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FACTORS ASSOCIATED WITH THE INCIDENCE OF ANEMIA IN PREGNANT WOMEN IN INDONESIA: ANALYSIS OF INDONESIAN HEALTH SURVEY (SKI) 2023 DATA

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Abstract

Anemia is a common nutritional issue among vulnerable populations, including toddlers, adolescents, women of reproductive age, and pregnant women. Anemia in pregnant women impacts both the mother and fetus. For the mother, it reduces quality of life and can lead to mortality. Babies born to anemic mothers are at risk of congenital abnormalities, stillbirth, and stunting. Maternal health issues during pregnancy affect the critical first 1000 days of a child's life, with permanent consequences for survival, necessitating appropriate interventions to minimize these risks. The 2023 SKI Report indicates a 27.7% prevalence of anemia among pregnant women in Indonesia, classified as a moderate public health issue. This study is a quantitative study using a cross-sectional design aimed to identify factors associated with anemia in pregnant women in Indonesia in 2023, utilizing secondary data from the 2023 SKI. The dependent variable was anemia, with independent variables from socio-demographic factors, lifestyle factors, dietary patterns, and pregnancy-related factors. Data analysis used complex samples, including univariate and bivariate analyses with chi-square tests. The study found significant associations between anemia in pregnant women and consumption of meat, poultry, and their processed products (p-value = 0.047), pregnancy interval (p-value = 0.033), and consumption of supplementary feeding (PMT) (p-value = 0.001) in Indonesia in 2023.

Keywords: Anemia, Pregnant women, Meat consumption, Pregnancy interval, Supplementary feeding (PMT)

Introduction

Anemia is one of the most common form of malnutrition where the hemoglobin (Hb) levels in the body are below normal[1] and is considered a global public health problem. The decrease of hemoglobin (Hb) levels corresponds to the oxygen levels that goes within important tissues and organs such as the brain and muscles. Thus, anemia will result in symptoms of fatigue, shortness of breath, and the risk of losing consciousness, therefore reducing one's overall quality of life.[2,3]

Vulnerable populations of anemia include toddlers, adolescents, women of childbearing age (15-49 years old), and pregnant women. Specifically, for pregnant women, anemia will occur physiologically to adjust for the fetus' developmental requirements. Anemia during pregnancy can worsen if the conceiving mother does not consume adequate nutritional needs, causing nutritional deficit.[4] Pregnant women with anemia have an increased risk of experiencing preterm delivery and develop pre-eclampsia as well as post-partum hemorrhage, increasing maternal mortality risk.[5] Some studies even found that anemia could lead to a decrease in sleep quality and sleep disorders, both of which lead to disruptions in the production of growth hormones that are used to repair body cells, including blood cells, turning it into a cycle of sleep disorder and anemia.[6]

Anemia has become a health problem that warrants more concern for pregnant women because of its effects on both the mother and fetus. Iron deficiency can cause placental insufficiency. This condition could allow the baby to be born with low birth weight (LBW), low

birth length (LBL), and premature birth – one of the main causes of neonatal morbidity and mortality.[3,7]

The First 1000 Days of Life (1000 HPK) is a golden period for child growth and development, calculated from the moment the fetus is conceived, and has permanent effects over their life course. If the mother experienced anemia during pregnancy, it is possible that the children will be born with anemia as well. Anemia in children will interfere with tissue growth, leading to growth disruption, such as stunting. The relationship between stunting and anemia in children goes both ways, meaning anemia can further cause stunting, or vice versa.[8] Children born to mothers with anemia are at risk of neurocognitive developmental disorders, motor delays, and susceptibility to infectious diseases, which would then impact the child's future productivity and well-being.[9,10,11]

According to WHO, about 40% of maternal deaths are related to anemia during pregnancy.[12,13] One such factor is through the mechanism of postpartum hemorrhage, where a lack of red blood cells reduces the blood's ability to clot effectively, causing excessive bleeding during and after childbirth.[14]

As an effort to achieve the Sustainable Development Goals (SDGs), WHO targets a 50% reduction in the prevalence of anemia among women of childbearing age by 2030.[15] The 2021 Global Burden of Disease data shows a global prevalence of anemia reaching 24.3%, while in Southeast Asia it has reached 52% among pregnant women.[16] In Indonesia, the prevalence of anemia in pregnant women was recorded at 48.9% in 2018 and 27.7% in 2023.[17,18] Despite the decrease, however, the prevalence is still classified as a public health problem according to WHO guidelines.[1]

