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LITERATURE REVIEW

Iron deficiency in Indonesia: known facts

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Abstract

More than half cases of anemia are due to iron deficiency. Anemia is a major and global public health problem that affects maternal and child mortality, child cognitive development and eventually productivity. Infancy, adolescence, and pregnancy are particularly at risk. Indonesia is a low middle country with the prevalence of anemia as high as 48.9% in pregnant women and 38.5% in children under 5 years old. It is even higher among adolescents aged 12-18 years, especially in rural areas. Low income and level of education seem to also contribute to iron deficiency. Indonesia government aims to prevent anemia in young and pregnant women by providing iron pills. Still, the etiology of anemia in Indonesia is various and many elements are preventing Indonesia women to consume pills and/or iron-rich foods. We aim to review the prevalence, risk factors associated with iron deficiency especially among women of reproductive age in Indonesia, including the socio-determinant influence on iron deficiency. We will also discuss the management of iron deficiency in Indonesia in comparison with international guideline to identify the potential gaps.

Keywords iron deficiency, anemia, Indonesia

Introduction

Prevalence of iron deficiency in Indonesia

Iron deficiency (ID) is a common micronutrient deficiency found in low-middle income countries.[1,2] This is the commonest type of nutritional status that have significant impact on health of different age groups in different stage of life especially in children, maternal woman and woman in reproductive age. A recent study in seven Southeast Asian countries found iron deficiency in more than half of the female reproductive age population.[1] In Indonesia, the overall prevalence of anemia regardless gender and age group is 23.7%. Whereas in pregnant woman and children under 5 years old, shown 48.9%, 38.5%, respectively.[2] In iron deficiency cases, the prevalence of children in adolescent age group ranged from 14.1% to 18.4% ; the prevalence of iron-deficient anemia was 5.8%.[3] The high prevalence of anemia among adolescent aged 12-18 years living in rural areas outside Java Island in Indonesia was 57.9%.[4] The prevalence of iron-deficiency anemia (IDA) among adolescent girls aged 12-15 years of low socioeconomic status family in urban areas of Java Island is 15.8%.[5]

Chronic manifestation of iron deficiency is clinically seen in anemic condition and it is known as iron-deficiency anemia (IDA) or nutritional anemia. Iron deficiency can disrupt optimal functioning of the endocrine and immune systems

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and be associated with increased absorption of environmental metal toxins. The iron deficiency has impaired cognitive function in children that will affect a child's future quality of life.[3,6–8]

Risk factors of iron deficiency

Studies have been trying to determine the risk factors for ID, however due to the significant manifestation is ID-anemia related, hence data that makes the risk factors for IDA to be more accessible. Some risk factors have been identified in this article, and author is trying to update data from Indonesian analysis. There are three physiological risk factors that encourage IDA, i.e. infancy, adolescence in girls, and pregnancy. Blood loss, malabsorption, chronic diseases (e.g., chronic kidney diseases, cancer), and genetic abnormalities are the medical conditions that contribute to IDA.[7] Serum ferritin is the standard laboratory indicator of non-inflammatory ID, while serum ferritin and hemoglobin levels are taken into account in IDA.[7]

Age

Children in younger age groups are vulnerable to moderate/severe anaemia, i.e. children aged 6-11 months are 4.71 times more likely to have anaemia than children older than 60 months of age. [9] This age group may have inadequate consumption of iron nutrient which may have resulted in iron deficiency anaemia. There is an increased risk of IDA due to the menstrual cycle in teenage girls.[7]

One Indonesian study found that the incidence of anemia in pregnant women age 21 – 35 years was lower than other age groups. [10] Myanmar and Indian women indicate that different age classes are at higher risk, i.e. women >40 years of age are more likely to be anemic.[11,12] One study in Tanzania found that rising age was associated with an increased risk of anemia.[13] In rural China, women aged 45-49 are more likely to have anemia compared to younger people.[14] The different results suggested a higher prevalence of anemia among adult women than among young women, as contraception protects younger women from bleeding and abortion and the number of live births increases the risk of anemia.[15]

