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# Risk Factors of Nutritional Anemia among Women Pregnancy in Rural Area: Literature Review

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**Abstract**— Anemia causes an enormous burden of disease worldwide. Globally, there were more than 1-2 billion case of Anemia in 2016. Iron deficiency anemia is one of top five causes of disability globally, the leading cause of disabilities live in income countries low and middle income (LMICs). The purpose of this study was to determine the anemia with associated factors in pregnant women. This is a literature review studies about risk factor of anemia. Search engines used in literature review are Medline, Embase, Web of Science, Cochrane Library, Pubmed. This study was focus conducted asses the relative contribution of iron deficiency to anemia in pregnant woman in rural area. This study revealed three key factors to be associated with anemia among pregnant women. Intervention including nutrition counseling and enrolling pregnant women with low nutritional status in nutritional program should be the core components of anemia control strategies, needed to address the high prevalence of anemia among women pregnancy in rural area.

**Keywords**— Risk Factors, Nutritional, Anemia, Pregnant women, rural area

## 1. Introduction

Anemia causes an enormous burden of disease worldwide. Globally, there were more than 1-2 billion cases of anemia in 2016. [2] anemia is one of the top five causes of disability years globally, the leading cause of years of living with disabilities in income countries low and middle income or better known as *low-income, middle-income countries* (LMICs), and are the main causes of years of living with disabilities among women in 35 countries [2]. Control of anemia is a global health priority: The World Health Organization (WHO) has set a target to reduce 50% prevalence of anemia in women by 2025 [3].

In 2016, 41 .7% of children (under 5 years), 40 .1% pregnant women, and 32. 5% of nonpregnant women suffer from anemia worldwide [4,5]. WHO estimates that 42% of cases of anemia in children and 50% in women can be corrected by iron supplementation, with variations between regions [6]. Studies meta-population analysis demonstrated the contribution of iron deficiency to anemia can be smaller than the WHO estimate: 25% of children and 37% in women[7]. Absence of a study population measuring iron biomarkers (excluding hemoglobin) and the complexity of their interpretation during inflammation, estimates of the prevalence of iron deficiency in LMICs are uncertain. A representative population study is possible: for example, the prevalence of iron deficiency in children aged 6 months to 5 years is estimated to be 20. 2% in Cameroon, 10. 6% in Colombia, 18. 4% in Laos, 26. 1% in Liberia, and 14. 8% in Mexico; in the same country, the adjusted prevalence of iron deficiency in nonpregnant premenopausal women was 13. 7%, 24. 1%, 24. 0%, 19. 9%, and 30. 4%, respectively in their respective countries. [8] In US, 11% of a boy aged 6 months to 5 years, 15% of premenopausal women and an estimated 18% of pregnant women have iron deficiency. [9] Deficiency of iron and anemia is more common in subpopulations belonging to the lower middle social class, including low-income earners, indigenous peoples, and refugees and migrants from LMIC [10]. In the Indonesian context, anemia occurred in 50. 5 % of women

were pregnant [11]. In Indonesia and Asia, the overall death rate from anemia is estimated to be 7.26 percent [12].

***Risk Factor Anemia in Pregnant Women***

Hypervolaemia are associated with pregnancy normal average increase blood volume of 40 to 45 percent in the upper levels of the blood of women do not get pregnant after the age of pregnancy 32 to 34 weeks. The percentage of this expansion varies greatly from individual to individua. In some women, the volume that accumulates only rose slightly, while in women the current volume of blood is almost two times as much. The presence of embryo is not essential for this increase in blood volume, because an increase in blood volume occurs in some pregnancies with hydatidiform moles [13]. Hypervolemia due to pregnancy has several functions. First, hypervolemia meets the metabolic needs of the enlarged uterus and vascular systems that undergo hypertrophy massive. Second, hypervolemia provides abundant nutrients and trace elements to support the rapid growth of the placenta and fetus. Third, intravascular volume increases will protect the mother, and in turn, the fetus, the effects of destructive interference in venous return in the supine and upright positions. Lastly, hypervolemia protects the mother from the detrimental effects of birth-related blood loss [13].