Indonesia continues to strive for and promote nutritional improvement throughout communities, as outlined in The National Medium-Term Development Plan (RPJM Nasional) for 2025-2029.[19] Given the long-term impact of anemia in pregnant women on the survival and quality of future generations, as well as the high prevalence recorded in the 2023 Indonesian Health Survey (SKI 2023), it is imperative to analyze and understand the contributing factors of anemia in pregnancy so the data can be used to formulate a more targeted approach, alongside policies and intervention measures in order to address the problem of anemia in pregnant women. Therefore, this study aims to identify factors associated with the occurrence of anemia in pregnant women in Indonesia in 2023.

Method

This study employed a cross-sectional design with a quantitative approach using secondary data from Survei Kesehatan Indonesia (SKI) 2023. The data collection process of SKI 2023 was conducted nationally by Badan Kebijakan Pembangunan Nasional (BKPK) from August-October 2023 with a reach of 514 regencies/cities and 38 provinces in Indonesia. Results of the survey were published in 2023, and further analyzed in this research from April-June 2025. Research instruments used in this study include individual questionnaires, household questionnaires, dan biomedical questionnaires from SKI 2023.[18,20,21]

The target population of this study is the entire population of pregnant women in Indonesia in the year 2023, with the study population being all pregnant women who were included as respondents of SKI 2023 (n = 5055), and the eligible subjects being all pregnant respondents of SKI 2023 who have biochemical data in the form of hemoglobin count (n =

294). The exclusion criteria is pregnant women who have infectious diseases related to anemia, which are malaria and tuberculosis. The final sample size of this study amassed 293 pregnant women in Indonesia. After the sample size had been determined, a variable power test was performed using a formula from Lemeshow.[22] Sample size (1- β) is inferred to be a strong sample size if it reaches a minimum of 80%. The results of the variable power tests were found to be in the range of 91-100% which means that the sample size and variables have fulfilled the minimum criteria.

Data processing was performed using the software IBM SPSS (Statistical Package for Social Sciences). Data processing starts with editing and cleaning, where data is inspected for their congruence and completeness. The next process is computing where certain numeric variables are counted. All variables are recoded then recategorized to make them suitable for the desired measurement results. The processed data will then be analyzed using complex samples to achieve accurate results in order to integrate with the specifications of the complex samples collection design in SKI 2023.[21]

Categorization of each variable was performed in accordance with previous theories and studies, with adjustments to the questionnaires in SKI 2023. The dependent variable in this study is anemia, which is categorized into anemic (Hb < 11g/dL) and non-anemic (Hb ≥ 11g/dL).[18,21]

Independent variables in this study are differentiated into four main factors. The first main factor is socio-demographic factors. These include education level, categorized into primary education (never attended school or did not complete elementary school until completed elementary school), secondary education (completed junior high school until

completed senior high school), and tertiary education (completed diplomas, bachelors, masters, and doctoral degrees); employment status, categorized into employed (civil servants/armed forces, private employees, entrepreneurs, hard laborers, etc.) and unemployed (unemployed or still in education); residence, categorized into rural and urban. The second main factor is lifestyle, consisting of physical activity, further categorized into excessive (> 1200 MET/week), inadequate (<600 MET/week), and adequate (600-1200 MET/week).

The third main factor is food consumption. These include consumption of meat, poultry, and their products; fish, clams, shrimps, and their products; as well as eggs and its products. All of these factors are categorized as **inadequate** consumption (< 1 meal per day) and adequate consumption (≥ 1 meal per day), based on recommendations from the Indonesian Ministry of Health[23] which stated that pregnant women require 4 portions of animal protein consumed per day in order to meet nutritional needs for them and the infant. In the 2023 Indonesian Health Survey Individual Questionnaire, the results are unspecifically categorized into either daily, weekly, or monthly consumption. Taking into consideration suggestions from the Indonesian Ministry of Health, we decided to generalize the categories into inadequate and adequate consumption based on daily intake as mentioned above. Fruits and vegetables consumption are also taken into consideration, categorized into non-routine consumption (< 7 days/week), and routine consumption (7 days/week).

