% [31] and lower than India's, where it can reach 100% [30, 32]. The main causes of anemia include nutritional deficiencies—such as iron, folate, and vitamin B 12—parasitic infections like malaria, infectious diseases such as tuberculosis and HIV, and inherited or acquired disorders that impair hemoglobin synthesis, red blood cell production, or red blood cell lifespan [33]. Additionally, environmental and socioeconomic factors, especially lower socioeconomic status, are associated with higher deficiency rates, as shown in WHO studies [4]. The types of anemia found among women with anemia included 63 cases of microcytic hypochromic anemia, representing 21.4%. This type of anemia is characterized by small, poorly hemoglobinized red blood cells and is often linked to iron deficiency. There were 24 cases of micronormocytic anemia, accounting for 8.1%, indicating RBCs that are normal in size but insufficient in number. Six cases of normocytic hypochromic anemia, making up 2.0%, involved cells that are normal in size but low in hemoglobin. Additionally, 202 cases of normocytic normochromic anemia, which constitute 68.5%, involved RBCs that are normal in size and hemoglobin concentration but are insufficient in number. This could suggest anemia due to nutritional deficiencies or other causes not related to RBC abnormalities. Ferriprivate anemia is generally defined as any pathological state where the blood's hemoglobin content becomes abnormally low due to iron deficiency [34]. It is the most common type of anemia worldwide, which confirms our findings and those of Kassebaum et al. [35]. Regarding age distribution, this study revealed that 49.3% of the anemic pregnant women were aged 20 to 30 years, while 45.3% were over 30. These findings align with previous reports by Adebo et al. [36] in Benin, who observed that young adult pregnant women aged 18 to 35 years were most affected by anemia based on a cross-sectional, descriptive, and analytical study [36]. According to Anoua [37], socio-demographic factors related to age contribute to the risk of anemia in pregnant women. For example, women under 20 years old made up only 5.3% of the anemic pregnant women. This is likely because pregnant women in the Beni Mellal province under 20 generally have good nutrition [38]. Young pregnant women still need a high intake of nutritious foods because they are classified as adolescents [39]. Adolescence is a period of ongoing growth and development necessary for optimal health, as noted by Aisyah and Fitriyani [39]. Therefore, pregnant teenagers require a substantial and nutritious diet to support fetal growth and development [40]. A lack of nutritious foods during pregnancy in women under 20 can pose risks to both mother and fetus, as their reproductive systems are not fully developed [40]. According to Anfiksyar et al. [41], regular intake of iron tablets can help maintain Hb levels in pregnant women, especially those aged 35 and older, who are more prone to anemia because of physiological changes. Pregnant women 36 and older start to regenerate their body's cells, including their reproductive systems, making pregnancy riskier for women in this age group. In Morocco, data on the diet of anemic pregnant women reported by Ouzennou et al. [21] showed high consumption of cereals, fats, and vegetables, with lower intake of meat and dairy

