

CAUSES OF ANEMIA IN PREGNANT WOMEN – A SYSTEMATIC REVIEW OF EVIDENCE FROM DEVELOPING COUNTRIES

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ABSTRACT

Anemia during pregnancy is a well known public health challenge facing the world. The burden of anemia in pregnant women is significantly higher in developing countries. To date, epidemiological studies have been conducted to find the causes of anemia among women who are pregnant and its associated factors mainly in African and Asian countries. However, findings from the existing literature are not synthesized in a systematic way to help policy makers make evidence-based decisions. Given the high burden of anemia in Asian and African countries and an enormous amount of literature on the prevalence and determinants of anemia, there is a need to undertake a systematic review on prevalence and causes of anemia among pregnant women in developing countries of Asia and Africa. Hence, the objective of this study is to conduct a systematic review that identifies the main causes of anemia among pregnant women in developing countries of Asia and Africa. This synthesis of literature will help to understand the causes of anemia to design targeted and context-based interventions for marginalized pregnant women. In addition, this systematic review will also assist policymakers, stakeholders and managers to make informed and evidence-based decisions mainly in developing nations.

Keywords: - *Anemia, Developing Countries, Pregnant Women*

1.0 INTRODUCTION

Anemia during pregnancy has proved to be a severe global health problem in the world. Despite the fact that anemia affects the whole world, its prevalence is highest in developing countries. More so it should be noted that both males and females of all ages are affected, however; the most vulnerable groups are pregnant women and young children. Around the world, more than 50% of pregnant women and over 30% of all women suffer from anemia. According to Naila

Baig-Ansar et al. (2008), anemia affects almost 66% of pregnant women in developing countries, it is likewise connected with adverse pre-birth and maternal outcomes. The upsetting consequences of anemia in women range from increased fatigue, decreased cognitive ability, diminished work productivity and subsequent economic costs of increased morbidity and mortality and low birth weight. According to the World Health Organization (WHO), anemia is also the second leading cause of disability. Carolyn MacDonald (2002), believes that, women with severe anemia in pregnancy have a 3.5 times greater chance of dying from obstetric complications compared with non-anemic pregnant women. Iron deficiency is the most predominant nutritional deficiency and the chief cause of anemia worldwide. The World Health Organization (WHO) in 2011 estimated that iron deficiency is responsible for approximately 50% of all anemia cases. Other noteworthy causes which may vary by geographic location, include deficiencies of other nutrients, malaria, helminth (worm) infections, and a variety of other diseases. Effective management of anemia in high prevalence contexts requires an investigation of the main contributors and continued implementation of an integrated package of interventions to address all major causes.

1.1 Overview

Mayet (1985) alluded to the fact that anemia implies a reduction in the oxygen-carrying capacity of the blood as a result of fewer circulating erythrocytes than normal or rather a decrease in the concentration of haemoglobin (Hb). He went on further to explain that the deficiency occurs through the reduced production or an amplified loss of red blood cells. The World Health Organisation (WHO) defines anemia as a hemoglobin value below 13 g/d, for non-pregnant women over 15 years it will be below 12 g/dl, and below 11 g/dl in pregnant women. In 2011, WHO went on to redefine anemia and termed it as a condition in which the number of red blood cells or their oxygen carrying capacity is insufficient to meet physiologic wants. This is seen to vary with ones' age, sex and pregnancy status. Pregnant women are seen to be the most vulnerable group, this is so due to the additional demands that are made on maternal stores during this period, various latent deficiencies tend to manifest themselves as anemia (Mayet, 1985). In 2011, a WHO report showed that anemia affects more than half a billion reproductive age women globally. From the figure, 38% of the anemic women were pregnant. More so, anemia is the most common complication related to pregnancy, known to affect nearly half of pregnant women globally, Praxis (1999). World Health Organization (2011) and Ouedraogo (2013) all agreed that this daunting health challenge is more common in developing countries i.e Africa (57%) and South East Asia (43%), where there unbalanced diets and poor intake of prenatal vitamins, iron and folic acid. Letsky (2000) noted that anemia prevalence rates were reported to be around 35-75%. The fact that anemia prevalence in many areas persists at moderate to severe levels conferring to internationally accepted standards primarily reflects the difficulty of meeting the dietary iron needs of women. However, there are numerous other causes of anemia, which vary in their significance by geographic region. Most often, anaemia co-exists with an underlying ailment and infrequently occurs on its own. The commonest causes of anaemia in developing countries, particularly among pregnant women are nutritional disorders thus iron deficiency and infections. Understanding the main causes of anemia is a critical component of any effort that aims to reduce the global burden of anemia in women.

