

**DETERMINANTS OF ANAEMIA AMONG PREGNANT WOMEN IN NIGERIA – A  
LITERATURE REVIEW**

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LITERATURE REVIEW*

A thesis submitted in partial fulfilment of the requirement for the degree of Master of Science  
in International Health

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Declaration:

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## **Abstract**

**Background:** Anaemia is a significant public health issue, affecting a large percentage of pregnant women, especially in Nigeria. Despite interventions of treating and preventing anaemia, still many pregnant women are affected by anaemia-related health problems. The contributing factors for the persistence of high incidences are not fully known. While studies show high prevalence among pregnant women in Nigeria, there, however, exists a dearth of research that provides an overview of the determinants of anaemia in pregnancy in Nigeria.

**Objectives:** The main objective of this study was to explore the direct causes, intermediate and underlying risk factors determinants of anaemia among pregnant women in Nigeria.

**Methodology:** A literature review was conducted using the WHO anaemia framework to identify determinants of anaemia among pregnant women in Nigeria. The Scopus electronic database was searched for relevant articles. Guided by the anaemia WHO framework of anaemia aetiology, data were extracted and analysed to identify themes related to direct, intermediate, and underlying factors contributing to anaemia.

**Key Findings:** The key results highlighted iron deficiency, malaria, HIV, and inherited red blood cell disorders as direct determinants of anaemia in pregnancy, with significant intermediate risk factors including food insecurity, poor diets, and limited access to health services. Underlying risk factors identified included low educational attainment, poverty, and cultural norms.

**Conclusion:** The results of this study show that several levels of factors influence the prevalence of anaemia among pregnant women in Nigeria. Future research should investigate the impact of tuberculosis, water sanitation and hygiene and conflicts as determinants of anaemia.

**Keywords:** Anaemia, determinants, iron deficiency, pregnant women, Nigeria

**Word Count: 7984**

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## Key Terms

1. **Anaemia:** Anaemia is a health condition characterised by quality or inadequate red blood cells, resulting in reduced oxygen sent to the tissues, causing tiredness, with other health issues.
2. **Pregnant Women:** This refers to women that are with one or more embryos or foetuses in their wombs.
3. **Determinants:** refer to the conditions or factors that cause the occurrence and manifestation of a health problem.
4. **Micronutrients:** These are minerals and vitamins that are important, which the body requires a small amount to function properly. Vitamin B12, iron and folate are some of the important micronutrients that are related to anaemia.
5. **Deficiency:** This is the state of not having enough or the lack of important substances like nutrients.
6. **Infection:** This is when pathogens like fungi, parasites or bacteria cause a disease.
7. **Antenatal Care:** This is the type of health care that is being rendered to a pregnant woman to make sure they have a healthy pregnancy.
8. **Malaria:** Malaria is a mosquito-borne infectious disease, caused by plasmodium parasite.

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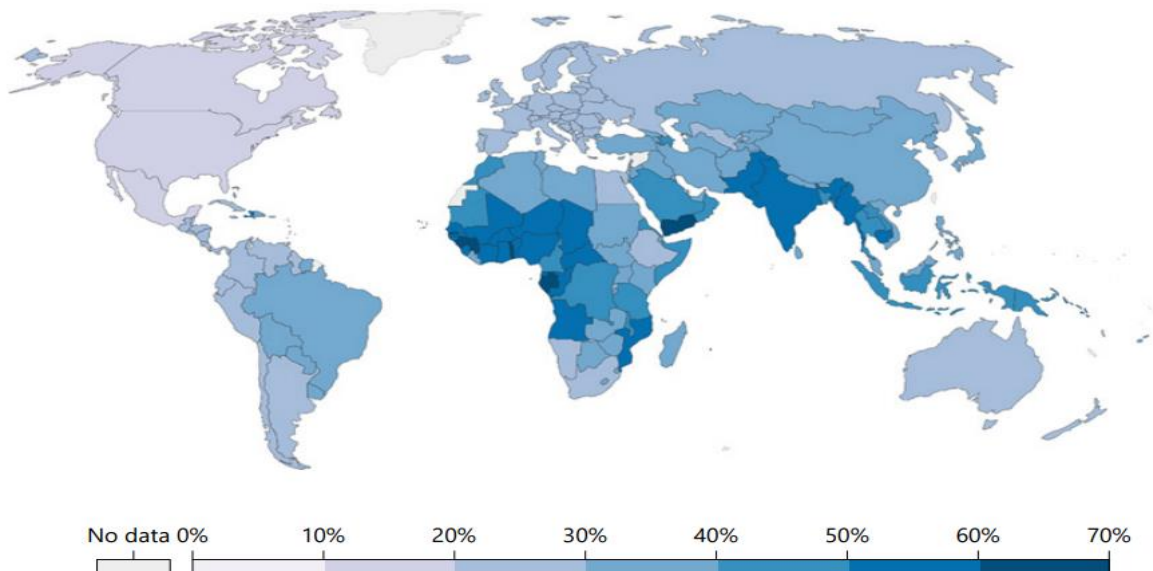


# CHAPTER ONE

## INTRODUCTION

### 1.1 Background

The prevalence of anaemia varies among countries globally but is a major public health problem in the low- and middle-income countries (LMICs), reflecting differences in race, socioeconomic factors, nutritional habits, medical care, and the frequency of parasitic illnesses [1]. Figure 1 presents the global prevalence of anaemia among pregnant women. A systematic review of evidence from 107 countries suggested that the prevalence of anaemia among pregnant women was 38%, impacting approximately 32 million women [2], of whom about 75% were manifested with iron deficiency [3]. The prevalence of iron deficiency anaemia varies across regions, from 3% in Europe to over 50% in Africa. In Sub-Saharan Africa, the magnitude of anaemia in pregnancy is alarming, whereby its prevalence is widely contributed by poor nutrition, iron and other micronutrients deficiencies, parasitic infestations, chronic infections, illiteracy, and short pregnancy intervals [4].



**Figure 1:** Global prevalence of anaemia in pregnant women, measured as the percentage of pregnant women with a haemoglobin level less than 110 g per litre at sea level [5]

In Nigeria, the prevalence of anaemia among pregnant women remains very high, with various studies reporting rates ranging from 47% to 70% across different regions of the country [6, 7, 8]. The aetiology of anaemia in pregnancy in Nigeria, like in other countries, is multifactorial, with iron deficiency resulting from micronutrient deficiencies being the most common cause [9]. This high prevalence is largely due to inadequate dietary iron intake, increased iron requirements during pregnancy, and the high burden of parasitic infections such as malaria and hookworm, which increase the rate of iron loss [10]. Malaria, endemic in Nigeria, plays a significant role in the high prevalence of anaemia among pregnant women. A study by Ugwu et al. in southeastern Nigeria found that malaria infection was associated with a 2.5-fold increased risk of anaemia in pregnancy [11]. The Plasmodium parasite breaks down red blood cells and stops the body from making new ones, which lowers haemoglobin levels. Additionally, infected red blood cells can gather in the placenta, harming the growth and development of the foetus. Nutritional deficiencies, particularly of folate and vitamin B12, also contribute to anaemia in pregnancy. A secondary analysis of the 2018 Nigeria demographic health survey by Adeyemi et al. found that 22% of anaemic pregnant women had folate deficiency, while 18% had vitamin B12 deficiency [12].

Haemoglobin is a commonly used, well validated and widely accepted indicator for anaemia. The World Health Organization (WHO) defines anaemia according to haemoglobin levels due to the link between iron level, haemoglobin synthesis, poor blood oxygenation, and anaemia. [13]. However, anaemia is also commonly presented based on cut-offs. Table 1 presents cut-offs used to classify anaemia severity. Anaemia occurs at all stages of the life cycle and is highly prevalent among women in reproductive age and during pregnancy [14].

**Table 1:** Haemoglobin cut-off points to classify anaemia severity [13]

<b>Parameter</b>	<b>Nonpregnant women of reproductive age (15-49 years)</b>	<b>Pregnant women</b>
Non-anaemic	≥ 12 g/dL	≥11 g/dL
Mild anaemia	10-11.9 g/dL	10-10.9 g/dL
Moderate anaemia	7-9.9 g/dL	7-9.9 g/dL
Severe anaemia	>7 g/dL	>7 g/dL

Anaemia has many causes. According to WHO the direct causes of anaemia include micronutrient deficiencies, infection, inflammation and chronic diseases, gynaecological and obstetric conditions and inherited red blood cell disorders [15]. These direct causes are worsened by immediate risk factors, underlying risk factors, and broader social inequities.

Anaemia resulting from iron deficiency is the most common form of anaemia [16], and when it occurs in pregnancy, it may be associated with postpartum haemorrhage and puerperal sepsis. So far, most efforts to tackle anaemia have concentrated on preventing and treating iron deficiency. However, other factors such as nutritional deficiencies, malaria, other infections including parasitic diseases, chronic diseases, inflammation, gynaecological and obstetric conditions, and inherited red blood cell disorders also significantly contribute to anaemia prevalence [15]. Furthermore, anaemia can negatively impact foetal development, leading to low birth weight, prematurity, and increased infant mortality [17]. Pregnancy is a period of significant increase in iron requirement over and above the non-pregnant state. The increased iron requirement is due to expansion of maternal red blood cell mass for increased oxygen transport, including transfer of iron, to both the growing foetus and the placental structures, and as a needed reserve for blood loss and lochia at parturition. Due to increased iron requirements, a high proportion of women become anaemic during pregnancy [18].