products. All women consumed at least one cereal daily (such as bread, Moroccan pancakes, wheat or barley soup, couscous, pasta, etc.) and one type of fat (olive oil, argan oil, table oil). Additionally, 85% ate vegetables every day, while only about half regularly ate meat (47%) and dairy products (56%). Moreover, none of the women were referred to a dietitian for personalized dietary advice. However, 41.2% of anemic women received dietary guidance from health professionals, mainly encouragement to eat iron-rich foods (liver, spleen, lentils, green vegetables, beetroot) or to avoid drinking tea and coffee. Among the anemic women, 42.3% drank 1 to 9 glasses (cups) of tea daily, averaging approximately 3.2 cups per day. Regarding hematological data, the analysis offers valuable insights into the indices of 400 pregnant women, of whom 295 were anemic. Comparing the overall sample with the subgroup of anemic women highlights specific patterns related to anemia. In the total sample, 95% of women had Pla counts within the normal range of 150,000 to 400,000/mm³. In the anemic group, although 93.2% remained within this normal range, the percentage of women with platelet counts below 150,000/mm³ increased slightly to 5.4%, indicating a possible trend toward thrombocytopenia, though this change is modest. The differences are more significant for RBCs. While 52% of all women had RBC counts below 4.20 million/mm³, this proportion rose to 70.5% among anemic women, showing that low RBC count is a key marker of anemia. Conversely, the proportion of women with RBC counts within the normal range (4.2 to 5.55 million/mm³) decreased from 47.5% to 28.8% among anemic women. For Hb, 41% of women in the overall group had levels below 12 g/dl, which is characteristic of anemia. Among the anemic women, this percentage increased to 55.6%. Women with Hb levels from 12 to 16 g/dl made up 58.8% of the total sample but only 44.1% of the anemic group, confirming the link between low Hb and anemia. The MCV also shows a difference, with 21.5% of all women having an MCV less than 80 fl, compared to 29.2% of anemic women. Since MCV indicates the average size of RBCs, a higher prevalence of microcytosis in anemic women suggests types of anemia like iron-deficiency anemia. Regarding the MCH, which measures the average Hb per RBC, less than 27 pg is observed in 16.3% of the total sample and 22% of anemic women, highlighting the prevalence of hypochromic anemia in this subgroup. Lastly, blood sugar levels are relatively stable across groups with few variations, indicating that blood sugar is not directly impacted by anemia in this population. In this investigation, hematological indices such as RBCs and Hb levels were higher in anemic pregnant women (70.5% and 55.6%) compared to their non-anemic counterparts (28.8% and 44.1%), respectively. However, indices such as MCHC and MCV were lower in anemic pregnant women (22% and 29.2%) compared to their non-anemic counterparts (69.8% and 70.8%), respectively. This aligns with several previous studies [42–45] among anemic pregnant women. The mean Hb level of less than 9.9 g/dl observed among the anemic pregnant women (55.6%) falls within the moderate anemia category (Hb < 9.9 g/dl), according to WHO classification criteria for anemia [46]. This study also observed a significantly low mean MCV level among anemic pregnant women, with 29.2% having MCV < 80 fl. A reduced MCV below the lower reference limit indicates microcytic anemia or iron deficiency anemia [42, 44]. Our finding that MCV levels were increased in anemic pregnant women contradicts those of Ahenkorah et al., who reported 16.9% [42] and 70.9% [47] among anemic pregnant women in Bolgatanga (Ghana) and Sokoto (Nigeria), respectively. Erhabor and Ahenkorah attributed their results to microcytic hypochromic anemia [42, 47].

Conclusion

In summary, this descriptive epidemiological study highlights the alarming level of anemia prevalence among pregnant women in the Beni Mellal region, along with the variety of anemia types found within this population. The data stress the urgent need to strengthen public health initiatives aimed at improving maternal health and reducing the risks associated with anemia during pregnancy. Continued

engagement and coordinated efforts among healthcare professionals, policymakers, and the community are essential to tackling this public health issue and ensuring safer, healthier pregnancies for all women.

Acknowledgments

The authors wish to sincerely thank everyone who contributed to this work's success.