The fourth main factor is gestation period factors, which include parity, categorized into multipara (≥ 2 children), primipara (1 child), and nullipara (0 child); pregnancy interval, categorized into at risk (< 2 years and ≥ 5 years) and not at risk (2 years - <5 years); iron-folic

acid tablet consumption, categorized into inadequate (< 90 tablets during pregnancy) and adequate (≥90 tablets during pregnancy); supplementary food consumption (PMT), categorized into not consuming and consuming; and protein energy wasting (PEW) status, categorized into PEW (MUAC < 23,5 cm) and non PEW (MUAC ≥ 23,5 cm).

Ethical approval for this study was obtained from the Research Ethics Committee of the Faculty of Public Health, Universitas Indonesia under number Ket-498/UN2.F10.D11/PPM.00.02/2025. Informed consent was obtained from all respondents in accordance with the SKI 2023 data collection guidelines.

Results

The results of this study are presented in univariate and bivariate analyses using complex samples chi-square test. From the total sample of 293 pregnant women in 2023, there were a few missing data related to certain variables, which include physical activity (n = 231), supplementary feeding consumption (n = 239), and PEW status (n = 287). In relation to parity and pregnancy interval, sample sizes were found to be fewer due to the pregnant mothers being interviewed during their first pregnancy which means there would be no history of previous pregnancies or births. The results of univariate analysis can be seen in **Table 1**.

Based on univariate analysis, from the 293 pregnant women in Indonesia in 2023, 213 (72.7%) were found to be non-anemic, while 80 (27.3%) were anemic, with an average Hb count of 11,8966 g/dL. For socio-demographic factors, the majority of respondents have completed secondary education (63.9%), are currently unemployed (71.6%), living in urban

residence (62%), and have low risk of developing anemia based on age group (81.7%). For lifestyle factors, the majority of respondents were found to have excessive physical activity (52.8%).

For food consumption factors, the majority of respondents consume inadequate meat, poultry, and their products (89.6%); consume inadequate fish, clams, shrimps, and their products (82.8%); consume inadequate eggs and its products (77.2%); with routine consumption of vegetables (62.4%) and non-routine consumption of fruits (68.8%). For gestation period factors, the majority of respondents experienced primipara (42.1%), have a not at risk pregnancy gap (72.7%), had inadequate consumption of iron-folic acid tablets (77%), are not consuming supplementary foods (82.7%), and don't have PEW (81%).

Table 2 contains the results of bivariate analysis, which shows no significant correlation of anemia in pregnant women with sociodemographic factors. Some food consumption factors, namely the consumption of fish, clams, shrimps, and their products, consumption of eggs and its products, vegetable consumption, and fruits consumption, also show no correlation with anemia in pregnant women. Moreover, parity, iron-folic acid tablet consumption, and PEW status show no correlation with anemia in pregnant women as well (p-value > 0.05). In contrast, consumption of beef, poultry, and their products; pregnancy interval; and supplementary food consumption show significant correlation with anemia in pregnant women (p-value < 0.05).

In contrast, significant relationships with anemia were found in consumption of beef, poultry, and their products (p-value = 0.047; OR = 1.913 CI: 0.968–3.655); pregnancy interval

(p = 0.033; OR = 2.402 CI: 1.062–5.436); and supplementary food consumption (p = 0.001; OR = 2.153 CI: 0.729–1.782).

Table 1. Univariate Analysis

Variables	n	Percentage (%)
Dependent Variable		
Anemia Status		
Anemic	80	27,3
Non-Anemic	213	72,7
Independent Variable		
Sociodemographic Factors		
Education		
Primary	82	27,9
Secondary	187	63,9
Tertiary	24	8,2
Employment Status		
Unemployed	210	71,6
Employed	83	28,4
Residence		
Rural	111	38
Urban	182	62
Age		
High Risk	54	18,3
Low Risk	239	81,7
Lifestyle Factors		
Physical Activity		
Excessive	122	52,8
Inadequate	88	38,2
Adequate	21	9
Food Consumption Factors		
Consumption of Meat, Poultry, and Their Products		
Inadequate	263	89,6
Adequate	30	10,4
Consumption of Fish, Clams, Shrimp, and Their Products		
Inadequate	243	82,8
Adequate	50	17,2
Consumption of Eggs and Its Products		
Inadequate	226	77,2
Adequate	67	22,8
Vegetable Consumption		
Not routine	110	37,6
Routine	183	62,4
Fruit Consumption		
Not routine	202	68,8
Routine	91	31,2
Gestation Period Factors		
Parity		
Multipara	100	36,9
Primipara	114	42,1