The state of healthcare in Nigeria presents a mix of progress and challenges (see Appendix A for an overview of the challenges of the healthcare system). Maternal mortality has shown

minimal improvement over the past 25 years, with Nigeria's maternal mortality ratio remaining high [19]. Additionally, Nigeria continues to bear a substantial burden of malaria cases and deaths [20, 21, 22]. Pregnant women in Nigeria often struggle to access quality healthcare services due to various systemic issues within the healthcare system [23]. This lack of access could lead to inadequate prenatal care, increased risks during childbirth, and higher maternal mortality rates. Initiatives such as free health care programmes for pregnant women and children under five in certain areas are facing challenges due to funding constraints [23]. According to Fagbamigbe et al. the state of the healthcare system in Nigeria significantly impacts anaemia in pregnancy due to several factors such as limited access to prenatal care, inadequate nutrition education, shortage of healthcare professionals, poor infrastructure and medical supplies, and economic barriers to healthcare services [23]. These issues lead to delayed diagnosis of anaemia, insufficient iron supplementation, inadequate treatment of underlying causes, and higher rates of maternal and foetal complications. Although efforts have been made by Nigeria and its development partners to address these health challenges such as through the passage of the National Health Bill, which aims to strengthen primary healthcare systems, improve monitoring and evaluation, and move towards universal health coverage [20], more still needs to be done to reduce the prevalence of anaemia in pregnancy in Nigeria.

## **1.2 Statement of the Problem**

Anaemia in pregnancy is a significant public health issue, affecting 38% of pregnant women globally and 41% in Africa [24]. In Nigeria, the prevalence ranges from 47% to 70% [6, 7, 8]. Iron deficiency anaemia (IDA) is responsible for 50-75% of anaemia cases during pregnancy, resulting from inadequate iron intake, poor absorption, and increased demand from the foetus [16]. If left undetected and untreated, IDA can lead to severe fatigue, impaired physical and cognitive function, and depression [24]. It also increases the risk of postpartum haemorrhage, which, together with anaemia, contributes to 40–43% of maternal mortality in Africa and Asia

[25]. Furthermore, it is associated with twice as high maternal mortality in women with severe anaemia than those without [26]. Although reports exist about what is being done, and what should be done globally to address anaemia in pregnancy, the global prevalence of maternal mortality due to anaemia remains high [16, 27, 28]. Despite interventions of treating and preventing anaemia among pregnant women, still many pregnant women are affected by anaemia-related health problems. However, the contributing factors for the persistence of high incidences are not fully known [29].

The prevalence of anaemia in pregnancy in Nigeria can be linked to several challenges faced by the health sector of the country. For instance, Akinajo, et al., in their study on the acceptability of intravenous (IV) iron treatment for IDA in pregnancy in Nigeria reported that there are no sufficient health care facilities to cater for the needs of pregnant women. Where such exists, it is not yet designed to effectively deliver IV iron therapy [25]. The deficiency in infrastructure is attributed to lack of accountability in the healthcare system [30]. Ozumba et al. also revealed that inequities exist in accessing quality healthcare services when women required medical attention [31]. These disparities in accessing antenatal care were largely influenced by the type of settlements (urban or rural) of the women. Living in urban areas and the presence of good antenatal care service points were significantly associated with higher odds of accessing health services. The prevalence is also strongly associated with lower education and socio-economic status [32]. Gendered power dynamics within households can limit women's autonomy and access to resources, affecting their ability to make decisions about their own health during pregnancy [33]. This can result in inadequate prenatal care, poor nutrition, and increased health risks for both mother and child.

Despite ongoing efforts to improve maternal health in Nigeria, the prevalence of anaemia among pregnant women remains high. There are many factors affecting the prevalence of anaemia such as nutritional, infectious, and socioeconomic factors which can be either a direct cause, intermediate or an underlying cause. Understanding the determinants of anaemia is

crucial for developing effective interventions to reduce its incidence and associated complications. However, despite several studies on the prevalence of anaemia among pregnant women in Nigeria, there exist a dearth of research that provides an overview of the determinants of anaemia in pregnancy in Nigeria.

### **1.3 Significance of the Study**

This thesis aims to provide a scoping overview of the determinants of anaemia among pregnant women in Nigeria. By exploring the key factors contributing to anaemia, the study will offer insights that can support the development of targeted interventions and inform policy decisions. The findings will be valuable for healthcare providers, policymakers, and international development programmes focused on maternal health.

### **1.4 Aim and Objectives of the Study**

The main objective of this study is to explore the determinants influencing the prevalence of anaemia in pregnancy in Nigeria. The specific objectives of the study are to:

- i. understand the direct factors that influence the prevalence of anaemia in pregnant women in Nigeria.
- ii. understand the intermediate factors that influence the prevalence of anaemia in pregnant women.
- iii. understand the underlying factors that influence the prevalence of anaemia in pregnant women in Nigeria.

## CHAPTER TWO

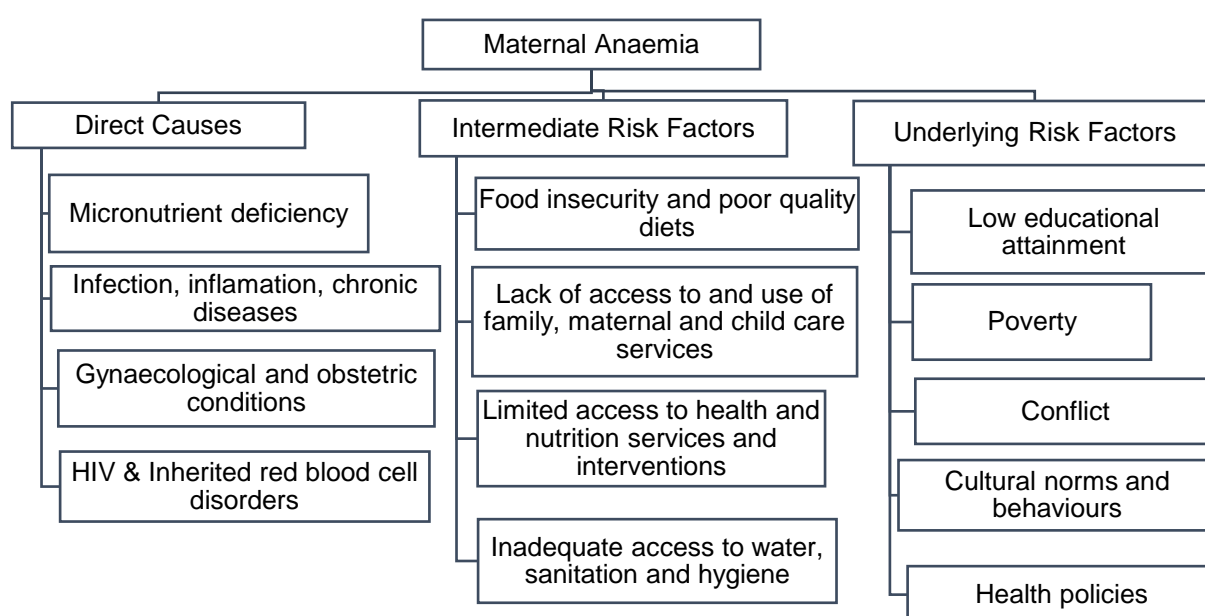
### METHODOLOGY

#### 2.1 Conceptual Framework

The framework that guides the study is the anaemia framework on the determinants of anaemia developed by the World Health Organisation (WHO) [15]. The framework is five-layered, consisting of physiological mechanisms, direct causes, intermediate risk factors, underlying risk factors, and fundamental drivers, all of which are interconnected (see Figure B1 of Appendix B). At the physiological level, anaemia can arise from decreased or ineffective erythrocyte production, haemolysis, or blood loss, which are the immediate biological processes leading to a reduced number of red blood cells [15]. These physiological mechanisms are often triggered by direct causes such as micronutrient deficiencies (notably iron, vitamin B12, and folate), infections (like malaria), chronic diseases, and inherited disorders affecting red blood cells. For instance, iron deficiency can stem from inadequate dietary intake or absorption, which is directly linked to food insecurity and poor-quality diets i.e., the intermediate risk factors [15].

The intermediate risk factors are influenced by underlying risk factors, including socio-economic conditions such as poverty and low educational attainment, which limit access to nutritious food and health care services [15]. Cultural norms and health policies also play a significant role; for example, cultural practices may restrict dietary diversity, while ineffective health policies can hinder access to necessary interventions [34]. Finally, at the right side of the model are the fundamental drivers, including socio-demographic variables, political stability, and systemic inequities. These fundamental drivers create the broader context in which the underlying risk factors operate, ultimately influencing the prevalence of anaemia in specific populations.

