World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Correlation between iron intake and ferritin levels in maternal serum

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World Journal of Advanced Research and Reviews, 2023, 18(02), 641–646

Publication history: Received on 22 February 2023; revised on 08 April 2023; accepted on 10 April 2023

Article DOI: https://doi.org/10.30574/wjarr.2023.18.2.0555

Abstract

Background: Iron deficiency in pregnant women is mainly caused by inadequate intake. Iron reserves in the body are stored in the form of ferritin which serves as a clinical marker of the status of the body's iron stores. Ferritin levels will decrease as the gestational age increases. If ferritin levels are low can be diagnosed as iron deficiency. This study aimed to examine the relationship between iron intake and serum ferritin levels in the maternal.

The type of study used was an observational analysis with a cross-sectional research design, the study sample was the serum of pregnant women from 40 pregnant women. Research locations at Hermina Hospital, BMC, and Army Hospital. Iron intake using FFQ. The serum was examined using the ELISA method at the Unand Biomedical Laboratory. The test used in this study was the Pearson correlation test.

Average iron intake was 28.87±3.78 mg/day, maternal serum ferritin 41±50.97. The association of iron intake with maternal serum Ferritin levels (r=0.836) significantly (p=0.000).

The conclusion of this study is that iron intake is associated with maternal serum ferritin levels

Keywords: Iron Intake; Ferritin Serum; Maternal; Pregnancy

1. Introduction

Iron deficiency is a condition of too little iron in the body ranging from iron depletion without anemia (iron stores are reduced with average hemoglobin concentration) to marked anemia, in which the supply of iron is insufficient to maintain an average Hb concentration. According to the World Health Organization (WHO), in 2020 the prevalence of anemia in pregnant women around the world decreased by 4.5% over the past 19 years, from 2000 to 2019. Based on the results of Riskesdas 2018, shows that 48.8% of pregnant women have anemia. As many as 84.6% of anemia in pregnant women occurs in the age group of 15-24 years (Ministry of Health RI, 2018). While in West Sumatra the prevalence of anemia in Padang City in 2017 for pregnant women who experienced anemia was 7.10% while in 2018 pregnant women who experienced anemia was 7.72% [5].

Based on the results of research conducted by Aji which reported the prevalence of anemia and factors associated with pregnant women in West Sumatra, Indonesia 2019, it was stated that the majority of anemia was found to be 61.90% with the criteria for the prevalence of moderate and mild anemia respectively being 34% and 27%. There is still a high prevalence of anemia in pregnant women in West Sumatra. Therefore, increasing awareness of iron supplements and health related to nutrition during pregnancy needs to be considered to improve maternal health status to reduce anemia [2].

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One of the populations most at risk of experiencing an iron deficiency is pregnant women because the need for iron increases during pregnancy. iron is essential for supporting the growth of the placenta and fetus and maintaining an increase in the mother's red blood cells. Therefore, pregnant women need to pay attention to their nutritional intake because this will have a negative impact on the mother and fetus [12].

Hwang et al., (2013) stated that giving iron intake to pregnant women from food sources alone is not sufficient for iron needs during pregnancy so iron supplementation is necessary. Iron supplementation during pregnancy can consistently increase hemoglobin levels and ferritin levels in pregnant women. Iron intake is important to prevent anemia during pregnancy. Most of the iron needs of pregnant women come from iron tablet supplementation [16].

Iron deficiency in pregnant women is mainly caused by inadequate intake. Iron reserves in the body are stored in the form of ferritin. Each 1 ng/mL of serum ferritin represents 8-10 mg of iron stores. therefore, if there is a decrease in serum ferritin levels, it can reflect a deficiency of iron reserves in the body [17].

Based on the results of research conducted by Sunarti in 2019 which aimed to see the correlation between nutritional status, iron intake with ferritin levels, the results showed that there was a relationship between nutritional status, iron intake, and ferritin level.

Ferritin is a protein that is important in iron metabolism. Under normal conditions, ferritin stores iron that can be recovered for use as needed. In a state of iron overload, the body's iron stores are greatly increased and far more ferritin is present in tissues, such as the liver and spleen [12].

The concentration of ferritin levels describes the storage capacity of iron in the body. So if the concentration of low ferritin levels can be diagnosed iron deficiency. Ferritin levels will decrease with increasing gestational age, in the first trimester it drops to 32%, the second trimester to 39%, and during the third trimester it drops to 53%. Iron deficiency anemia will be seen from the third trimester of pregnancy because at that time the fetus stores iron reserves for itself as a reserve after delivery. Daru et al's study regarding the serum ferritin threshold used for the diagnosis of iron deficiency in pregnancy, found that 6 out of 76 studies showed serum ferritin levels <30 ng/L [3].