Parity, Number of Live Births and Miscarriages'

Multiparity is related to the number of pregnancy and childbirth, leading to blood loss. Iron deficiency anemia will increase the bleeding episode during labour. Thus, multiparity women were at risk of having more than one bleeding episodes in childbirth. One study found that women with more than two children were not significantly associated with anemia.[12] However, women with more than three children appear to be anemic, as revealed in one study in Ethiopia and Myanmar.[11,16] Studies in India found that anemia was more general among women of high parity due to recurrent pregnancy and insufficient spacing between pregnancies.[17] There was no association between parity and anemia in an observational study conducted in East Java.[18] However, analysis from large sample studies in Indonesia have shown that multiparity increase the risk of anaemia by 58%.[10]

Bleeding by miscarriage can cause anemia. One rural research in China found that women with a history of miscarriage were more likely to have anemia than to adapt to other independent variables. [14] In the study, women had a history of miscarriage and also a history of intrauterine device (IUD) use. The risk of anemia will decrease compared to women with a history of miscarriage but not to women with a history of IUD use.[14] Bleeding has two pathways to induce anemia; the first is through direct blood loss, and the second is through prolonged blood loss. The most common cause of miscarriage is direct blood loss, including loss of hemoglobin-containing red blood cells. Decreased amounts of hemoglobin also lead to anemia. Women suffering miscarriage, in general, can also suffer blood loss. Disorder can be aggravated by extreme bleeding in women. The number of miscarriages in this study will be further explored in order to determine its relationship with anemia.[19]

Body mass index (BMI)

The body mass index (BMI) is measured at the individual level as the height and weight are female-derived measurements. BMI can describe the history of the intake of anemia-induced nutrients. Women with BMI <18.5 kg/m^2 (underweight) were significantly more likely to be anemic than women

with normal weight. BMI was related to malnutrition, which included a dietary deficiency of iron, so women seemed to have anemia. In addition, overweight status was clarified as a protective effect.[20] Increasing BMI was correlated with the risk of recovery from anemia, which indicates that underweight individuals tended to have anemia.[21] However, current research indicated that obesity was more likely to have a duplicitous relationship with ID and it was considered as a nontraditional risk factor of ID.[22,23] Two Indonesian studies back up this janus-faced clinical condition of obesity in pre-marital reproductive-aged women and female adolescent.[24,25] In a premarital reproductive-aged women (age 18 to 22 years) with obesity, their iron status were slightly lower than those who are not obese.[24] Different result shown from another study involving female adolescent (age 10 to 18 years), there was no difference in the iron status of obese adolescent female with normal BMI.[25] The regulation of iron metabolism in the obese occurs, is still on debate. There was an indication that it was through a hepcidin regulation. While there are links between obesity and ID, decreased dietary iron absorption, and increased serum hepcidin, it is still unclear how weight gain affects iron status mechanistically.[23] However, a current study found that hepcidin levels did not contribute to the development of IDA in obese children.[26]

Pregnancy

Pregnancy is the individual state of women because of inner processes. Pregnancy is one factor that may affect anemia because the mother supplies nutrients to her fetus. Pregnancy greatly raises the risk of anemia. Individual level variables revealed anemia-related pregnancy. [27] Pregnant women not only face anemia due to inadequate intake of micronutrients, but also a shortage of iron pills. Pregnant women must eat at least 90 iron pills during pregnancy. Increased needs of iron during pregnancy is one cause of anemia worldwide.[28] Pregnant women provide iron to the fetus so they need more iron for themselves and the fetus.[18]