For this study, an adapted version of this framework is used and presented in Figure 2. A significant body of research has already explored the biological processes that lead to anaemia, such as decreased erythrocyte production, haemolysis, and blood loss. Also, fundamental drivers, such as socio-demographic and political factors are often broad and systemic, making them more challenging to address within the scope of this study. Therefore, this thesis focused on the direct causes, intermediate risk factors, and underlying risk factors, in order to streamline the study and maintain a clear focus on the most actionable elements.



**Figure 2:** Conceptual framework used in this study. Adapted from [15]

The first layer of the framework highlights the direct role nutrient-rich diets play in supporting overall health and well-being, yet many individuals, particularly in resource-constrained settings, face challenges in accessing and consuming foods that are rich in essential nutrients such as iron. The lack of diversity in diets, limited availability of nutrient-dense foods, and cultural dietary practices may all contribute to inadequate nutrient intake, leading to deficiencies that can manifest as anaemia [35]. The layer also identifies the role of infection,



gynaecological disorders, HIV and inherited red blood cell diseases etc. as direct causes of anaemia in pregnancy.

The second layer include Inadequate care practices include a range of behaviours and actions that may hinder optimal health outcomes, including insufficient prenatal care, lack of access to essential healthcare services, and suboptimal hygiene practices. These factors can impede the ability of individuals to maintain adequate iron levels and overall nutritional status, thereby increasing the risk of developing anaemia. Moreover, the absence of proper care practices may exacerbate existing health conditions and contribute to the perpetuation of anaemia within vulnerable populations including pregnant women [35].

Finally, the underlying risk factors refer to the broader social, economic, and environmental conditions that contribute to the prevalence of the condition. These factors often create an environment where direct intermediate risk factors and causes of anaemia, such as nutritional deficiencies and infections, are more likely to occur. For instance, pregnant women living in poverty often have limited access to nutritious food, healthcare services, and education. This lack of resources can lead to inadequate dietary intake of essential nutrients which are crucial for preventing anaemia. Additionally, poverty can increase vulnerability to infections and chronic diseases [36].

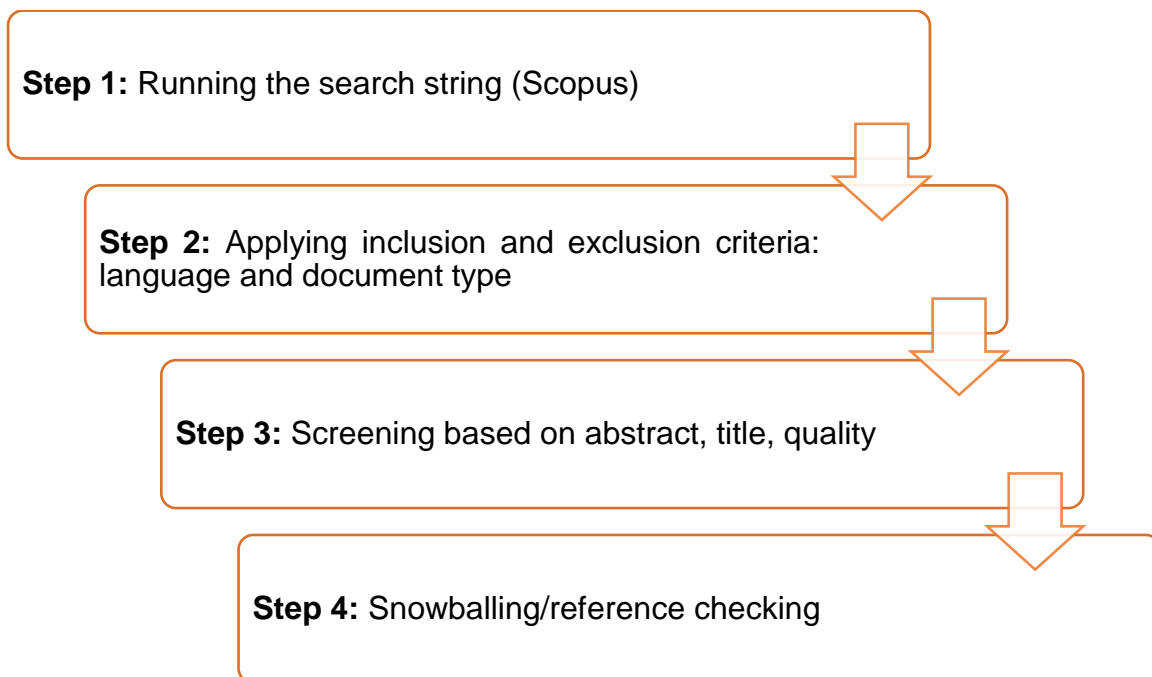
## **2.2 Literature Search Strategy**

This thesis employed a comprehensive literature review to gather and synthesize available research on the direct, intermediate, and underlying determinants of anaemia among pregnant women in Nigeria. The literature review synthesized findings from peer-reviewed articles, and grey literature to understand the determinants of anaemia during pregnancy in Nigeria.

A systematic literature review was carried out following the guidelines outlined in [37]. To perform this, four different steps were considered, as shown in Figure 3. The main search terms for this study related to anaemia, pregnancy, determinants, and Nigeria. Some studies

in literature use “factors”, “causes” or “drivers” instead of determinants or “maternal anaemia” in place of anaemia in pregnant women. Following these considerations, the search string was divided into four layers joined by the Boolean operator AND; the first layer includes the keywords “determinants” OR “factors” OR “driver” OR “cause”, the second layer includes “anaemia” OR “anemia”, the third layer includes “pregnant” OR “pregnant women” OR “maternal”, and the fourth layer includes the country “Nigeria.”

The search query was run on the Scopus database because Scopus is one of the largest abstract and citation databases, covering a wide range of disciplines. This ensures access to a vast number of relevant and high-quality research articles [38, 39]. The search was carried out within “article title, abstract and key words.” For the inclusion and exclusion criteria, only articles written in English language were considered in the research. Further only scientific peer-reviewed articles using qualitative and/or quantitative were included in the study. Others such as letters, reviews and books, book chapters and conference papers were excluded from the study.



**Figure 3:** Flowchart for literature search

The third step involved a title and abstract screening process to identify articles relevant to the primary focus of the research. In evaluating the quality and relevance of literature pertaining to research focus, priority was given to sources featuring a well-defined research question, a clearly defined methodology, and a literature review with recent references in relation to the date of its publication [40]. Other considerations included the clarity of results and their interpretation, and overall presentation quality. During the final step, a more in-depth reading of the full text was carried out on the selected articles to finalize the sample selection. Finally, the reference lists of the selected articles were then reviewed through a snowballing technique to include other articles may not have been indexed in Scopus.

To analyse the selected literature, the findings were organized into a detailed table to facilitate clear comparison and synthesis of the data. This table (see Table C1) included key elements for each selected article: the authors, year of publication, sample details, study design, identified determinants and the specific state/region within Nigeria where the study was conducted. The extracted information was then categorized into themes based on the identified determinants of anaemia as highlighted in Figure 2.

In the initial stage, the search query in Scopus database identified 146 articles related to the determinants of anaemia in pregnancy in Nigeria. The second stage involved applying inclusion and exclusion criteria, which refined the results to 104 articles.

In the third step, the articles were filtered through screening the titles and abstracts, leading to a total of 29 articles. Finally, snowballing technique resulted in including five more documents. A total of 34 articles were included in the final sample of the review.