Variables	n	Percentage (%)
Nullipara	57	21
Pregnancy Interval		
At risk	27	27,3
Not at risk	72	72,7
Iron-Folic Acid Tablet Consumption		
Inadequate	173	77
adequate	52	23
Supplementary Food Consumption		
Not consuming	242	82,7
Consuming	51	17,3
PEW Status		
PEW	55	19
Non PEW	232	81

Table 2. Bivariate Analysis

Independent Variables	Anemia Status				Total		OR (95% CI)	*p-value*
	Anemia		Non-anemic					
	n	%	n	%	n	%		
Sociodemographic Factors								
Education								
Primary	24	28,6	58	71,4	82	100	2,528 (1,266–5,050)	0,191
Secondary	53	28,5	134	71,5	187	100	2,518 (1,401–4,525)	
Tertiary	3	13,7	21	86,3	24	100	1,000 (-)	
Employment Status								
Unemployed	63	30,1	147	69,9	210	100	1,702 (0,968–2,995)	0,063
Employed	17	20,2	66	79,8	83	100		
Residence								
Rural	34	30,7	77	69,3	111	100	0,763 (0,467–1,246)	0,274
Urban	46	25,3	136	74,7	182	100		
Age								
High Risk	15	28,5	38	71,5	53	100	1,077 (0,651–1,783)	0,770
Low Risk	65	27,1	175	72,9	240	100		
Lifestyle Factors								
Physical Activity								
Excessive	27	22,1	95	77,9	122	100	0,546 (0,270–1,104)	0,243
Inadequate	24	27,3	64	72,7	88	100	0,721 (0,367–1,414)	
Adequate	7	34,2	14	65,8	21	100	1,000 (-)	
Food Consumption Factors								
Consumption of Meat, Poultry, and Their Products								
Inadequate	75	28,5	188	71,5	263	100	1,913 (0,968–3,665)	**0,047***
Adequate	5	17,2	25	82,5	30	100		
Consumption of Fish, Clams, Shrimp, and Their Products								
Inadequate	65	26,6	178	73,4	243	100	0,821	0,439

Independent Variables	Anemia Status				Total		OR (95% CI)	*p-value*
	Anemia		Non-anemic					
	n	%	n	%	n	%		
Adequate	15	30,6	35	69,4	50	100	(0,496–1,361)	
Consumption of Eggs and Its Products								
Inadequate	59	26	167	74	226	100	0,759	0,416
Adequate	21	31,7	46	68,3	67	100	(0,387–1,488)	
Vegetable Consumption								
Not routine	28	25,5	82	74,5	110	100	0,862	0,526
Routine	52	28,4	131	71,6	183	100	(0,542–1,371)	
Fruit Consumption								
Not routine	53	26,3	149	73,7	202	100	0,849	0,538
Routine	27	29,6	64	70,4	91	100	(0,502–1,438)	
Gestation Period Factors								
Parity								
Multipara	31	31	69	69	100	100	1,475 (0,724–3,002)	
Primipara	35	30,8	69,2	69,2	114	100	1,464 (0,657–3,262)	0,519
Nullipara	13	23,3	76,7	76,7	57	100	1,000 (-)	
Pregnancy Interval								
At risk	12	45,8	15	54,2	27	100	2,402	**0,033***
Not at risk	19	26,1	53	73,9	72	100	(1,062–5,436)	
Iron-Folic Acid Tablet Consumption								
Inadequate	54	31,1	119	68,9	173	100	1,140	0,560
adequate	15	28,3	37	71,7	52	100	(0,729–1,782)	
Supplementary Food Consumption								
Not consuming	72	29,6	171	70,4	243	100	2,153	**0,001***
Consuming	8	16,3	42	83,7	50	100	(1,393–3,329)	
PEW Status								
PEW	16	28,9	39	71,1	55	100	1,116	0,779
Non PEW	62	26,7	170	73,3	232	100	(0,515–2,418)	