Maternal blood volume begins to increase during the first trimester. At 12 weeks of menstruation (menstrual weeks*)*, plasma volume increases about 15 percent compared to pre-pregnancy. Maternal blood volume grows most rapidly during the middle of the trimester, increases at a much slower rate during the third trimester, and reaches a steady point during the last few weeks of pregnancy. Blood volume increases more dramatically with multiple pregnancies. During blood volume expansion, plasma volume and erythrocyte count increase. Although more plasma than erythrocytes is usually added to the maternal circulation, the increase in erythrocyte volume is quite large and averages 450 mL. Erythroid hyperplasia is developing in the bone marrow, and the reticulocyte count increases slightly during normal pregnancy. These changes are almost certainly associated with an increase in maternal plasma erythropoietin levels [13].

Due to the intense plasma augmentation, the hemoglobin and hematocrit concentrations are slightly decreased during pregnancy. As a result, blood viscosity decreases. The average hemoglobin concentration is 12.5 g / dL, and in about 5 percent of women, the hemoglobin concentration ranges below 11 .0 g / dL. So, the hemoglobin concentration is below 11. 0 g / dL, especially in late pregnancy, is considered abnormal and is usually due to iron deficiency anemia rather than pregnancy hypervolemia. [13]

The red blood cell index changes slightly during pregnancy. However, there was a slight increase in *mean corpuscular volume* (MCV), from a mean of 4 fl in women with adequate iron levels, which reached a maximum at 30-35 weeks of gestation and did not indicate a vitamin B12 deficiency. and folate. The increased production of red blood cells to meet the needs of pregnancy, reasonably explains why there is an increase in MCV (due to a higher proportion of pink blood cells of a larger size). However, MCV did not change significantly during pregnancy and the hemoglobin concentration was <9. 5 g / dL associated with a mean corpuscular volume <84 may indicate concomitant iron deficiency or some other pathology. [14]

Post pregnancy, plasma volume decreases because of diuresis, and blood volume returns to pre-pregnancy values. As a result, hemoglobin, and hematocrit increase. Plasma volume increases again two to five days later, probably due to increased aldosterone secretion. After that, these levels will decline again. Significant increases have been documented between hemoglobin measurements taken at 6–8 weeks postpartum and those taken at 4–6 months postpartum, suggesting that it takes at least 4–6 months after pregnancy, to restore the physiological decline in hemoglobin to pre-pregnancy values. [13.14]

The total iron content of normal adult women ranges from 2.0 to 2. 5 g, or about half of what is normally found in men. Most of this iron is bound to hemoglobin or myoglobin, and thus, iron stores of normal young women are only about 300 mg. Although iron levels are lower in women may be partly due to blood loss during menstruation, other factors play a role, especially the hormone hepcidin which is a peptide that

functions as a homeostatic regulator of iron metabolism in systemic. Hepcidin levels increase with inflammation, but decrease with iron deficiency and some hormones, including testosterone, estrogen, vitamin D, and possibly prolactin. Lower hepcidin levels are associated with greater iron uptake via ferroportin in enterocytes [13]. The approximate 1000 mg substance iron which is needed for pregnancy is normal, approximately 300mg are actively transferred to the fetus and placenta, and 200 mg of others lost through various pathways excretion of normal, particularly tract digestion. This iron is also called *obligatory losses* and this deficiency even increases even when the mother is deficient in iron. The increase in the average total volume of red cells that circulate - about 450 mL - require 500 mg of additional iron. [13.14]

Iron is using during the second half of pregnancy so that the iron requirement be increased significantly after mid-pregnancy and the need for increased an average of 6 to 7 mg / day. In most women, this amount is usually not available in iron or dietary reserves. Thus, without additional iron, the optimal increase in maternal erythrocyte volume will not occur, and the hemoglobin and hematocrit concentrations will drop significantly with the increase in plasma volume. At the same time, fetal red blood cell production is not compromised because the placenta transfers iron even though the mother has severe iron deficiency anemia. [1 3]