References

- [1] M. Karami, M. Chalesghar, N. Salari, H. Akbari, and M. Mohammadi, "Global prevalence of anemia in pregnant women: a comprehensive systematic review and meta-analysis," *Maternal and child health journal*, vol. 26, no. 7, pp. 1473-1487, 2022.
- [2] M. Alem, B. Enawgaw, A. Gelaw, T. Kena, M. Seid, and Y. Olkeba, "Prevalence of anemia and associated risk factors among pregnant women attending antenatal care in Azezo Health Center Gondar town, Northwest Ethiopia," *J Interdiscipl Histopathol*, vol. 1, no. 3, pp. 137-144, 2013.
- [3] S. McGuire, "World Health Organization. Comprehensive implementation plan on maternal, infant, and young child nutrition. Geneva, Switzerland, 2014," *Advances in Nutrition*, vol. 6, no. 1, pp. 134-135, 2015.
- [4] U. Who, "Unu," *Iron deficiency anaemia: assessment, prevention and control, a guide for programme managers*. Geneva: World Health Organization, pp. 1-114, 2001.
- [5] G. Obai, P. Odongo, and R. Wanyama, "Prevalence of anaemia and associated risk factors among pregnant women attending antenatal care in Gulu and Hoima Regional Hospitals in Uganda: A cross sectional study," *BMC pregnancy and childbirth*, vol. 16, no. 1, p. 76, 2016.
- [6] S. Ahmed *et al.*, "Prevalence and associated factors of Anemia among pregnant women receiving antenatal care (ANC) at Fatima Hospital in Jashore, Bangladesh: a cross-sectional study," *Food and Nutrition Sciences*, vol. 10, no. 09, p. 1056, 2019.
- [7] S. Shams, Z. Ahmad, and A. Wadood, "Prevalence of iron deficiency anemia in pregnant women of district Mardan," *Pakistan. J Preg Child Health*, vol. 4, no. 6, pp. 1-4, 2017.
- [8] F. Asrie, "Prevalence of anemia and its associated factors among pregnant women receiving antenatal care at Aymiba Health Center, northwest Ethiopia," *Journal of blood medicine*, pp. 35-40, 2017.
- [9] O. T. Okube, W. Mirie, E. Odhiambo, and W. Sabina, "Prevalence and factors associated with anaemia among pregnant women attending antenatal clinic in the second and third trimesters at pumwani maternity hospital, Kenya," 2016.
- [10] A. M. Liyew *et al.*, "Prevalence and determinants of anemia among pregnant women in East Africa; A multi-level analysis of recent Demographic and Health Surveys," *PloS one*, vol. 16, no. 4, p. e0250560, 2021.
- [11] M. F. Young, B. M. Oaks, S. Tandon, R. Martorell, K. G. Dewey, and A. S. Wendt, "Maternal hemoglobin concentrations across pregnancy and maternal and child health: a systematic review and meta-analysis," *Annals of the New York Academy of Sciences*, vol. 1450, no. 1, pp. 47-68, 2019.
- [12] G. Stephen, M. Mgongo, T. Hussein Hashim, J. Katanga, B. Stray-Pedersen, and S. E. Msuya, "Anaemia in pregnancy: prevalence, risk factors, and adverse perinatal outcomes in Northern Tanzania," *Anemia*, vol. 2018, no. 1, p. 1846280, 2018.
- [13] B. De Benoist, E. McLean, I. Egli, M. Cogswell, and M. Cogswell, "WHO global database on anaemia," *Geneva: WHO*, pp. 1993-2005, 2008.
- [14] M. C. Siteti, S. D. Namasaka, O. P. Ariya, S. D. Injete, and W. A. Wanyonyi, "Anaemia in pregnancy: Prevalence and possible risk factors in Kakamega County, Kenya," *Science journal of public health*, vol. 2, no. 3, pp. 216-222, 2014.