Level of education and literacy status

Training is a vital aspect of living that has been repeatedly investigated. Training has a long-term role to play in terms of work opportunities, health knowledge, and income that can affect health. One study in Bali confirmed these findings, explaining how education influences the awareness of disease.[29] Ethiopian women without formal education were more anemic than educated women,[30] and uneducated women seemed to have anemia more than educated women in Mali.[20] Education is related to anemia and increased education decreases the risk of anemia in North Sumatra Province.[31] Women in rural China who have completed only or below primary school, were more likely to have anemia than those in higher education.[14] Training influences the knowledge of fitness, socio-economic status and profession, such that women with higher education tend to have knowledge of the prevention of anemia. They had a higher socio-economic status and work that could meet their normal nutritional needs.[29] In addition, low levels of education have been related to unemployment and low socio-economtyle to ease contact. Literacy is defined as the ability to read and write.[32]

Literacy is directly linked to lifesage properly and is related to knowledge to prevent anemia. Illiteracy was significantly associated with high prevalence of anemia during pregnancy.[17] Women's level of literacy was associated with anemia based on a study in Tamil Nadu, India.[33] Women's educational status is important and has led to greater understanding of the value of iron-rich diet, personal hygiene and environmental sanitation.[33]

Frequency of micronutrient intake

The intake of micronutrients is an important eating behavior. Iron-containing micronutrients can increase hemoglobin levels. Fish and meat produce high iron relative to eggs, milk and vegetables. One study in China showed that insufficient riboflavin (B_2) intake was associated with anemia.[34] In low-income countries, riboflavin deficiency was one of the most common vitamin deficiency, particularly in a community where rice was the main food with insufficient milk and meat intake.[35] In support of previous research, pernicious anemia was the most

common risk due to vitamin B_{12} deficiency, a nutrient found in meat, fish, eggs and milk. [36] Intake of micronutrients such as energy, fat, total protein iron, nonheme iron, heme iron, vitamin C, riboflavin and fiber has been significantly associated with anemia in China.[34] Dietary considerations included significant risk factors for iron anemia deficiency due to lower intake of iron from meat.[18] However, a micronutrient rich supplement drink increase haemoglobin level in school-aged children in Indonesia.[37]

Region/Province

Region is one element that defines living environments, such as living in risky areas, which may impact access to food. An analysis of anemia determinants in Myanmar has shown that the geographical region, especially the coastal region, was more likely to have anemia than the delta, central plain and hilly areas.[11] Coastal and delta lands have been vulnerable to natural disasters, including cyclones, floods and landslides that threaten to cause food shortages, increasing food prices and reduced salaries.[38] Study in rural areas has shown that women living in the northwest are more likely to have anemia than other areas.[14] In Indonesian scope, each province had its own geographical characteristics which could constitute a risk factor for anemia.

Birth attendants

The involvement of childbirth attendants is related to accessibility of health facilities. The role of birth attendants includes the management of bleeding and the use of health services to prevent anemia. Traditional birth attendants have played an important role in preventing disease and promoting healthy childbirth in difficult-to-access areas where antenatal clinics have rarely been held.[39] However, unskilled childbirth attendants could not handle bleeding episodes during delivery if there was a shortage of childbirth medical equipment and decreases hemoglobin levels were stabilized.

Socio-determinant influence on iron deficiency

Income level

The level of income is included in the lifestyle domain, as income is derived from work activities. The amount of income is one factor that reflects the economic status and its relationship to access to food. Poor families are more likely to be anemic because of access to healthy food.[40] Family income was correlated with anemia, with household incomes below GDP (Gross Domestic Product) appearing to have anemic family members.[18] Women in Bangladesh's reproductive age were more likely to have anemia. This could be demonstrated by the activities of rural communities and agricultural sectors.[41] The low socio-economic status of pregnant women in rural India was a risk factor for anemia.[17] The socio-economic status was closely linked to anemia due to lack of nutrition and poor health care. In addition, one study in the Indian tribal community showed that women with low economic status were more likely to be anemic.[12] They were unable to access their own income or wealth due to lower rates of extra household employment and reduced economic influence within the household.[40] Lower income households tended to have anemia that could be related to the family dependency ratio. Large low-income families could only meet their basic needs and nutritional needs, but lack access to iron sources and other nutritious food sources.[18] Women with low income levels would have low purchasing power for healthy food.[42]

Increased income, particularly in low to middle income countries, is very important in deciding how to safeguard basic needs such as food. Women with higher incomes will meet various nutritional and food requirements. Lower consumption of nutrients is related to anemia. The income level was also included in this analysis in order to better understand its relationship with anemia.