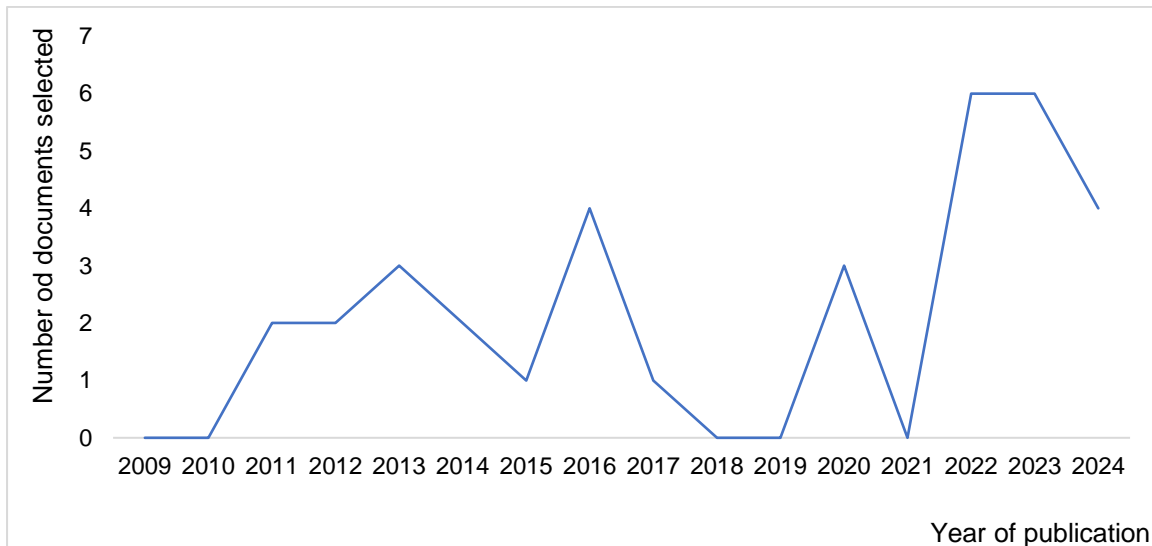
## CHAPTER THREE

### RESULTS

#### 3.1 General Overview of Studies included

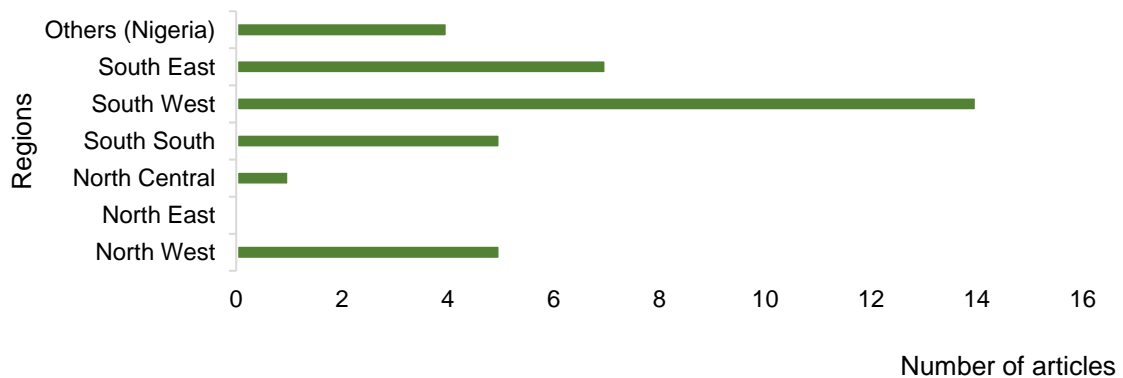
Table C1 in Appendix C provides a brief overview of the selected articles. Most of the studies reviewed as presented in the table, were cross-sectional in nature, reflecting a predominant focus on capturing data at a single point in time. Although this approach provides valuable snapshots of the determinants under investigation, this trend also underscores a notable gap in the literature, with fewer qualitative studies represented. The distribution of the articles by year of publication and geo-political regions are shown in Figure 4 and Figure 5, respectively.

From Figure 4, it can be observed that there were no documents selected in 2009, 2010, 2018, 2019, and 2021. However, overall, a significant rise in publication numbers is observed in recent years, with 2022 and 2023 each having six documents, which may indicate an increase in research interest in this aspect.



**Figure 4:** Document distribution by year of publication

Figure 5 shows a significant disparity in the number of documents across regions (see Figure A1 in appendix A for map of Nigeria showing the regions). The southern regions (South-West, South-East, and South-South) collectively account for a majority of the documents. The North-East region has the lowest number of documents, indicating a significant gap in research output compared to other regions.



**Figure 5:** Distribution of assessed articles by geo-political region

### 3.2 Direct Factors

Multiple studies have identified iron deficiency, malaria parasitaemia, and infections as direct causes of anaemia in pregnancy. Babah, et al. emphasized iron deficiency as a major factor contributing to anaemia among pregnant women in Lagos and Kano States, with 41.2% of women with moderate or severe anaemia being iron deficient, establishing a direct correlation between micronutrient deficiency and anaemia prevalence. Furthermore, it highlighted the role of malaria parasitaemia, which is associated with lower odds of IDA, signifying that while malaria could contribute to anaemia through mechanisms such as haemolysis, its presence may be linked to a reduced incidence of IDA in the study area [8]. Okunade, et al. and Talabi, et al. also highlighted nutritional deficiencies, particularly iron, as a leading cause of anaemia in pregnancy, which could be linked to the broader context of micronutrient deficiencies that may also affect susceptibility to infections like malaria [41, 42]. Micronutrient deficiency was also suggested by the finding that the average daily dietary intake of iron was 17.7mg, with no

significant difference between urban and rural respondents [43]. However, a study by Obasi and Nwachukwu revealed that urban pregnant women had significantly lower iron levels compared to their rural counterparts, leading to higher rates of gestational iron deficiency (GID) and IDA. This directly linked lower iron levels in urban areas to higher incidences of GID and IDA [44].

In a national survey the majority (75%) of anaemia in pregnancy was attributed to iron deficiency, which is a micronutrient deficiency. The study also listed parasitic infestations, such as hookworm and malaria as significant contributors to anaemia in pregnant women [12]. In a similar study that utilised data from the Nigeria Demographic and Health Survey (NDHS), recent sexually transmitted infections were identified as a risk factor [45].

The result obtained from a national study showed high parasitic infections prevalence among the study population. Prevalence of plasmodium species, hookworm, ascaris lumbricoides and those with co-infection was estimated at 47.2%, 16.7%, 17.8% and 25.0% respectively; and age, educational level, trimester, and parity were all significant predictors of plasmodium species prevalence. The study found significant correlations between parity, education, and parasitic infections in pregnant women. Anaemia affected 40% of participants, with trimester and education level strongly predicting its occurrence. Plasmodium species were most linked to anaemia, followed by intestinal helminths [46]. While co-infections showed lower anaemia rates, a significant association was observed between anaemia and intestinal helminth infections [46]. These findings highlight the complex interplay between socio-demographic factors, parasitic infections, and anaemia in pregnancy.

A study carried out by Adebayo, et al. in Lagos found that micronutrient deficiency was evident as 83.8% of respondents had IDA, and that higher dietary iron intake (DII) was inversely associated with the odds of IDA in pregnant women [47]. Ajepe et al. also asserted that micronutrient deficiency could be addressed through routine antenatal iron supplementation,

which significantly reduces the odds of anaemia in pregnancy [10]. In Kano State, infection, particularly malaria, had been found to be linked anaemia in pregnancy. The study also noted significant prevalence of haemolytic features indicative of malaria [48].

Rabiu et al.'s study in Southwest Nigeria emphasized that malaria infection was a significant contributor to anaemia among pregnant women. It reported a high prevalence of infection-associated anaemia (35.5%), with HIV being the highest contributor. This study found that the direct presence of malaria parasites in the bloodstream was a critical factor affecting the health of pregnant women, leading to complications such as anaemia, which could have serious implications for both maternal and foetal health [49]. Similarly, in the South-South, Omote et al. reported that infections, including malaria and HIV were significant contributors to maternal anaemia [50]. Ezugwu et al. also reported that HIV-positive and inherited red blood disorder pregnant women experienced a significantly higher prevalence of anaemia compared to HIV-negative pregnant women, indicating a direct impact of HIV and inherited red blood disorder on the likelihood of developing anaemia [51]. However, although Okoh et al. pointed out inherited red blood cell disorders were suggested by the significant prevalence of anaemia in women with the sickle cell genotype in South-South, there was no significant association between anaemia and HIV status [52].

In a study to determine the compliance of iron supplementation in Enugu, Ugwu et al. found that compliance with iron supplementation was influenced by factors like gastrointestinal side effects [53]. These side effects were likely to increase the vulnerability to anaemia in pregnancy as pregnant women avoid taking the iron supplementation.

### **3.3 Intermediate Risk factors**

Various studies have highlighted intermediate risk factors such as food insecurity, poor-quality diets, and limited access to health services as significant contributors to anaemia in pregnancy in Nigeria. Babah, et al. identified intermediate risk factors such as food insecurity and poor-

quality diets, noting that dietary habits significantly influence the odds of IDA. For instance, consuming green leafy vegetables correlated with a notable reduction in the odds of IDA, whereas the intake of soybeans and edible kaolin clay was found to be associated with higher odds. Additionally, the study pointed to limited access to health and nutrition services, implying that gaps in antenatal care and nutritional interventions might contribute to the high prevalence of anaemia and iron deficiency [8]. In a similar study, Okunade, et al. indicated that low socio-economic status, which often correlated with food insecurity, was predictive of anaemia in Lagos. Women living in poverty may have limited access to nutritious food, impacting their overall health and potentially increasing vulnerability to infections [41].

In a similar vein, Oyewole, et al.'s findings highlighted a relationship between dietary diversity and anaemia status among pregnant women. This association showed the role that a varied and balanced diet plays in maintaining optimal haemoglobin levels during pregnancy. The study asserts that dietary diversity is often considered a proxy for nutrient adequacy, suggesting that women who consume a wider range of food groups are more likely to meet their increased nutritional needs during gestation [34]. Anenga, et al. also revealed that where lack of dietary diversity was evident such as non-consumption of meat, poultry, and fish there was increased likelihood of anaemia [54].

A study using the NDHS data identified intermediate risk factors such as breastfeeding status, which was associated with higher haemoglobin levels, and Body Mass Index, which showed a nonlinear effect on both haemoglobin levels and anaemia risk [45]. Use of unsafe water and lack of internet access were also linked to increased anaemia risk [45]. A similar study the same data identified intermediate risk factors such as food insecurity and poor-quality diets, with women not taking a minimum adequate diet being more likely to suffer from anaemia. Limited access to health and nutrition services were indicated by the higher prevalence of anaemia in rural areas [36]. Barriers such as distrust in health services which could limit women's access to antenatal care, has also been identified as one of the intermediate risk



factors [55]. Another study from the source inferred that poor-quality diets and inadequate access to health services are the most common underlying risk factors [56].