1.2 Relevance & Timeliness of the Study

It is sad to note that even after the country specific studies that have been done on anemia in pregnant women over the past two decades, there hasn't been much change in terms of managing to eradicate anemia in pregnant women. This is evident, especially, in developing countries. Correspondingly there hasn't been much policy prescriptions devised that help governments to combat this ailment so far. It is the aim of this study to systematically review literature that has been shared to the research fraternity and device ways in which anemia may be unanimously combated. Furthermore, the burden of anemia in pregnant is vividly higher in developing countries, this is why studies have been done to determine the causes, prevalence and magnitude of anemia during pregnancy and its associated influences mainly in Africa and Asia. Nevertheless, findings from the present literature are not produced in a systematic way to make evidence-based decisions. Given the high burden of anemia in Asian and African countries and an enormous amount of literature on the prevalence of anemia, there is a need to undertake a systematic review on the causes or determinants of anemia among pregnant women in developing countries of Asia and Africa.

1.3 Objectives

- i. To conduct a systematic review on the causes of anemia among pregnant women in developing countries of Asia and Africa.
- ii. To have an amalgamation of literature that will help understand the causes of anemia and help design targeted and context-based interventions primarily for pregnant women.

2.0 METHODOLOGICAL APPROACH

To conduct this systematic review results from published studies were used to determine the prevalence of anemia, types and its causes among pregnant women in developing countries. The major databases of PubMed, Google Scholar and African Journals Online were reviewed for all published studies relevant to anemia during pregnancy and its causes. All studies that were published from 2000 up to April 09/2020 were retrieved to be assessed for eligibility of inclusion in this review. Also, to note is that we reviewed literature using key words of the thrust of the paper hence, search terms such as prevalence, burden, causes, treatment and prevention of anaemia in developing countries were used. In addition, the reference lists included per study were also searched, retrieved and assessed for inclusion eligibility. The key words that were used for searching were: "anemia OR anemia during pregnancy OR causes of anemia AND developing countries".

2.1 Studies Selected for Review

Table 1: Studies selected for review

| Author(s) | Year | Country | Period | Title of study | Nature of Data |
|--|------|----------|-----------|---|----------------|
| Nynke R van den Broek and Elizabeth A Letsky | 2000 | Malawi | 1990-2000 | Etiology of anemia in pregnancy in south Malawi | OLS |
| Naila Baig-Ansari et al | 2008 | Pakistan | 2003-2005 | Anemia prevalence and | Cross- |