**2. Method**

For this integrated review, search engines include Medline, Embase, Web of Science, Cochrane Library, Pubmed. Searches conducted include risk factor, anemia, pregnancy women, rural area. The inclusion criteria that used in this study are as follow, publications in the last 10 years (2009-2020), English-language articles the population is pregnant women who are suspected of anemia. To search the related articles according to inclusion criteria, this study used some keywords, namely anemia OR nutritional anemia AND risk factor of nutritional anemia AND pregnancy women. From this process, there are 12096 matched articles, consist of medline 5306 articles, Ebsco 2775 articles, Pubmed 1158 articles, Springer 1669 articles and Science Direct 800 articles.
References that have been found in line with the keywords are managed using Mendeley software. Since one article can be sourced from different database, a duplicate check needs to be performed afterwards, according to PICOS. After screening process, it has resulted 15 articles.

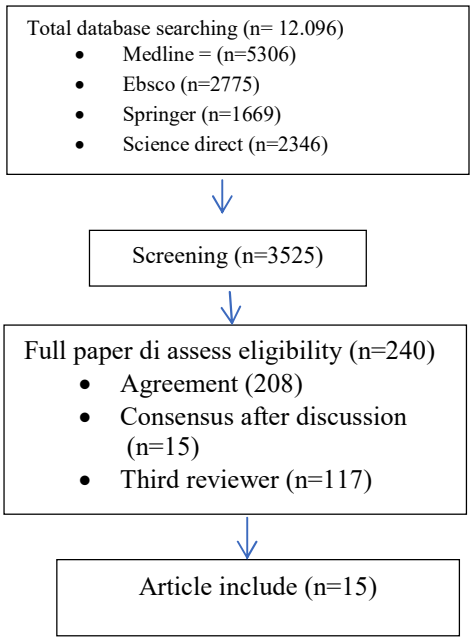

Figure 1 Literature Review Flow Chart

**3. Result**

The main risk factor of anemia in pregnant women are excessive blood loss, and inadequate iron intake or absorption that fails to meet physiological requirements. Each 1 mL of blood contains 0.4–0.5 mg of iron. Thus, negative iron balance is promoted by physiological, pathological, or iatrogenic blood loss[16].

Anemia is a considerable public health problem worldwide. In rural area, this becomes even more of a problem during pregnancy. Anemia has multiple causes, and the associated risk factors vary widely across populations and communities. The current study identified three predictors of anemia among pregnant women who were attending antenatal care in rural area. One of the main objectives of the present study was to relate the presence of anemia with dietary intake during pregnancy. The odds of developing anemia were significantly higher in pregnant mothers who consumed red meat 1–2 times a month (AOR=7.245), or not at all (AOR=8.7), in comparison to mothers who consumed it every day. This finding is in agreement with previous studies conducted which showed that pregnant mothers who did not eat red meat or organ meat were more likely to be anemic compared to pregnant women who did, because red meat is rich in iron that enhances the hemoglobin level, especially during pregnancy where iron demand is high. These studies may be in agreement because of similar choices by the study population to reduce or exclude red meat from the diet as a dietary preference, or due to low socioeconomic status, since both the countries referred to are low-income countries where food availability and food security are low.

Another important finding in this study was that relating to green vegetables. The odds of being anemic were significantly higher among mothers who ate green vegetables 1–2 times a week (AOR=2.97 times) more likely to become anemic compared to Their counterpart (every day), [AOR= 2.970, 95% CI (1.012–8.716)] and the odds of being anemic among mothers who eat 1–2 times a month green vegetable were 8 times risk or 1–2 times a month (AOR=8.057), compared to mothers who ate green vegetables every day [AOR= 8.057, 95% CI (2.358–27.526)]. This finding is consistent with a previous study conducted in Dessie, northern Ethiopia, which reported low consumption of green vegetables to be significantly associated with an increased risk of anemia.20 Consumption of leafy green vegetables increases hemoglobin concentration, and has the potential to minimize the risk of anemia.21 The correspondence between these findings could be due to poor dietary diversity, which results in a dietary shortage of micronutrients, or due to the widespread inability to grow, source or afford green vegetables. In contrast, a study from the West Arsi Zone, Oromia Region, Ethiopia reported that the intake of green vegetables had no association with anemia.19 This disparity might be due to other factors that may act to reduce iron absorption and storage in the body.