Social and community networks

Social and community networks generally describe how people interact and engage with their peers. Women's involvement in group activities can reflect social and community networks. Women who

contribute to and engage in group events will affect their health literacy and empowerment. In health care, iron pills are usually given, health support is provided, and other activities are implemented by community services, including women's groups, religious groups and other community organizations.[43] In addition, women's activities were mostly related to health and mostly organized through the Community Health Centre, making it easier to share health information. The Semarang, Central Java study found that peer groups of fertile elderly women in a community such as PKK RT (*Pemberdayaan Kesejahteraan Keluarga Rukun Tetangga*; Family Empowerment and Welfare Organization Neighborhood Association) were significantly associated with anemia prevention knowledge, attitudes and skills.[44] The role of peer group education has changed behavior and improved health promotion and prevention practices. The quasi-experimental research has shown varying levels of understanding, skills and attitudes between intervention and control groups.[45]

Occupation

Occupation is linked to working conditions that can affect women's health. The study stated that women, working as agriculturalists, engaged in risky activities, e.g. working barefoot, so that hookworms could cause infection. Parasitic infection is likely to destroy red blood cells. Similar to farmers, gardeners also had a high risk of anemia because exposure to a pesticide may lead to aplastic anemia. Women working in the industrial sector were also at risk of anemia due to toxic pollutant effects, including cadmium and mercury corresponding to hemolytic anemia.[46] However, one study in Nigeria found that occupation was significantly associated with anemia in which housewives were more likely to have anemia compared to civil servants and traders.[32] According to this report, housewives do not have their own income to select food.

Household food security

Depending on living conditions, household food insecurity is related to food access. A household with food stock can prepare healthy food and is related to prevention of anemia. Food insecurity is characterized as a state of insufficient access to enough food for growth and development processes. Studies have shown a conflicting correlation between food security and iron deficiency. While there is no clear connection between food insecurity and anemia, the widespread assumption of food insecurity is related to household capacity to prepare safe food stock. For families with low economic status or low-income status.[47-49]

Migration is another factor causing food insecurity in the family. Migration is an aspect that defines human movements from the place of origin to the final destination in terms of living conditions. Migrants adapting to a new location may have trouble of getting food. Women from low-income countries were more likely to be anemic since they were an ethnic group that had migrated. They have experienced a lack of access to food.[50] The major cause of migration is economic factors. The key causes of migration were economic factors. Migration can influence diet spending and on improving health outcomes. One analysis in China found that the rates of anemia in migrant households were slightly higher because they were unable to adapt economically well.[51]

Management of iron deficiency in Indonesia (government programs, available guidelines, and policies) in comparison with international guideline: potential gaps

The management of iron deficiency in Indonesia is focusing on the supplementation of iron pills. These tablets, also known as a blood replacement pills, are administered to both pregnant women and women of reproductive age. This act aims to prevent menstrual and iron-deficiency anemia. According to the Ministry of Health regulations, women in reproductive age may take iron pill once weekly and once during menstruation. Pregnant women should take iron pills daily, with a minimum intake of 90 pills. The pill should at least contain 60 mg elemental iron and 400 μg folic acid.[52]

Iron pills intake is linked to the practice and discipline of taking medicine. Distribution of iron pills for the prevention anemia is part of community health care. The evidence based on finding that women who did not regularly take iron pills were more likely to be anemic than women with daily iron

pills.[29] Adequate iron pill intake was associated with anemia based on a thesis from Deli Serdang District, North Sumatra, Indonesia.[31] The qualitative study found that women in Southeast Sulawesi perceived that iron tablets could enlarge the fetus, making difficult to deliver.[53] In addition, avoiding these types of food was thought to have an effect on anemia.[53] Another barrier that prevents female adolescents from taking iron tablets is their perceived benefit from doing so. A study done in an urban city of East Java found that, they are skeptical of the benefits of iron supplements.[54] Still, more research are needed to support that findings.