Adeboye, et al. also found that poor-quality diets were indicated by the mean DII of  $20.3 \pm 3.3$  mg/day in Lagos, and the study suggests that promoting the consumption of iron-rich foods could help alleviate anaemia in pregnancy [47]. Additionally, the use of iron supplements significantly influenced anaemia prevalence, with those not taking supplements being 5.8 times more likely to develop anaemia [54]. Along with poor quality diets, Ajepe et al. also highlighted inadequate pregnancy spacing as one of the intermediate risk factors, with an interpregnancy interval of at least two years significantly reducing the odds of anaemia [10]. In Kano, poor access to health and nutrition services were evident, as many women booked late for antenatal care, reducing opportunities for early diagnosis and management of anaemia. Additionally, the study found poor-quality diets as a contributor to anaemia [48].

Rabiu et al. pointed out the lack of routine malaria screening during antenatal visits and poor compliance with Intermittent Preventive Treatment in pregnancy [49]. According to the study, this limited access to health services was a significant intermediate risk factor that could worsen the prevalence of malaria among this population, thereby making them vulnerable to anaemia. The study is supported by findings by Omote et al. which indicated that inadequate access to maternal and childcare services could impair the prevalence of anaemia among pregnant women. Women who did not receive regular antenatal care could miss out on essential screenings and treatments for infections like malaria, which could lead to higher rates of anaemia [50].

Engwa et al. reported that in Enugu, micronutrient deficiency was indicated by the association of low serum ferritin with anaemia and inherited red blood cell disorders are suggested by the significant association of Glucose-6-Phosphate Dehydrogenase deficiency with anaemia [57].

A Similar study in Enugu indicated that a lack of knowledge about the prevention and management of anaemia was significant [58].

In a study to determine adherence to routine iron supplementation among pregnant women in Ibadan, Ohaeri et al. found that forgetfulness, taking too many tablets, unavailability of supplements, and poor information from nurses were significant factors affecting adherence, thereby increasing the likelihood for anaemia [59]. Similarly, non-affordability, and forgetfulness were reported by Ugwu et al. as factors affecting compliance to iron supplementation [53]. In another study, inadequate antenatal care was implied as a significant factor, as quality antenatal care was shown to be a valuable preventive intervention. Despite ANC attendance, 9.2% of women persisted with anaemia, highlighting the need for effective and comprehensive antenatal care [60]. In another study, it was found that women who booked for antenatal care in the 3rd trimester have a higher prevalence of anaemia [51]. The study suggested that delayed or inadequate access to antenatal care services could contribute to a greater risk of anaemia. Adanikin and Awoleke also found that the higher prevalence of anaemia among students/unemployed women and those who registered for antenatal care at more than 21 weeks' gestation suggests that limited access to early maternal care and limited access to health are intermediate risk factors contributing to anaemia [61]. Owolabi et al [62] reported that the significantly higher prevalence of anaemia among those in the middle and lower socio-economic classes suggests that factors like limited access to resources and poor-quality diets may contribute to the increased incidence of anaemia. This is supported by other studies in Rivers State [63] and Ibadan [64, 65].

Findings by Yesufu et al. revealed that less than half of the respondents believed contraceptives could prevent anaemia by reducing closely spaced pregnancies. The study showed that a lack of understanding the influence of family planning anaemia [66].

### 3.3 Underlying Factors

Underlying risk factors such as low educational attainment, occupation and employment status as well as cultural norms have been shown to significantly influence the prevalence of anaemia in pregnancy. According to Babah, et al., one of the underlying risk factors associated with prevalence of anaemia included low educational attainment. Moreover, socioeconomic status was mentioned as a factor influencing health and nutritional status, with women from lower socioeconomic backgrounds likely facing difficulties in accessing nutritious foods and healthcare services, thereby contributing to higher rates of anaemia. Cultural norms and behaviours also played a role, with dietary practices, such as the consumption of edible *kaolin* clay, being influenced by cultural norms [8]. These practices could either alleviate or worsen the risk of IDA among pregnant women. Okunade, et al. further reported the relationship between poverty and poor nutritional outcomes, reinforcing that low socio-economic status was a critical underlying factor influencing health during pregnancy in Lagos [41]. In Kano, Kuliya-Gwarzo, et al. pointed out that there was a general lack of understanding about anaemia and its prevention, which may be associated with low educational levels among the population [55]. The study also identified financial limitations as a barrier to accessing formal healthcare services, leading women to seek informal care instead.

Eze, et al. found that haemoglobin concentration was significantly influenced by age, occupation, educational and income levels [67]. The study concluded that haemoglobin concentration significantly increased with increase in educational and income levels. A negative correlation existed between respondents' parity and haemoglobin; and women with four to six previous pregnancies had the lowest haemoglobin concentration among the respondents in Enugu [67]. Ezenweke, et al. also highlighted that underlying risk factors played a significant role, with higher education and older age associated with higher hemoglobin levels, while low education and unemployment increased anemia risk. Socioeconomic factors such as living in rural areas and belonging to a lower wealth class were

associated with higher anemia risk. Geographical variations were observed, with the highest prevalence in the South Eastern part of Nigeria, particularly in Imo state [45]. However, Oyewole, et al. presented a contrasting perspective on the relationship between knowledge and anaemia status in pregnant women [34]. Their study found no significant association between the respondents' knowledge of anaemia in pregnancy and their actual anaemic status in Lagos [34]. Their finding suggested that although more than 50% of the respondents were anaemic and had poor knowledge of anaemia in pregnancy, simply being aware of or knowledgeable about anaemia did not necessarily translate into improved health outcomes or prevention of the condition. However, Onyeneho et al reported that education and socio-economic status played crucial roles, with better knowledge and practices observed among those with post-secondary education, paid employment, and those living close to a health facility [58]. A similar study highlighted educational and informational gaps, with a significant relationship found between the respondents' age, parity, and knowledge [59].

A study using the NDHS identified low educational level as one of the underlying risk factors, as women with no formal education have higher anaemia rates (64.1%), and poverty, with the poorest wealth quintile experiencing a 65.8% prevalence. Cultural norms and behaviours also played a role, as indicated by the 59.9% prevalence among MUSLIM women. High fertility rates were another factor, with women having six or more children showing a 62.1% prevalence [36]. Using similar data, Ogbuabor, et al. identified low level of education, poverty (indicated by low wealth index and unemployment), and rural residence as factors that increase the likelihood of anaemia and severe anaemia among pregnant women. In the South-East region, the study linked rural residence, low education, and unemployment as factors associated with anaemia among pregnant women, while in the South-South region, unemployment is the mostly factor [56]. In Kano, low level of educational and poverty are significant underlying risk factors. Women with no formal education and those from lower socio-economic backgrounds have higher anaemia prevalence, reflecting broader issues of

limited health education and resources [48]. Elsewhere, educational attainment and occupational status were also found to be significantly associated with the prevalence of malaria parasitaemia and anaemia, respectively [11].

## CHAPTER FOUR

### DISCUSSION

The reviewed literature aimed to identify the to explore the determinants influencing the prevalence of anaemia in pregnancy in Nigeria.

#### 4.1 Direct Factors

Findings illustrates the complex nature of anaemia in pregnancy, with a strong focus on iron deficiency as a major contributor across different regions in Nigeria. Iron deficiency was repeatedly identified as a leading cause, supported by findings that indicate inadequate dietary iron intake and notably lower iron levels. Malaria and other parasitic infections also significantly influence anaemia. Similarly, while iron deficiency was reported as the main cause of anaemia in South Africa, other risk factors included HIV, malaria and other infections [68, 69]. Another study in Kenya also found that close to 20% of women who had anaemia was due to micronutrient deficiency [70]. In another study carried out in sub-Saharan countries of Burundi, the Democratic Republic of the Congo, Gambia, Ghana, Mali, Senegal and Togo, the anaemia prevalence in pregnant women with malaria infection only was 56.0%; HIV infection only, 62.5%; malaria- HIV coinfection, 60.0% [71]. Sartorius et al. also showed that HIV-positive pregnant women in South Africa, similar to other African regions, had a higher prevalence of anaemia linked to advanced disease and prolonged illness [72]. However, this risk was lower compared to Nigeria and Kenya because malaria is not endemic in South Africa. Globally, there is an increase in the prevalence of anaemia in HIV-positive pregnant women and those with AIDS, possibly due to increased blood loss from concomitant neoplasia or gastrointestinal lesions, or due to decreased red blood cell production, destruction or inefficient production [68].

Nigeria has the highest burden of tuberculosis (TB) burden infection in Africa; according to WHO, the disease kills about 268 people in the country every day [73]. The association of anaemia in patients with TB has been established in literature [74]. However, no reviewed identified TB as a direct cause of anaemia in pregnancy. This gap in knowledge is significant, particularly because Nigeria is an LMIC and lower socio-economic status is linked to a higher risk of TB, as evidenced in similar environments [75]. Similarly other diseases such as high hypertensive disorders, which have been shown to associated with anaemia [76], were not highlighted in the articles.