Pregnant women with a MUAC of less than 23 cm were 16 times more likely to acquire anemia comparing to those who had MUAC greater than 23 cm [AOR= 16.432, 95% CI (5.240–51.526)]. MUAC is a measure widely used for the assessment of nutritional status, and 23 cm is the threshold circumference considered to determine the level of nourishment of an adult female, and circumferences less than this signifying undernourishment. The similarity of these studies demonstrates beyond a doubt that undernourished pregnant women have a higher probability of developing anemia because pregnancy is widely understood to be the most nutritionally-demanding period in a women's life. The nutritional disadvantage of pregnancy may take its toll later in pregnancy, as women are not able to meet with the demand from the growing fetus, resulting in harm to the mother and ultimately loss of the fetus.

This cause is not very common in pregnant women, except for pregnant women who experience massive postpartum haemorrhage or severe gastric bleeding due to acute abdominal causes. Common causes of upper gastrointestinal bleeding include erosions or ulcers associated with aspirin and other non-steroidal anti-inflammatory drugs. The most important causes of lower gastrointestinal bleeding are colorectal cancer, angiodysplasia, and colon polyps[17,18].

The recommended daily intake for iron is highest during pregnancy (27 mg), and lowest in adult men (8 mg) [18]. Dietary iron is stored as haem iron in meat and non-haem iron from plant sources. Haem iron is absorbed efficiently and is less susceptible to modulation by other food components, whereas non-haem iron absorption is less efficient and susceptible to external influences; for example, vitamin C increases the absorption of non-haem iron, and phytate (found in grains and seeds), calcium, and tannins (found in tea and coffee) inhibits the absorption of non-haem iron [19].

Iron absorption from a vegetarian diet is less efficient than a meat-inclusive diet, and vegetarians have lower iron stores and are more likely to be iron deficient [20]. In addition, stomach acidity is essential for maintaining the solubility of iron in the duodenum for absorption. Patients using proton pump inhibitors or histamine-2 receptor antagonists had a higher risk of IDA than those not taking these drugs. The effect of the drugs on anemia depends on the dose and duration [21]. Iron uptake in overweight and obese women is lower than in women in the healthy weight range because of increased hepcidin concentrations [22].

The current classification lists the following levels as anemia: Hb (g / dL) and Hct (percentage) levels below 11 g / dL and 33%, respectively, in the first trimester; 10.5 g / dL and 32%, respectively, in the second trimester; and 11 g / dL and 33%, respectively, in the third trimester [23]. Pale conjunctiva, lips, oral mucosa, nail bed and palmar folds may be seen in anemic patients. The Strobach study showed a correlation between Hb concentration and the degree of pallor of the conjunctiva of the lower eyelid, nail bed and palmar crease, indicating that accuracy. Physical examination can evaluate the severity of anemia [24], and for this reason, physical examination is an important step in diagnosing this disorder, especially in developing countries where other tests are not available.

A microcytic hypochromic red blood cell with anisocytosis and poikilocytosis can be found through the peripheral blood smear, but since hypochromic anemia can also occur in other cases (i.e. chronic abnormalities anemia, thalassemia), other parameters should be included in laboratory studies to diagnose anemia. For this purpose, we can consider serum ferritin as the gold standard[25]. Laboratory evaluation is essential for the definitive diagnosis anemia.