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|---|------|------------------|-----------|---|--|
| | | | | risk factors in pregnant women in an urban area of Pakistan | sectional |
| Adam et al | 2018 | Sudan | 2005-2018 | Prevalence, types and determinants of anemia among pregnant women in Sudan | Systematic review |
| Ejeta et al | 2014 | Western Ethiopia | 2014 | Prevalence of Anaemia in Pregnant Women and Associated Risk Factors in Western Ethiopia | Cross sectional |
| M. Ag Ayoya et al | 2002 | Mali | 2002 | Determinants of anemia among pregnant women in Mali | Cross-sectional |
| Martin N Adokiya | 2019 | Ghana | 2017 | Determinants of anemia among pregnant women in northern Ghana | Cross-sectional |
| Kayode O. Osunghade and Adeolu O. Oladunjoye | 2010 | Nigeria | 2000-2010 | Anaemia in Developing Countries: Burden and Prospects of Prevention and Control | Cross-sectional |
| Shoboo Rahmati1 et al | 2016 | Iran | 1990-2016 | Maternal Anemia and Pregnancy outcomes | Systematic review |
| Ranjana Singh et al | 2015 | India | 2015 | Correlates of anemia in pregnant women | Cross-sectional, Multiple logistic regression |
| M Hoque, E Hoque & SB Kader | 2014 | South Africa | 2002-2014 | Risk factors for anaemia in pregnancy in rural KwaZulu-Natal, South Africa | Cross-sectional, Multiple logistic regression. |

Table 2: Summary of the Main Causes of Anemia in Developing Countries

| Author(s) | Year | Major Findings | Secondary Findings |
|---|-------------|---|---|
| Nynke R van den Broek and Elizabeth A Letsky | 2000 | --Iron deficiency was significantly associated with anemia --Inflammation was likely to contribute to anemia in pregnancy. --Lack of iron supplements in pregnant women led to anemia | -The roles of deficiency of vitamins A and B-12 in causing anemia require further clarification |
| Naila Baig-Ansari et al | 2008 | -iron deficiency was a prime cause of anemia in pregnant women | -socioeconomic factors like poverty and unemployment among pregnant women were |

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|---|------|---|---|
| | | -Nutritional status before as well as during pregnancy was associated with anemia | seen to cause anemia |
| Adam et al | 2018 | -Malaria infection was highly associated with anemia in pregnant women -Pregnant women in rural Sudan had high iron deficiency rates and hence were anemic -Pregnant women had the anemia of inflammation. -Lack of micronutrients in pregnant women led to anemia | -age and parity of pregnant women had no association with anemia in pregnant women. |
| Ejeta et al | 2014 | -HIV infection was highly associated with anemia -Unbalanced diets were found to cause anemia in pregnant women. -Parasite infections i.e hookworm were significantly associated with anemia in pregnant women | -Socioeconomic factors like family income, family size and water source were associated with anemia in pregnant women. -Lower gestation levels in pregnant women were associated with anemia |
| M. Ag Ayoya et al | 2002 | -Infections and food constraints were the major causes of anemia in pregnant women | -Hemoglobinopathies have also been reported to be prevalent and associated with anemia in pregnant African women |
| Martin N Adokiya | 2019 | -Lack of deworming medication was associated with severe anemia in women. -Poor diet diversity led to severe anemia in women. | -Unemployment and lack of a stable income was seen to be associated with anemia in pregnant women. |
| Kayode O. Osungbade and Adeolu O. Oladunjoye | 2010 | -Nutrition disorders, parasitic diseases and infections were the commonest causes of anemia in women | |
| Shoboo Rahmati et al | 2016 | -Maternal anemia was seen to be associated with iron deficiency. | |
| Ranjana Singh et al | 2015 | -Significant association between anemia and parity was observed. -Lack of sufficient micronutrients during pregnancy was seen to be a cause of anemia | -Socio-demographic factors like maternal age, place of residence, and obstetrics factors were found to be associated with anemia. |
| M Hoque, E Hoque & SB Kader | 2014 | -Parasitic infections, HIV infection, and nutritional | |

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|--|--|--|--|
| | | deficiencies were significantly associated with anemia during pregnancy. | |
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3.0 DISCUSSION ON THE MAJOR CAUSES OF ANEMIA IN PREGANANT WOMEN FROM DEVELOPING COUNTRIES

The Etiology of Anemia

According to the World Health Organization, (2011) prevalence rates of anaemia are consistently higher in pregnant compared with nonpregnant women. Anaemia in pregnancy has been largely perpetuated by the increase in the demand for nutrients, especially iron. Other causes include the increased vulnerability to malaria as a result of compromised immunity in women and on too many pregnancies occurring too frequently and commencing at too young an age. Jackson DJ, et al (1991), advocated that the etiology of anaemia in pregnancy in developing countries is probably multifactorial, thus the causes include nutritional deficiencies of iron and folate, haemoglobinopathies and secondary effects of infection and parasitic infestation, especially malaria and hookworm.