The review also highlighted challenges in iron supplementation, a key strategy for preventing and treating anaemia. Issues with knowledge about proper supplementation and compliance due to side effects indicate that medical interventions alone may be insufficient. These findings underline the importance of addressing both nutritional deficiencies and infectious diseases in managing anaemia in pregnant women.

#### **4.2 Intermediate Risk Factors**

Dietary factors played a significant role in the prevalence of anaemia. Studies consistently identified poor dietary quality and low dietary diversity as risk factors. Consumption of specific foods, such as green leafy vegetables, was associated with reduced odds of anaemia, while others like soybeans and edible *kaolin* clay correlated with increased risk. Food insecurity, often linked to socioeconomic status, emerged as a significant contributor to anaemia risk. A study in Ghana found that pregnant woman who had a varied diet had better haemoglobin levels, which is an indicator of improved nutritional status and lower risk of anaemia. Specifically, women who included meat, fish, and dark leafy vegetables in their diet tended to have higher dietary diversity scores, suggesting these foods contribute to a more balanced and nutritious diet [77]. Similar study in Tanzania found that inadequate dietary diversity coupled with inadequate daily meal intake and consumption of tea or coffee were the dietary habits predicting anaemia in pregnant women [78]. According to a meta-analysis on the

relationship between inadequate dietary diversity during pregnancy and the risk of maternal anaemia in Africa, pregnant women who did not consume adequate dietary diversity had twice the odds of developing maternal anaemia and giving a low birth weight compared to their counterparts. Women who achieve minimum dietary diversity were expected to have a higher likelihood of meeting their micronutrient intake recommendations [79].

Access to healthcare services, particularly antenatal care, was another crucial factor identified in the reviewed literature. Late booking for antenatal care, inadequate screening protocols, and poor compliance with preventive treatments (such as for malaria) were associated with higher anaemia prevalence. Women who use antenatal care services complied more than those who did not use antenatal care services [16]. This is not surprising since using antenatal care services exposes women to a lot of benefits including health education. Health education was demonstrated to be valuable as pregnant women who attend antenatal care were enlightened on the need for routine iron therapy, good nutrition, dispel misconceptions and harmful practices [80]. A study in South Africa identified late booking, and inadequate child spacing because of lack of family planning as intermediate risk factors [69]. Similar study in Ethiopia found implantable family planning method, no previous use of family planning, and household food insecurity as risk factors of anaemia in pregnancy [81]. These findings highlight the importance and need for improved antenatal care services, which includes screening and management of anaemia, suggesting that inadequate access to healthcare can worsen health issues during pregnancy

Although the conceptual framework highlighted inadequate access to water, sanitation, and hygiene as one of the intermediate risk factors, this literature review identified only one study that highlighted unsafe drinking water as a determinant of anaemia. However, the WHO/UNICEF Joint Monitoring Programme reported that in 2022, only 29%, 32% and 31% of the Nigeria's total population had access to safely managed drinking water, safely managed sanitation and basic hygiene, respectively [82]. The implication of this is significant, especially



considering the potential indirect impact of inadequate WASH on anaemia. Poor access to clean water and sanitation can lead to a higher incidence of waterborne diseases and infections, which can contribute to nutritional deficiencies and chronic health conditions, thereby increasing the risk of anaemia.

### **4.3 Underlying Risk Factors**

Several key themes emerged on the underlying risk factors contributing to anaemia in pregnancy across various regions of Nigeria from the literature. Level of education consistently appeared as a significant determinant of anaemia. Multiple studies reported an inverse relationship between education level and anaemia risk, with pregnant women having no formal education or lower educational levels at higher risk. This association likely reflects the impact of education on health literacy, economic opportunities, and healthcare-seeking behaviours. Poverty, often measured through wealth indices or occupational status, was also strongly associated with increased anaemia risk. Women from lower socioeconomic backgrounds face challenges in accessing nutritious foods and healthcare services, contributing to higher anaemia rates. This finding is consistent with findings from South Africa [83], Uganda [84] and Ghana [85].

The rural-urban divide was also evident, with rural residence often linked to higher anaemia prevalence. This is in line with other literature that found that prevalence of anaemia was higher among pregnant women in Uganda who were rural dwellers [84]. Dietary practices influenced by cultural norms, such as the consumption of certain clay types, could impact iron status. Religion was also highlighted in some studies [36, 61]. This is because some religions have dietary laws that may limit the consumption of certain iron-rich foods, potentially contributing to anaemia; also, religious beliefs may influence healthcare-seeking behaviour, such as the preference for traditional healers over modern medical practices, which can affect the management and prevention of anaemia, though the underlying mechanisms require further exploration. Age and parity are identified as important factors. This is in line with a study

in Ghana that found that cultural and religious beliefs in food restrictions existed and fairly a significant number of women were denied potential dietary nutrients [86].

Some studies reported a positive correlation between age and haemoglobin levels, while others noted increased anaemia risks with higher parity. These findings suggest that reproductive history and maternal age are important considerations in anaemia risk assessment.

Some of the important underlying factors such as health policies and conflict were missing in the reviewed articles but could potentially affect anaemia. Nigeria has been faced with terrorism and insurgency, notably from groups like Boko Haram in the northeastern part of the country. This insurgency has resulted in a devastating humanitarian crisis. A conservative estimate suggests over 20,375 fatalities, with approximately 30,000 individuals wounded [87]. The impact of terrorism and insurgency on health outcomes, including anaemia, cannot be overlooked. The humanitarian crisis caused by the insurgencies has led to widespread displacement, and disruption of healthcare services, all of which can contribute to poor health outcomes. Future research could, therefore, investigate the influence of conflict and government policies on anaemia among pregnant women.

#### **4.4 Strengths and Weaknesses**

This study provided an overview of the determinants of anaemia among pregnant women in Nigeria. The study utilised the WHO's framework of anaemia aetiology which covers a broad spectrum of determinants, ensuring that most of the potential factors contributing to anaemia in pregnancy are considered. This study does not only highlight these determinants but also identified some key determinants not highlighted in the reviewed literature such as tuberculosis, hypertensive disorders, WASH-related factors as well as conflict.

Although the conceptual framework used in this study greatly aided in achieving the objectives of this study, it is less suitable for capturing individual behavioural determinants

such as knowledge, intentions and attitudes of pregnant women towards the prevention of anaemia. Also, other psychosocial factors such as stress, depression, and other mental health issues which can affect nutritional status and health-seeking behaviours of pregnant and thereby, potentially contributing to anaemia in pregnancy, are not captured in the framework. A framework used in [88] highlighted access to knowledge and education about anaemia as a determinant, and therefore, maybe incorporated in further studies. Also, future research could use behavioural theories such as the theory of planned behaviour [89] to better understand behavioural determinants.

This study is not without limitations. Firstly, the initial search in the Scopus database may have excluded relevant studies not indexed in Scopus, leading to potential selection bias. To cover more articles, future research should include other databases such as PubMed, Web of Science. Secondly, the final selection of articles did not adequately represent all geo-political regions of Nigeria. Some regions were overrepresented, while were underrepresented, leading to an imbalance in the geographical distribution of the data. For instance, there was no study from the Northeastern part of the country. Further research on the determinants of anaemia in pregnancy in the north-eastern region of the country is recommended as there exists paucity of maternal anaemia-related research in that region. Additionally, most studies were cross-sectional in nature, only two qualitative studies were included. Therefore, more qualitative and mixed-methods research to complement the predominantly cross-sectional studies is recommended, as this would further to gain more in-depth insights. Despite these limitations, this thesis provides a valuable overview of the current state of knowledge on the determinants of anaemia in pregnancy in Nigeria.

## CHAPTER FIVE

### CONCLUSION AND RECOMMENDATIONS

#### 5.1 Conclusion

This thesis aimed to explore the determinants of anaemia in pregnancy in Nigeria, synthesizing evidence from a comprehensive literature review. At the direct causes level, findings showed that iron deficiency was commonly found as determinant of anaemia in pregnancy in Nigeria. The literature consistently highlights the critical role of micronutrient deficiencies, particularly iron, in the high prevalence of anaemia among pregnant women. Other significant direct included parasitic infections such as malaria and hookworm, could which aggravate the condition through mechanisms like haemolysis and blood loss.

Form this study, it is evident that intermediate risk factors, such as poor dietary quality, food insecurity, and inadequate access to health and nutrition services significantly influenced anaemia prevalence. Underlying risk factors identified included low level of education, poverty, and cultural practices. Women from lower socio-economic backgrounds and rural areas face higher anaemia risks due to limited access to nutritious foods and healthcare services. Cultural norms and behaviours, such as the consumption of certain clays and dietary restrictions, also play a crucial role in shaping nutritional status and health outcomes.

Overall, this review has shed light on the factors leading to anaemia in pregnancy in Nigeria. By providing an overview of the direct causes, intermediate risk factors, and underlying determinants, it has uncovered notable regional differences and as well as gaps in understanding.