Serum ferritin level is the most useful parameter, easily, and is considered the best marker of iron stores available for assessing iron deficiency. Levels <15 μg/mL are diagnostic of iron deficiency. Pregnant women are very susceptible to iron deficiency anemia because during pregnancy the oxygen demand is higher, which triggers an increase in erythropoietin production. As a result, plasma volume increases, and red blood cells (erythrocytes) increase. However, an increase in plasma volume occurs in a larger proportion when compared to an increase in erythrocytes, resulting in a decrease in hemoglobin (Hb) concentration due to hemodilution [8].

Serum ferritin examination is proven to be the earliest indicator of decreased if there is depletion of iron stores and has a less invasive procedure. Ferritin is an iron storage protein and is present extracellularly in serum. Ferritin serves as a marker of the clinical status of body iron stores. Examination of serum ferritin (SF) is an examination parameter used to assess iron stores in the body. The SF examination has limitations, its levels are affected by the presence of inflammation because ferritin is an acute-phase protein [9].

Based on the description above there are still many problems regarding iron intake in pregnant women so researchers are interested in taking the title of the relationship between iron intake and maternal serum ferritin levels.

2. Material and methods

The type of research used in this research is observational analytic with cross sectional design. This research starts from June to December 2022 with no. Ethics 2937/UN.16.02.D/PP/2022. The subjects of this study were 40 term pregnant women with inclusion criteria of normal term pregnant women who were willing to be research subjects. Exclusion criteria for pregnant women who have chronic diseases (hypertension, DM, liver, kidney, etc.). The research location is Hermia Hospital, Bunda BMC Padang General Hospital, Dr. Army Hospital. Reksodiwiryo. Intake of iron using the Food Frequency Questionnaire (FFQ) questionnaire conducted by enumerators. Umbilical cord serum was examined using the ELISA method at the Andalas University Padang Biomedical Laboratory. The test used in this study is the Pearson correlation test.

3. Results and discussion

The research subjects were of healthy childbearing age, most of them were highly educated, did not work, and had a good number of pregnancies. The average iron intake was in the sufficient category, the mean maternal and umbilical cord serum ferritin levels were in the normal category as can be seen in table 1. The correlation between iron intake and maternal serum ferritin levels was significantly correlated.

Table 1 Maternal Characteristics, iron Intake and serum ferritin level

Characteristics N % Mean SD Age	**n**	**%**
Age		
20-35	35	87.5
>35	5	12.5
Education		
Junior High School	2	5
Senior High School	12	42.5
PT	26	65
Work		
Unmployed	14	35
Employed	26	65
Parity		
Primipara	12	30
Multipara	17	42.5
Grandemultipara	11	27.5
Total	40	100

Table 2 Average maternal iron intake and serum ferritin levels

Variable	**Mean±SD**	**Minimum**	**Maksimum**
Iron intake (mg)	28.97±3.71	21.44	39.97
maternal serum ferritin levels (ng/ml)	41.00±50.97	5.98	254.97

Table 3 Correlation between iron intake and ferritin levels in maternal

		Iron intake
Maternal ferritin levels (ng/ml)	r	0.836
	p	0.000

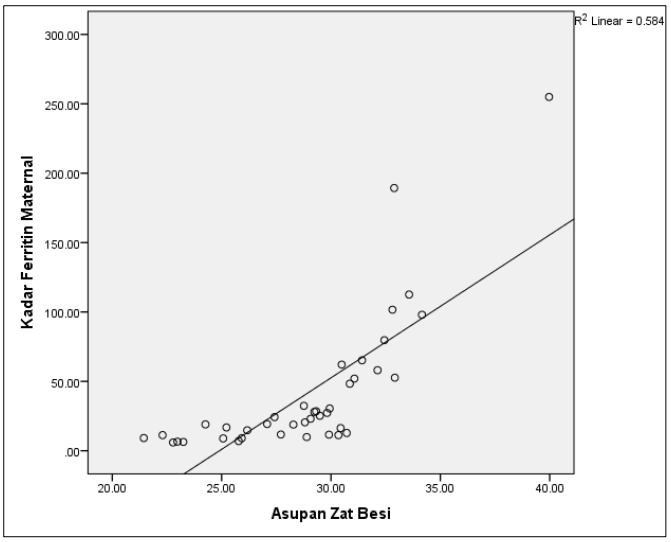

Figure 1 Correlation between iron intake and maternal serum ferritin levels

4. Discussion

4.1. Correlation between iron intake and maternal serum ferritin levels

In this study, there was a statistically significant positive relationship between iron intake and ferritin levels in pregnant women with a strong relationship (p=0.000 r=0.836). This shows that the higher the iron intake of pregnant women, the higher the ferritin level.