One has to note that the different causes interact to form a multifaceted picture, for example hemolysis as a result of malaria may result in folate deficiency and associated further destruction of red blood cells. The contribution of each of these etiological factors has been seen to vary according to geography and season, R. J. Guidotti, (2000). To help with this, the Africa Regional Consultation on control of anemia proposed that studies to be undertaken in each region in a bid to provide baseline information to help in the design of prophylactic and therapeutic interventions, R. J. Guidotti, (2000). As highlighted earlier in this paper, there have been a few studies from developing countries which report a detailed examination of local etiological factors responsible for anemia and also for most developing countries published data is still not at our disposal. From our literature searching, it can be seen that most authors characterize anaemia in pregnancy to nutritional deficiency and infectious diseases

3.1 Nutritional Deficiencies

Most developing countries are characterized by a disparity as a result of low nutrient intake, poor absorption and increased nutrient loss or demand in all likelihood. Dietary deficiencies are often linked to cooking and dietary habits as well as to cost. Home-grown food taboos for pregnant women are many and are commonly adhered to during most pregnancies.

(a) Iron deficiency anaemia (IDA)

Iron deficiency is believed to happen even when the dietary intake is satisfactory. Whittaker PG, (1991) highlighted that even though iron absorption rises in response to iron deficiency and in the course of normal pregnancy absorption is often repressed by the tall phytate content of countless of the grain-based diets. According to the World Health Organisation (2005), the risk factors for IDA include a low intake of iron, poor absorption of iron from diets high in phytate or phenolic compounds and early period of life when iron requirements are likely high. Correspondingly they went further to say that, iron requirements are highest for pregnant women

- 1.9mg/1,000 kcal of dietary energy in the second trimester and 2.7 mg/1,000 kcal in the third trimester. Sources of dietary iron comprise of meat, fish and poultry. Other sources, nonetheless in less quantity, are cereals, dairy products, fruits and vegetables. About 40% of iron content of meat, fish and poultry is in the haem form, out of which about 25% is absorbed; Allen LH, (1997) whereas only about 2 - 5% of total iron is absorbed after consuming cereals and legumes. Therefore, these foods have a major influence on iron status, Allen LH, (1997) Unfortunately, intakes of these foods especially meat, fish and poultry are low among people of low socio-economic status in Africa, of these people include pregnant women. Letsky EA (1995) also found IDA maybe evaluated by assessment of bone marrow iron and that the most accurate method of assessing iron stores in pregnancy is still by examination of a stained bone marrow preparation.

(b) Folate deficiency

This type of nutritional deficiency may have consequences like dietary deficiency. Flemming AF et al, (1997) found out that the frequency of megaloblastosis in primigravidae was reduced by half after antimalarial prophylaxis was taken, and it was totally abolished if folate supplementation was added. In a study from India megaloblastic anaemia associated with malaria was more common than iron deficiency as identified on bone marrow aspirate. In pregnant women, the presence of iron deficiency folate deficiency is masked in the peripheral blood film. Brabin BJ, (1992), advocated that although red cell folate is commonly believed to be a more accurate marker of folate status than serum folate, red cell folate levels may be mistakenly elevated in the presence of reticulocytosis after haemolysis due to, for example; malaria. Marrow aspiration may then be a prerequisite for the certain diagnosis of folate deficiency, when vitamin B 12 deficiency has been omitted.