#### 5.2 Recommendations

Although anaemia in pregnancy remains prevalent, its risk factors are diverse. Iron deficiency is still widespread, but comorbidities such as malaria and HIV among pregnant women in

Nigeria also play a significant role and must be addressed. It is essential to evaluate pregnant women for anaemia causes beyond iron deficiency. Evidence suggests that infections and infestations may also contribute to anaemia. Therefore, basic parasite screening should be integrated into antenatal care at the primary health care level. This approach allows for targeted interventions, ensuring more effective outcomes rather than relying solely on widespread iron supplementation. To reduce the effects of the determinants of anaemia in pregnancy highlighted in this study, the following recommendations to government, policy makers and public health practitioners are proposed:

- i. Implement comprehensive nutrition education programmes and improve access to iron-rich foods and supplements, particularly for low-income and rural populations. This could include prioritizing practical, culturally relevant education on food preparation and dietary diversification to enhance iron absorption and providing cooking demonstrations using locally available iron-rich ingredients as highlighted in [90].
- ii. Improve access to and quality of antenatal care services, including early booking, routine screening for anaemia, and effective management of infections. This could involve training community health workers to conduct home visits for pregnant women, setting up mobile antenatal clinics for remote areas, and implementing a standardized protocol for anaemia screening and management across all healthcare facilities [6, 91].
- iii. Develop policies and programmes that target poverty reduction, improve female education, and promote women's empowerment to address underlying risk factors. This might include creating adult education programs with flexible schedules for mothers, and implementing workplace policies that support pregnant women and new mothers.
- iv. Implement targeted health education campaigns to increase awareness about anaemia prevention, proper nutrition during pregnancy, and the importance of

antenatal care. This could be achieved by considering using multiple communication channels such as radio shows, social media campaigns, and community theatre performances. Also, local influencers and religious leaders could be engaged to help disseminate information and challenge misconceptions, as the role of religious leaders has been well established in this aspect [92].

- v. Integrate family planning services with maternal health care to address issues of high parity and inadequate pregnancy spacing. Also, women should be educated through culturally appropriate interventions on harmful traditional practices that may lead to the likelihood of anaemia. This could involve training healthcare providers in culturally sensitive communication, developing educational materials in local languages, and organizing women's support groups led by respected community members to discuss and address harmful practices as reported in [93, 94].

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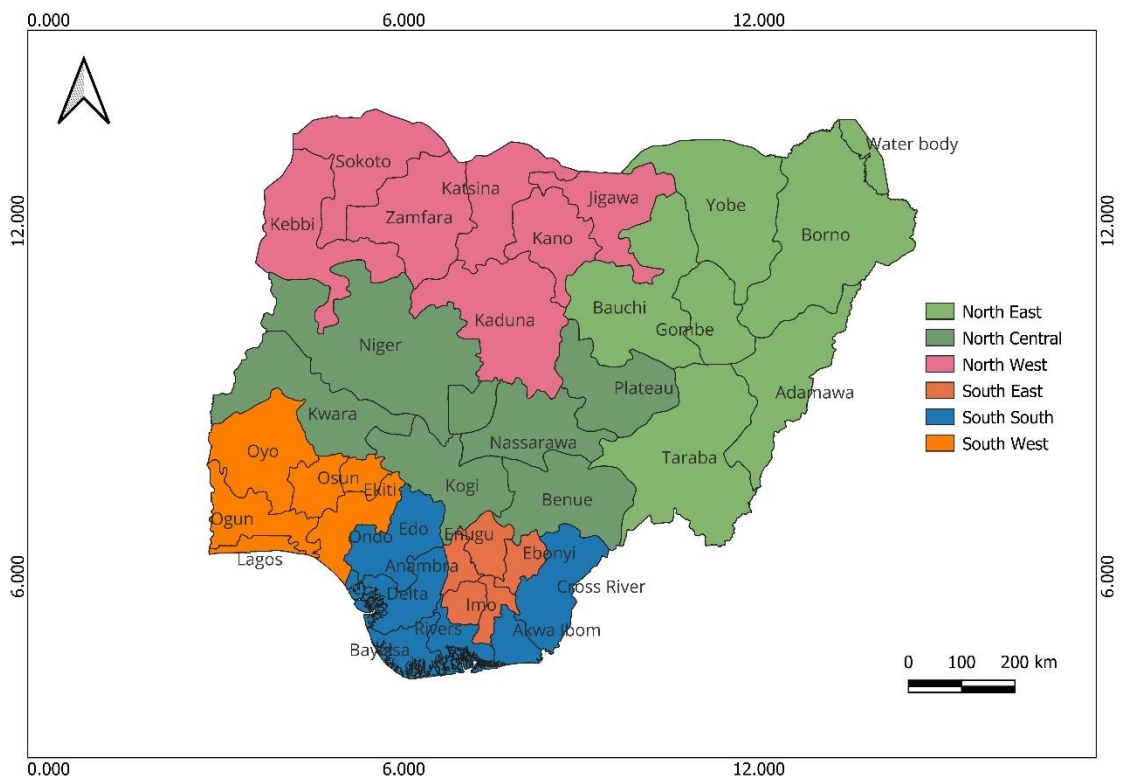
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## Appendix A: Background on Nigeria

### Country Profile

Nigeria is located in West Africa and shares borders with Benin, Chad, Cameroon, and Niger. It is the most populous country in Africa with approximately 180 million people. The country's population is experiencing a swift growth, and by 2050 it is projected to account for 4.2% of the world population, becoming the most populous country after China and India [95]. The country has a diverse geography ranging from savannahs in the north to tropical rainforests in the south. Politically, it is segmented into six geopolitical regions, namely the North-East, North-West, North-Central, South-West, South-East and South-South. Key geographic features include the Niger River and River Benue which flows through the country, and the Jos Plateau in the central region.



**Figure A1:** Map of Nigeria showing the 36 states and the geopolitical zones

Nigeria has a varied climate with the north experiencing a dry, arid climate and the south having a more humid tropical climate. The country experiences two main seasons: the dry season (November to March) and the rainy season (April to October) [96]. Temperatures typically range from 25°C to 40°C (77°F to 104°F), depending on the region and time of year [97].

Nigeria is experiencing rapid urbanization, with a significant portion of the population migrating from rural to urban areas in search of better opportunities. Urbanization in Nigeria is driven by factors such as population growth, rural-urban migration, economic opportunities, infrastructure development, and government policies. However, this rapid urbanization poses challenges including infrastructure deficits, growth of informal settlements, poverty and inequality, environmental degradation, and governance issues [98]. Major cities include Lagos, the commercial capital, Abuja, the political capital, and Kano, the largest city in the north. Lagos is one of the fastest-growing cities in the world and faces challenges such as congestion and inadequate infrastructure.

Nigeria is incredibly diverse, with over 250 ethnic groups, each with its own languages and cultural practices. The largest ethnic groups include the Hausa, Yoruba, and Igbo. English is the official language, but Hausa, Yoruba, and Igbo are also widely spoken. Islam and Christianity are the dominant religions, with a significant population practicing traditional African religions [99]. Nigeria has the one of the largest economies in Africa, driven primarily by oil exports. However, the economy is also diverse with sectors such as agriculture, telecommunications, and banking playing significant roles [100]. Despite this, the rising insecurity in Nigeria impacts key economic indicators by increasing unemployment, altering government spending priorities towards security, and deterring foreign direct investment. This leads to job losses, resource reallocation, and reduced investment inflows, hindering economic growth and stability [101].

## **Health Sector Overview**

Nigeria's healthcare system is structured into three tiers: primary, secondary, and tertiary healthcare facilities [102]. The primary healthcare (PHCs) systems are the first point of contact for individuals within the healthcare system and include health centres and clinics. PHCs are designed to provide basic health services, including maternal and child health, immunization, and treatment of common diseases [103]. Social healthcare facilities include general hospitals and are intended to provide specialized services such as surgeries, paediatrics, and general medical consultations [104]. Tertiary healthcare includes teaching hospitals and specialist hospitals that provide advanced medical care and are often affiliated with universities [105]. They offer specialized treatments and conduct medical research. While these institutions tend to have better facilities and more specialized personnel, they are often plagued by issues such as underfunding, outdated equipment, and brain drain [21]. Some of the key issues highlighted in literature include:

### ***Infrastructure Challenges***

The infrastructure of the Nigerian health system is a significant area of concern, with various issues such as the presence of dilapidated medical equipment, a lack of ambulances, and inaccessibility to essential services [21]. These challenges not only impact the quality of care provided but also contribute to a sense of mistrust among both professionals and non-professionals in the system. The inadequacy of health facilities and equipment can lead to compromised patient outcomes, further worsening the existing challenges within the health sector.

### ***Educational System and Workforce Morale***

The educational system in Nigeria plays a crucial role in shaping the quality of healthcare delivery. Many studies noted a jeopardized educational system that results in low morale among health workers due to poor remuneration and a perceived lack of professionalism [103,



106]. This lack of motivation and support can have detrimental effects on the overall functioning of the health system, affecting patient care and outcomes. Ogundeji et al. asserted that addressing issues within the educational system and improving the working conditions of health workers are essential steps towards building a more reliable and trustworthy health system in Nigeria [106].