Since the etiology of anemia includes a variety of causes, the diagnosis cannot be based solely on the Hb value. For diagnostic clarification, it is necessary to evaluate the red blood count and serum ferritin (SF) level. The most reliable parameter for developing iron deficiency is SF, and screening of SF concentrations in early pregnancy is recommended. If SF <30 g / L, there is a high probability that iron stores will be depleted, even without anemia. SF values <30 g / L associated with Hb concentrations <11 g / dL during the first trimester, <10.5 g / dL during the second trimester, and <11 g / dL during the third trimester are diagnostic for anemia in pregnancy [26]

However, in the presence of an inflammatory process or chronic disease, ferritin levels may become normal or increased, despite anemia. This is because ferritin reacts as an acute phase protein. Evaluation of C-reactive protein (CRP) levels can help establish the correct diagnosis by excluding infection or inflammation. If the CRP level is elevated, re-evaluation of the SF level is recommended after normalizing

the CRP concentration. Repeated measurements of SF levels after pregnancy are unnecessary if the patient is asymptomatic of anemia. Conversely, the Hb concentration should be measured in each trimester if the ferritin level is ≥ 30 g / L. In addition to measuring CRP levels, it is necessary to carry out other diagnostic tests such as determination of transferrin saturation and serum iron.[27,28].

If the ferritin level is normal, a serum transferrin value <15% indicates latent iron deficiency because more iron is released from the blood circulation by transferring to confirm erythropoiesis. Serum iron levels are susceptible to diurnal, intra- and inter-individual fluctuations, so, usually, the assessment of serum iron and transferrin levels is helpful in diagnosis, although SF is an appropriate tool[27]. Another parameter that can be useful for detecting iron deficiency during pregnancy, in the case of normal ferritin values and elevated CRP, is serum transferrin receptor (sTfR). During pregnancy, increased sTfR values are associated with increased erythropoiesis stimulation and major iron requirements due to the proliferation of iron-dependent cells. Low sTfR concentrations in the first period of pregnancy appear to be associated with delayed erythropoiesis in the first trimester, as shown by several studies. In addition, the sTfR concentration was not affected by infection or inflammatory reactions. 29

## 4. Discussion

Anemia in pregnancy women can affect a whole range of bodily functions, such as physical and mental performance, enzymatic function (eg, respiratory chain function), thermoregulation, muscle function, immune response and neurological function. Only a few of these potential effects have been studied specifically in iron deficiency anemia. In general, iron deficiency anemia causes a variety of symptoms such as fatigue, decreased physical performance and fitness for work, increased cardiovascular stress (tachycardia, decreased blood pressure), decreased thermoregulation and increased tendency to infection. Maternal thyroid function and thyroxine synthesis are closely related to maternal iron status [27,30].

In pregnant women, the tolerance for peripartum blood loss is greatly reduced. Maternal mortality increases depending on the degree of iron deficiency anemia. Causes include an increased rate of cardiovascular failure, a higher risk of hemorrhagic shock, and a higher rate of infection during the puerperium and impaired wound healing. Maternal morbidity may also be associated with additional factors such as socioeconomic status, level of medical care, and nutritional status [27,30]. If maternal Hb level below 9.0 g / dl increases the risk of preterm delivery, intrauterine growth retardation and intrauterine fetal death. The relationship between maternal Hb and birth weight follows a U-shaped curve. Hb levels greater than 11.0 g / dl and less than 9.0 g / dl are associated with a two to three times greater risk of preterm birth[30]. Hb levels greater than 12.0 g / dl at the end of the second trimester are associated with an increased risk of preeclampsia and IUGR, postulated because of a lack of plasma volume expansion. The 'ideal' Hb range with respect to prevention of prematurity and IUGR infants appears to be between 9.5 and 11.5 g / dl[30].

## 5. Conclusion

From this study indicates that treatment for anemia depends on its cause and severity. This study demonstrated that women who did not get sufficient red meat or green vegetables in their diet, and those had a middle-upper arm circumference of less than 23 cm were significantly more likely to develop anemia during pregnancy.

Based on the literature review, it is recommended that special attention be paid for anemia prevention strategies, through the preparation of a program to improve the nutritional status of pregnant women, specifically aimed at those with low nutritional status. Programs should include nutritional counseling on iron-rich foods and increasing nutritional diversity. Pregnant women in developing countries should be encouraged to enroll in such programs in order to prevent negative birth outcomes through improved iron intake and the provision of a varied diet. Following this, a community-based study with a large sample size and longitudinal study design should be conducted to assess the efficacy of interventions and monitor the impact of local and nationwide programs [28-30].

## 6. Conflict of Interest

The author states that there is no conflict of interest in this study.

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