(c) Vitamin B 12 deficiency

Reports highlight that riboflavin deficiency is common in developing countries, this is so as intake of animal products is truncated. This is also true during seasons when there is less intake of vegetables, Jennifer F. Friedman (2007). Vitamin B12 is essential for the synthesis of red blood cells and its deficiencies have been associated with megaloblastic anemia in pregnant women,(World Health Organization 2011) Consequently, in developing countries, the masses are subjected to diets with little or no animal protein, together with malabsorption (related to parasitic infections of the small intestine), might result in Vitamin B12 deficiency. Vitamin B 12 provisions are commonly believed to be sufficient to meet the additional demands of pregnancy, Letsky EA (1995). Results of a study from Zimbabwe suggest that vitamin B12 deficiency may be far more common than previously reported (World Health Organization 2011). Both economic reasons and food taboos, have an effect on the diet of pregnant women in many developing countries no wonder the diets are practically vegetarian in nature, this leads to anemia caused by the lack of Vitamin B12.

(d) Vitamin A deficiency

Evidence proliferates that haemoglobin (Hb) concentration of persons with Vitamin A deficiency (VAD) increases by about 10 g/L when vitamin A supplements are provided, Fishman SM (2003) Studies also suggest that vitamin A can improve hematologic indicators and enhance the

efficacy of iron supplementation, Fishman SM (2003) Thus, it is suggestive that Vitamin A deficiency (VAD) can prompt to anaemia in pregnant women.

3.2 Infectious Diseases

(a) Malaria

In sub-Saharan Africa, it is estimated that between 200,000 and 500,000 pregnant women develop severe anemia as a result of malaria, (World Health Organisation 2011) *P. falciparum* malaria in pregnancy is the primary cause of up to 10,000 maternal anaemia related deaths in sub-Saharan Africa annually, Steketee RW et al, (2001) Malaria, especially by the protozoon *Plasmodium falciparum*, causes anaemia by rupturing red blood cells and suppressing production of red blood cells (Onyemaobi, 2011) However, this cannot be explained simply by the direct destruction of parasitized red blood cells at the time of release of merozoites. Menendez (2000) et al added that decreased red cell production results from marrow hypoplasia seen in acute infection and dyserythropoiesis. While Phillips RE et al (1992) had advocated that *Plasmodium falciparum* is the primary cause of severe malaria in regions of the world where malaria is endemic, especially sub-Sahara Africa.

(b) Parasitic infestation

Many tropical areas are associated with Hookworm infection with *Necator americanus* or *Ankylostoma*. Helminthes such as flukes, hookworm and whipworm are seen to be the root cause of chronic blood loss and subsequently iron loss in women of child bearing age, Latham MC, (1997). Development of iron deficiency anaemia as a result of hookworm infection depends on the content and bioavailability of iron in the diet, thus the size of the body's iron stores and the intensity and duration of the infection (Flemming, 1981). Although laboratory assessment of hookworm infection is relatively simple, prevalence rates for pregnant women are rarely published (Gujjoit, 2000)

(c) Human Immuno- deficiency Virus infection (HIV)

According to the (World Health Organization 2011), developing countries are the worst hit by the HIV pandemic, which accounts for 22.5 million people (68% of global total) in sub-Saharan Africa and 4.9 million people (15% of global total) in Asia living with HIV/AIDS in 2009. The United Nations in (2012) further reported that, 1.3 million Africans died of HIV and this constituted 72% of the global total. Anaemia is a frequent complication among HIV positive pregnant mothers and it has been associated with a rapid HIV disease progression and mortality, Johannesen et al (2008). The prime cause of anaemia in the setting of HIV is anaemia of inflammation; this is also known as anemia of chronic disease, which is characterized by decreased red blood cell making through a series of mechanisms facilitated. Studies by Areechokchai et al (2009), have also shown that antiviral agents like zidovudine (AZT) causes anaemia in pregnant women as early as four weeks of commencing therapy. Moyle et al 2009, added that the cause of anaemia in HIV-positive patients is, therefore, multi-factorial and includes infections, neoplasm, dietary deficiencies, blood loss, medications and antibodies to antiretroviral agents. In addition, Odunukwe et al (2005) found that bone marrow suppression, especially the erythroid lines, by the AIDS virus is also known to cause anaemia in affected

persons. Guddoiti (2000) however points out that anemia occurs particularly in later stages of HIV infection, others like Street AM (1993) reported that it may present the first opportunity to diagnose HIV infection.