- [15] G. Kejela *et al.*, "Prevalence of anemia and its associated factors among pregnant women attending antenatal care follow up at Wollega University referral hospital, Western Ethiopia," *Contraception and reproductive medicine*, vol. 5, no. 1, p. 26, 2020.
- [16] H. Hameed, A. Hameed, S. Bashir, S. Akram, and M. Arshad, "Study of prevalence of anaemia among pregnant women and its correlation with different risk factors," *Drug Des*, vol. 7, no. 158, pp. 2169-0138, 2018.
- [17] L. L. Tiore *et al.*, "Factors associated with anaemia among women of reproductive age in Ethiopia: Multilevel ordinal logistic regression analysis," *Maternal & Child Nutrition*, vol. 17, no. 1, p. e13063, 2021.
- [18] I. n. d. l. statistique, *Recensement général de la population et de l'habitat*. Institut national de la statistique, 1996.
- [19] V. M. Bwana, S. F. Rumisha, I. R. Mremi, E. P. Lyimo, and L. E. Mboera, "Patterns and causes of hospital maternal mortality in Tanzania: A 10-year retrospective analysis," *PloS one*, vol. 14, no. 4, p. e0214807, 2019.
- [20] S. Geneva and W. H. Organization, "Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity," *Vitamin and Mineral Nutrition Information System. Document Reference WHO*, 2011.
- [21] N. Ouzennou, K. Tikert, G. Belkedi, and F. E. Jarhmouti, "Prévalence et déterminants sociaux de l'anémie chez les femmes enceintes dans la Province d'Essaouira, Maroc," *Sante publique*, vol. 30, no. 5, pp. 737-745, 2018.
- [22] R. Bennani, "Les formes graves de l'hypertension artérielle gravidique," 2006.
- [23] N. Hasswane, A. Bouziane, M. Mrabet, F. Z. Laamiri, H. Aguenao, and A. Barkat, "Prevalence and factors associated with anemia pregnancy in a group of Moroccan pregnant women," *Journal of Biosciences and Medicines*, vol. 3, no. 10, pp. 88-97, 2015.
- [24] Z. Rochdi, "Prééclampsie à propos de 1 084 cas," Thèse de médecine]. Casablanca (Maroc): Université Hassan II, Faculté de . . . , 2009.
- [25] M. L. Serbesa and M. T. Iffa, "Pregnant women's knowledge, attitude, and practice regarding the prevention of iron deficiency anemia among Ethiopian pregnant women," *Caspian Journal of Reproductive Medicine*, vol. 4, no. 1, pp. 1-7, 2018.
- [26] M. Mardani *et al.*, "Prevalence of anemia and its risk factors among pregnant women in Khorramabad (Iran) 2010–2014," *The Journal of Maternal-Fetal & Neonatal Medicine*, vol. 30, no. 7, pp. 826-829, 2017.
- [27] F. D. Jutcha, T. F. N. Hougna, N. Nvogue, M. Noubom, and N. Fomulu, "Prévalence de l'anémie ferriprive chez les femmes enceintes à yaoundé," *HEALTH SCIENCES AND DISEASE*, vol. 17, no. 1, 2016.
- [28] G. A. Stevens *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," *The Lancet Global Health*, vol. 1, no. 1, pp. e16-e25, 2013.
- [29] A. Demmouche and S. Moulessehou, "Anémie maternelle pendant la grossesse et la supplémentation en fer," *Antropo*, no. 24, pp. 20-30, 2011.
- [30] B. Vemulapalli and K. K. Rao, "Prevalence of anaemia among pregnant women of rural community in Vizianagaram, North Coastal Andhra Pradesh, India," *Asian Journal of Medical Sciences*, vol. 5, no. 2, pp. 21-25, 2014.
- [31] S. Z. Hyder, L.-Å. Persson, M. Chowdhury, B. Lönnerdal, and E.-C. Ekström, "Anaemia and iron deficiency during pregnancy in rural Bangladesh," *Public health nutrition*, vol. 7, no. 8, pp. 1065-1070, 2004.