There is no regulation or guidance in Indonesia to provide initial nor regular screening/assessment of iron status among high risk population. The World Health Organization (WHO) guideline for IDA comprises of assessment, prevention, and control. Before iron supplementation as prevention, assessment of iron deficiency anemia should be done to determine the magnitude, severity, and distribution of iron deficiency and anemia, and preferably its main causes. WHO recommended that assessment of iron status is done by examining the hemoglobin and hematocrit values—a relatively simple and inexpensive measurement. In resource-poor settings where routine laboratory testing of haemoglobin or haematocrit is not feasible, clinical signs should be regularly used to screen individual women and children. The purpose of this screening should be to identify high-risk subjects before the onset of life-threatening complications.

WHO advised to prevent IDA firstly by food-based approaches through dietary improvement. The government should ensure the access to these iron-rich foods. Iron supplementation is the most common strategy currently used to control iron deficiency in developing countries, including Indonesia. This may remain as the only approach until significant improvements are made in the diets of entire populations.

In populations with a severe prevalence of anemia (>40%), iron supplementation should start during pregnancy and continue during lactation for at least three months post-partum, at dosage of 60 mg iron and 400 µg folic acid daily. Similarly, in areas where the prevalence of anemia among women of childbearing age and pubertal girl is severe (> 40%), preventive iron supplementation of 60 mg/day iron with 400 µg folic acid for 3 months should be considered. Supplementation dosage and duration for adolescent girl and boy is the same in that area.

Iron supplementation programmes should be carefully assessed, and their efficiency and effectiveness monitored, to improve critical aspects of the system. Governement should establish a surveillance system to ensure appropriate monitoring of iron status and of programme implementation.[48]

Obviously, there is a big gap between programme set by Indonesia government to prevent IDA and what is guided by WHO. Increased advocacy, exchange of information, development of human resources, and action-oriented research may be the solution for accelerating the achievement of the goals for reducing iron deficiency.

Summary

National socioeconomic development, as well as personal health and productivity, are impaired by iron deficiency. Iron deficiency affects a significant part, and often a majority, of the population in nearly every country in the world.

Pregnancy and women of child-bearing age poses a higher risk for women to develop iron deficiency anemia due to physiological and socio-economic reasons. Programmes for the prevention of iron deficiency, particularly iron supplementation for pregnant women are essential. However, it has also become increasingly evident that the main target group for supplementation to prevent iron deficiency should be all women of childbearing age (in addition to infants older than 6 months, preschool children, and adolescent girls). This target group should not be limited to pregnant women, who are often accessible only through the health system and late in pregnancy.

If women enter pregnancy with adequate iron reserves, iron supplements provided during pregnancy will be more efficient at improving the iron status of the mother and of the fetus. As a result, the risk of maternal anemia at delivery and of anemia in early infancy will be reduced.

The government should mobilize the effective participation of community groups, the private sector, and nongovernmental organizations in

programmes promoting sustainable primary health care, maternal and child health, and prevention of iron and other micronutrient deficiencies.

Finally, iron supplementation programmes should be carefully assessed, and their efficiency and effectiveness monitored, to improve critical aspects of the system. To get here, the Governement should establish a surveillance system to ensure appropriate monitoring of iron status and of programme implementation.

Conflict of Interest

The authors declared no conflict of interest regarding this article.

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