4.0 RECOMMENDATIONS

- i. Literature gives strong evidence that RCT trials have proven the iron supplementation helps in reducing the incidence of anemia during pregnancy. However, it is our advice that more of the efficacy treatments ought to be done in developing countries to determine the conduct of intervention and they will also help to see whether pregnant women are compliant to the routine supplementation and dietary modifications.
- ii. In developing countries one can note that, daily diets are low of animal products. They comprise of a staple food high in unrefined carbohydrates, and legumes and vegetables accompany the staple. Thus, combinations provide a diet low of iron bioavailability that is also high in inhibitors and low in enhancers of iron uptake. In the analysis of iron uptake with pregnant women in rural Tanzania and Malawi, it was found that eating patterns largely consisted of grain and vegetable-based diets, which although were high in total iron content, was very low in absorbable iron due to the presence of phytates and polyphenols. So, in order to combat these causes brought about by nutritional deficiencies, iron supplementation, along with optimum diets are needed to prevent iron deficiency and anemia during pregnancy.
 - (a) Fortification is the process of adding vitamins and/or minerals to a staple food in order to improve its nutritional value. Fortification has the advantage being able to fortify a single food with multiple micronutrients, this helps address innumerable dietary deficits with one intervention. In addition, fortification provides the opportunity to reach an entire population with improved nutrition, without requiring any change in dietary habits thus even pregnant women will benefit. Another recommendation is to ensure that simple technologies to fortify foods at community level are developed, as in developing countries many households depend on subsistence farming and won't benefit from commercially fortified products.
 - (b) Dietary Diversification refers to interventions that promote an increase in the range and nutritional quality of foods consumed on a regular basis. The consumption of a limited variety of foods, can be seen as a contributor of nutritional deficiencies. Expanding dietary variety and quality through increased consumption of animal source foods has advantages of overall improvement in the nutritional status. Dietary diversification activities must be geared towards household consumption of the animals raised rather than income generation through livestock sales, this also applies for free range birds like ducks and chicken. Households must also ensure that these selected animals and birds must reproduce frequently enough to provide regular source of meat and it must be culturally acceptable and be able to thrive in the local environment. With the delivery of carefully planned nutrition education messages, inequitable distribution of food within households can be overcome, this is so as the common risk to the success of dietary diversification programs is affected by culture. In many cultures' meat is preferentially served to men, with women consuming very little of none of the meat.