### ***Misdiagnosis and Laboratory Interpretation***

The misinterpretation of laboratory investigation results leading to misdiagnosis emerged as a significant concern among participants. This issue not only affects individual patient care but also contributes to a broader sense of mistrust in the accuracy and reliability of healthcare services [22]. Improving the training and capacity-building of healthcare professionals, particularly in diagnostic accuracy, is crucial for enhancing trust in the Nigerian health system and ensuring better health outcomes for the population.

### ***Healthcare Financing Challenges***

Inadequate healthcare financing poses a considerable challenge to the Nigerian health system, leading to high out-of-pocket expenses for patients and hindering access to essential services. Arhin et al. emphasized the need for proper funding to implement universal health services and called for increased budgetary allocation to the health sector [107]. Improving healthcare financing mechanisms could help alleviate financial burdens on individuals and enhance the overall effectiveness of the health system [20].

### ***Inequality in Access to Health Services***

Disparities in access to health services between rural and urban areas, as well as across different Nigerian states, present a significant challenge to the health system [22, 108]. The unequal distribution of healthcare resources and services overwhelm existing health inequities and contribute to a sense of mistrust among the population. Ogueji, et al. asserted that addressing these disparities through targeted interventions, such as improving infrastructure

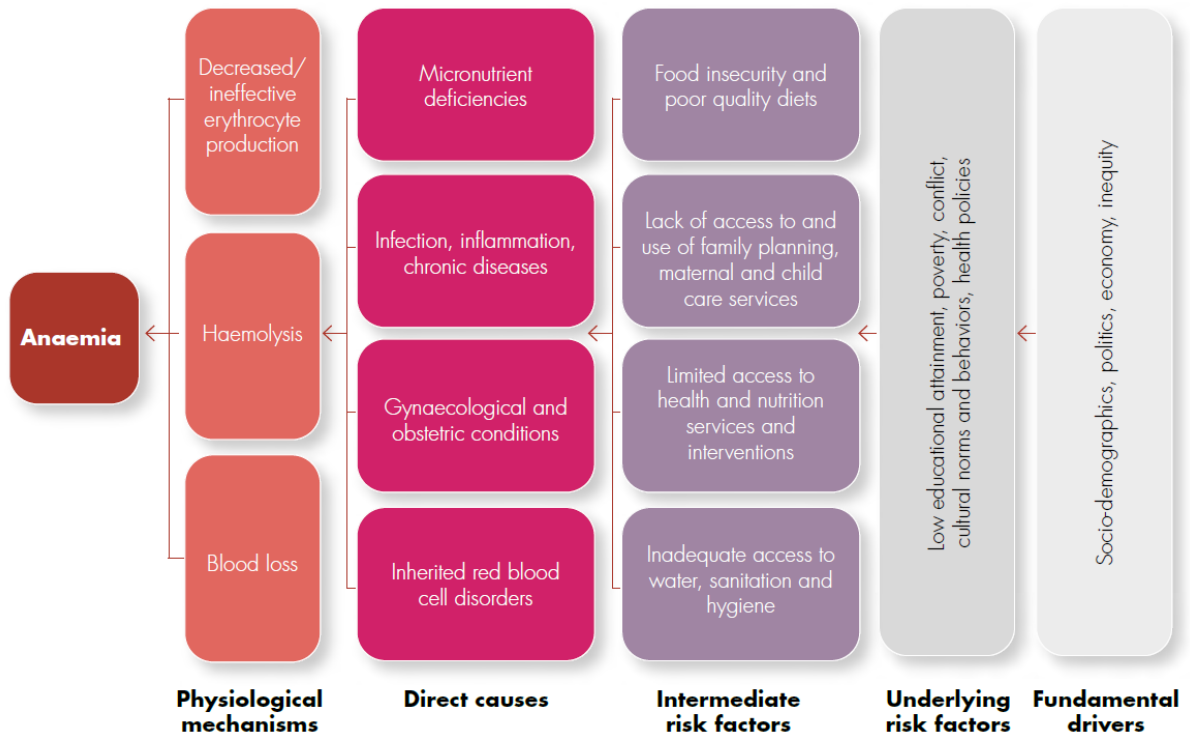
in underserved areas and implementing policies to promote equitable access to healthcare, is essential for building a more inclusive and trustworthy health system in Nigeria [22].

### ***Corruption and Accountability Issues***

Issues of corruption and poor accountability within the Nigerian health system further undermine trust among both professionals and patients. The mismanagement of resources, lack of transparency, and unethical practices erode confidence in the system and deter individuals from seeking healthcare services [22].

Pregnant women in Nigeria often struggle to access quality healthcare services due to various systemic issues within the healthcare system [23]. This lack of access often leads to inadequate prenatal care, increased risks during childbirth, and higher maternal mortality rates. Initiatives such as free health care programmes for pregnant women and children under five in certain areas are facing challenges due to funding constraints [23]. This can impact the availability of essential maternal healthcare services and contribute to disparities in access to care. Efforts have been made by Nigeria and its development partners to address these health challenges. Policies have been enacted to enhance access to quality healthcare, such as the passage of the National Health Bill, which aims to strengthen primary healthcare systems, improve monitoring and evaluation, and move towards universal health coverage [20].

## Appendix B: Conceptual Framework



**Figure B1:** Conceptual framework of anaemia aetiology [15]

## Appendix C: Results

**Table C1:** Profile and characteristics of articles assessed

State/Region	Sample Size/population)	Study Design	Determinants of Anaemia			Ref.
			Direct Causes	Intermediate	Underlying	
Kano and Lagos	140	Qualitative (focus group and informant interviews)	ID, malaria	-	-	[25]
Nsukka, Enugu	386	Cross sectional study	-	-	Level of education, Occupation, income level	[67]
Ibadan	300	Cross sectional study	-	Poor quality diet, Inadequate antenatal services	Educational attainment	[65]
Kano	10 key informant interviews, 28 in-depth interviews	Qualitative/Focus group discussions, in-depth interviews	-	Limited access to antenatal care services	Low educational level, poverty	[55]

Lagos and Kano	872	Cross sectional study	ID, malaria	Food insecurity, poor quality diet	Low educational attainment, cultural norms	[8]
Lagos	1216	Secondary data analysis	ID	Food insecurity, poor quality diet	Poverty	[41]
Ibeju-Lekki, Lagos	295	Cross sectional study	-	Lack of dietary diversity	Low educational level	[34]
Nigeria	1522	Secondary data analysis	ID, hookworm infection, malaria	-	-	[12]
Kaduna	180	Cross sectional study	Parasitic infections, co-infections	-	-	[46]
Nigeria		Secondary data analysis	Sexually transmitted infections	Unsafe water, breastfeeding	Low level of education, Employment status	[45]
Benue	299	Cross sectional descriptive study	-	-	Lack of dietary diversity, supplement intake	[54]

Nigeria	14454	Secondary data analysis	-	Poor quality diet, food insecurity, limited access to health and nutrition services	Level of education	[36]
Ado-Ekiti, Ekiti	378	Cross sectional descriptive study	ID	-	-	[42]
Akwa Ibom	180	Cross sectional study	ID	-	-	[43]
Nigeria		Cross sectional study from secondary data	-	Poor quality diet, inadequate access to health services	Level of education, poverty	[56]
Ifako-Ijaiye, Lagos	432	Cross sectional study	Micronutrient deficiency	Poor quality diet	-	[47]
Southwest Nigeria	517	Cross sectional study	Malaria, HIV	Lack of adequate and timely antenatal care	-	[49]

Lagos	220	Cross sectional study	Micronutrient deficiency	-	-	[10]
Warri, Delta	218	Cross sectional study	Malaria, HIV	Inadequate access to maternal and childcare services	-	[50]
Enugu	95	Cross sectional study	Micronutrient deficiency, inherited red blood cell disorders	-	-	[57]
Ekiti	232	Cross sectional study	-	Lack of adequate antenatal care services	Unemployment	[61]
Niger Delta	8751	Cross sectional study from secondary data	Inherited red blood cells	-	-	[52]
Southeastern Nigeria	1500	Cross sectional study	-	-	Level of education, employment status	[58]

Akinyele, Ibadan	200	Descriptive cross-sectional design	-	Unavailability of supplement, inadequate antenatal services	Level of education, employment status	[59]
South-South	3443	Retrospective cross-sectional study	-	Inadequate access to maternal and childcare services	-	[60]
Nkanu West, Enugu	300	Cross sectional study	-	-	Low level of education, occupation, employment status	[11]
Enugu	420	Cross sectional study	ID	Lack of quality antenatal care services	Poverty	[53]
Enugu	1306	Cross sectional study	HIV, inherited red blood cell disorders	Lack of quality antenatal care services	Poverty	[51]



Ifako-Ijaiye, Lagos	220	Cross sectional descriptive study	-	Lack of family planning	-	[66]
Ebonyi	307	Cross sectional study	ID			[44]
Oyo	350	Cross sectional study	-	Limited access to services, poor quality diet	Unemployment	[62]
Rivers	227	Cross sectional study	-	Limited access to antenatal services, poor quality diet	Low level of education, poverty	[63]
Kano	300	Cross sectional study	-	-	Poverty, educational attainment	[48]
Ibadan	2702	Cross sectional study	-	Poor quality diet, Inadequate access to maternal services	-	[64]

ID- iron deficiency