Iron is an essential microelement for the body. This substance is primarily needed in hemopoiesis (blood formation), namely the synthesis of hemoglobin (Hb). Hemoglobin (Hb) is oxygen that delivers erythrocytes to important functions for the body. Hemoglobin consists of Fe (iron), protoporphyrin, and globin (1/3 of the weight of Hb consists of Fe). Free iron exists in two forms, namely ferrous (Fe2+) and ferric (Fe3+). Converting the two forms is relatively easy. At high oxygen concentrations, iron is generally in the ferric form due to binding to hemoglobin, while in the transmembrane transport process, deposition is in the form of ferritin and heme synthesis, and iron is in the ferrous form [13]. In the body, iron is needed to form complexes of iron, sulfur, and heme. The iron-sulfur complex is needed in the enzyme complex that plays a role in energy metabolism. Heme is composed of a porphyrin ring with an iron atom in the center of the ring which plays a role in transporting oxygen to hemoglobin in erythrocytes and myoglobin in muscles [3].

Pregnancy is a period of growth and development of the fetus towards birth so nutritional disorders that occur during pregnancy will have a major impact on the health of the mother and fetus. When the body is deficient in iron, absorption will increase, as well as when the body has enough iron, absorption will decrease. Iron is absorbed primarily in the duodenal mucosa. When iron will be used for metabolism, iron will be transported by transferrin to the bone marrow (80%) or other tissues [6].

This research is in line with research by Ririn (2021) which states that there is a relationship between iron intake and ferritin levels in pregnant women [13]. Gordeuk's research (2012) explained that dietary iron intake has a significant relationship with the serum ferritin, where heme iron is the most dominant predictor and consumption of red meat has a positive effect on increased ferritin levels in adults in Australia [7].

This study is also in line with research conducted by Young et al (2018) who conducted a study on women aged 18-35 years in New South Wales, Australia, which found a significant relationship between heme and non-heme iron intake and serum ferritin levels. Heme iron intake has a stronger correlation with serum ferritin levels than non-heme iron intake [18]. This situation indicates that iron bioavailability is important for maintaining normal iron status in women of reproductive age. Consuming heme and non-heme iron together can increase the absorption of non-heme iron. Meat, fish, and chicken contain a factor that can help the absorption of iron. This factor consists of amino acids that bind iron and help its absorption [2].

The main reasons for retaining iron during pregnancy are to protect the mother's health, improve pregnancy outcomes and aid fetal development. A recent systematic review demonstrated that first and second-trimester iron deficiency is associated with increased maternal morbidity and an increased risk of adverse pregnancy outcomes defined as low birth weight, prematurity, or intrauterine growth restriction [5].

Ferritin examination needs to pay attention to certain conditions that can increase ferritin levels, namely, a history of chronic diseases such as kidney disease, hypertension, and diabetes mellitus. Meanwhile, there are several conditions that can reduce ferritin levels, namely hypothyroidism, ascorbic acid deficiency, acute and chronic blood loss, and increased iron requirements during pregnancy [15].

Several factors cause low ferritin levels caused by nutritional status, inflammation in overnutrition status, triggering hepcidin synthesis in the liver which inhibits the release of iron into the plasma from the three main reserves of iron in the body and blocks the work of the iron exporter, namely ferroportin. so that the iron that can enter into the blood plasma decreases and is stored more in the tissues so that high iron consumption will not affect ferritin levels in the body [11].

5. Conclusion

There is a significant relationship between iron intake and maternal serum ferritin levels, a very strong and significant correlation. It is expected that pregnant women will pay more attention to daily consumption and eat a variety of foods such as consumption of meat, fish, vegetables and supplemented with fruits to fulfill the nutrients needed during pregnancy and Further research is needed regarding the factors that affect iron absorption.

Compliance with ethical standards

Acknowledgements

Thank you for your collaboration with Padang City Hospital (Hermina Hospital, Bunda BMC, and Dr. Reksodiwiryo)

Disclosure of Conflict of interest

There is no conflict in this study.

Statement of ethical approval

This research has passed an ethical review from the ethics commission of FK Unand: no. 794/UN.16.2/KEP-FK/2022.

Statement of informed consent

This study has been approved by respondents and signed a consent sheet for their maternal blood to be drawn.

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