- iii. Guyatt HL et al (2001) highlighted that, Malaria is a key cause of anemia in endemic areas, particularly in seasons of high transmission. In one estimate, it was suggested that 400,000 pregnant women in sub-Saharan Africa may develop severe anemia as a consequence of malaria infection in one year. To combat this cause Interventions such as intermittent prevention therapy, insecticide-treated bed nets and general environmental management is advice.
 - (a) Intermittent Preventive Therapy refers to the provision of two doses of an anti-malarial drug (sulphadoxine-pyrimethamine) to women during pregnancy, through antenatal care services. Treatment of malaria in pregnancy by this method has been shown to reduce the prevalence of both severe maternal anemia (Shulman, 1999; Rogerson,1999). However, although intermittent preventive therapy is part of the national health policy of many countries, coverage is often low as many women have limited access to pregnancy care services or tend not to seek care until late in pregnancy. So, it is the aim of this paper to advise policy makers to make these interventions viable to women as early as the first trimester so as to combat anemia earlier.
 - (b) Insecticide-Treated Bed Net use has proved to be a key intervention for the prevention of malaria infection and has demonstrated positive effects on the prevalence of malaria and anemia in pregnant women, Marchant t (2002). Distribution of nets to vulnerable groups is a major focus of the global strategy of the Roll Back Malaria Partnership (2005). It is the aim of this paper to advise policy makers and stakeholders to provide insecticide-treated nets to pregnant women, this service ought to be incorporated into routine antenatal services in many endemic countries.
 - (c) Another recommendation is to have Environmental Management agencies reduce the breeding grounds for mosquito larvae as well as have larvicides being part of a malaria prevention programs where breeding sites are well defined
- iv. Martin N Adokiya (2009) identified the hookworm infection as the strongest predictor of iron status in pregnant women in his study in Ghana. An increase in Anemia prevalence increased as intensity of hookworm infection increased. Advice is that women in areas of high hookworm infection prevalence receive one dose of an anthelmintic medication after the first trimester. Another recommendation is to ensure Improved Hygiene and Sanitation, this can be done by use of latrines, hand-washing, avoiding stagnant water and wearing shoes when walking outdoors all contribute to reduced risk of parasitic infection.
- v. Chronic infections like HIV, tuberculosis, diarrheal disease tend to cause iron deficiency and anemia in pregnant women. Chronic inflammation is also associated with anemia due to swelling of tissues, while tuberculosis, greatly increase metabolism, thus increasing the body's requirement for iron, and other nutrients and for overall caloric intake. Interventions to treat infectious diseases vary according to the condition. We recommend developing countries to aim to optimize the nutritional status of individuals suffering from chronic diseases, as well as improve immune function and recovery. Green leaf vegetables are largely advised to be eaten by pregnant women.

- vi. Most of the recommendations tried to combat direct causes of anemia, however; there are some underlying causes like food insecurity which prevent consumption nutritious foods, no knowledge of anemia and its causes and prevention, poor hygiene and sanitation and no access to health services. Thus, the global burden of anemia is borne more by developing countries who are usually resource constrained. Advice is to have effective interventions that can be implemented in resource-poor settings. Establishing comprehensive anemia control programs in high prevalence contexts is also advised.
- vii. Community-based administration of anemia are needed, interventions should be integrated within existing structures and services, and implemented in partnership with relevant government ministries, community leaders and other agencies and partners as appropriate to the context. Governments ought to take a step in improving the quality of services, that help in educating and improving the social status of women. The patient to healthcare provider ratio, must be enough to ensure marginalized women are reached. Also, through public health promotion, healthy behaviors must be promoted and encouragement to adhere to prescribed programs should be ensured to achieve the best results.
- viii. The provision of long-term preventive weekly iron supplements and dietary modifications so as to improve the hemoglobin level of pregnant women.

5.0 CONCLUSION

Anemia in pregnant women in developing countries is often primarily attributed to iron deficiency. The prevalence of iron deficiency may be easily misunderstood if inflammatory disease is not taken into account. From the reviewed papers we found that though iron deficiency can be seen to be associated expressively with anemia, it is not usually an isolated associated deficiency. The roles of deficiencies of vitamins A and B-12 require further clarification. Inflammation is clearly likely to contribute to anemia in pregnancy in developing countries but the exact causes and mechanisms by which this could occur require further clarification. The role of acute or chronic inflammation as a possible contributing factor to anemia in pregnancy has important implications for the clinical evaluation and treatment of women. The often-cited reluctance of pregnant women to take their antenatal iron supplements is unlikely to be the only explanation for the disappointing results of many supplementation trials. All too often anemia in pregnancy in developing countries is thought to be a relatively simple problem for which a simple solution must soon become available. Results of this study suggest that iron supplementation alone will not provide the optimal solution; underlying conditions like HIV and Malaria also need to be addressed to have interventions that yield results.

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