- [32] M. Belomaria, R. Bengueddour, Y. Aboussaleh, F. Hattimy, and S. Ouaddi, "Study of the Prevalence of Anemia during Pregnancy: Case of 3 Urban Health Centers of Kenitra North West of Morocco," *International Journal of Medicine and Pharmaceutical Science*, vol. 10, no. 1, pp. 1-8, 2020.
- [33] E. J. Lema and S. A. Seif, "Prevalence of anemia and its associated factors among pregnant women in Ilala Municipality-Tanzania: Analytical cross-sectional study," *Medicine*, vol. 102, no. 23, p. e33944, 2023.
- [34] A. Zinebi, H. Eddou, K. M. Moudden, and M. Elbaaj, "Etiological profile of anemia in a department of internal medicine," *The Pan African Medical Journal*, vol. 26, pp. 10-10, 2017.
- [35] N. J. Kassebaum *et al.*, "A systematic analysis of global anemia burden from 1990 to 2010," *Blood, the Journal of the American Society of Hematology*, vol. 123, no. 5, pp. 615-624, 2014.
- [36] A. A. Adebo, A. G. Yessoufou, C. M. Kpanou, M. B. Bouko, M. M. Soumanou, and A. Sezan, "Anémie et facteurs associés chez les gestantes reçues en consultation au Centre de Santé d'Ekpè (Sud du Bénin)," *Antropo*, no. 40, pp. 35-41, 2018.
- [37] A. A. S. Judicaël, "Pratiques de soins liées à l'anémie chez la femme enceinte Baoulé Faali de Broukro en Côte d'Ivoire: du symbolisme au changement social et comportemental," *Revue Africaine des Sciences Sociales et de la Santé Publique*, vol. 6, no. 3, pp. 18-32, 2024.
- [38] A. E. Aznam and L. Inayati, "Relationship Between Age and Parity with Incidences of Anemia in Pregnant Women in Mayangrejo," *Jurnal Biometrika Dan Kependudukan*, vol. 10, no. 2, pp. 130-137, 2021.
- [39] R. D. Aisyah and F. Fitriyani, "Faktor Internal Dan Eksternal Yang Berhubungan Dengan Kejadian Anemia Di Wilayah Kabupaten Pekalongan," *Motorik*, vol. 11, no. 23, p. 153521, 2016.
- [40] J. Jasmi, "HUBUNGAN ANTARA PARITAS DAN UMUR DENGAN KEJADIAN ANEMIA PADA IBU HAMIL DI PUSKESMAS MELUR KECAMATAN SUKAJADI KOTA PEKANBARU," *JURNAL IBU DAN ANAK*, vol. 1, no. 2, 2016.
- [41] K. Anfiksyar, M. B. D. Aryana, I. Surya, and I. Manuaba, "Karakteristik anemia pada kehamilan di Poliklinik Kebidanan RSUP Sanglah tahun 2016-2017," *Jurnal Medika Udayana*, vol. 8, no. 7, pp. 1-7, 2019.
- [42] B. Ahenkorah, K. Nsiah, P. Baffoe, and E. O. Anto, "Biochemical and hematological changes among anemic and non-anemic pregnant women attending antenatal clinic at the Bolgatanga regional hospital, Ghana," *BMC hematology*, vol. 18, no. 1, p. 27, 2018.
- [43] A. I. Susanti, E. Sahiratmadja, G. Winarno, A. K. Sugianli, H. Susanto, and R. Panigoro, "Low Hemoglobin among Pregnant Women in Midwives Practice of Primary Health Care, Jatinangor, Indonesia: Iron Deficiency Anemia or β -Thalassemia Trait?," *Anemia*, vol. 2017, no. 1, p. 6935648, 2017.
- [44] W. Getahun, T. Belachew, and A. D. Wolide, "Burden and associated factors of anemia among pregnant women attending antenatal care in southern Ethiopia: cross sectional study," *BMC research notes*, vol. 10, no. 1, p. 276, 2017.
- [45] L. Karaoglu *et al.*, "The prevalence of nutritional anemia in pregnancy in an east Anatolian province, Turkey," *BMC public health*, vol. 10, no. 1, p. 329, 2010.
- [46] C. Who, "Worldwide prevalence of anaemia 1993–2005," *WHO global database on anaemia*, vol. 2008, 2008.
- [47] O. Erhabor, I. Isaac, A. Isah, and F. Udomah, "Iron deficiency anaemia among antenatal women in Sokoto, Nigeria," *Br J Med Health Sci*, vol. 1, no. 4, pp. 47-57, 2013.



This is an open-access article distributed under the terms of the Creative Commons Attribution License.