*Significant if p-value < 0.05

Discussion

From the analysis, it was found that there were more pregnant women who were anemic than non-anemic, and with a prevalence of 27.3% it can be said that this is a moderate public health problem according to WHO guidelines.[1] The first factor analyzed was sociodemographic factors. From that factor it was found that the proportion of anemic pregnant women was higher in pregnant mothers with their highest education level being

primary level (28.6%), though no significant association was found between the two variables (p-value > 0.05). The results of the analysis were not in-line with the theory where higher education levels were associated with higher nutritional awareness thus lowering the risk of anemia in pregnant women, increasing productivity alongside income to boost nutritional intake during pregnancy. The insignificant association could happen due to other factors that are more dominant such as socio-economic status and food consumption.[24,25] The proportion of anemic pregnant women was found to be higher in those with an unemployed status (30.1%), though no significant association was found between the two variables (p-value > 0.05). Employment status determines individual income which is closely related to education level, residence, socioeconomic status, consumption of healthy foods, and access to information, which in theory proves an indirect association to anemia incidence.[26] However, the findings in the study were not in-line with the theory. This insignificant association could happen due to other factors that have a more direct effect towards the incidence of anemia compared to employment status.

Pregnant women with anemia were found in higher proportions in rural residences (30.7%), though no significant association was found between the two variables (p-value > 0.05). The difference between rural and urban residences is a risk factor for health problems including anemia, in which rural residents have less accessibility to more nutritious foods and healthcare, meanwhile urban residents are at higher risk of malnutrition due to a fast-paced lifestyle and less healthy processed foods.[27] The insignificant results could happen due to the indirect influence of residence and anemia. It was also found that the proportion of pregnant women with anemia was higher in pregnant women in low-risk ages (27.1%) with the

association between the two variables being insignificant (p-value > 0.05). This could happen due to the proportion of pregnant women in low-risk ages being significantly higher than pregnant women in high-risk ages. Younger women (< 20 years old) and older women (> 35 years old) were found to have reproductive capabilities that were less supportive of pregnancy due to the reproductive organs being immature and still in the development phase, causing a competition for nutrition between the mother and the fetus, or due to the decline in bodily function respectively. Thus, the ideal age for pregnancy should be in the range of 20-35 years old.[28,29] From the results of the cross-tabulations with the other variables, women in high risk ages tend to have a primary education level, live in rural areas, have a multipara parity, alongside an at risk pregnancy interval, all these variables could be correlated to the susceptibility of anemia due to the lack of health knowledge alongside consumption of nutritious food during pregnancy.[30]

Based on Table 2, it was found that the highest proportion of pregnant women with anemia was in mothers with inadequate physical activity (27.3%) with the association between the two variables being insignificant (p-value > 0.05). Results of cross-tabulations with other variables found that pregnant women with excessive physical activity are more inclined to have a higher rate of consumption of animal products, alongside not having protein energy wasting (PEW). Other than the reasons stated above, other factors such as food consumption could be more dominant to anemia incidence in pregnant women. Excessive physical activity creates a metabolic burden on the mothers and causes loss of iron due to hemolysis and excessive sweating. An increase in cytokines due to exercise stimulates hepcidin production in the liver which inhibits the transportation and absorption of iron.[4,31]

Bivariate analysis shows a borderline significant association between meat, poultry, and their products' consumptions and incidence of anemia in pregnant women (p-value = 0.047; OR = 1.913 CI: 0.968–3.655), with a higher proportion of anemia incidence in pregnant women with inadequate consumption (28.5%). This variable also has a significant association with other variables including consumption of other animal products, PEW status, and employment status. In this study, pregnant women with inadequate consumption of meat, poultry, and their products tend to be unemployed. Other studies have also found that socio-economic factors from the family, including the mother herself, could have an effect towards the incidence of anemia, where unemployed mothers find it more challenging to afford and consume nutritious food.[24] Further analysis in this study shows that pregnant women with inadequate consumption of meat, poultry, and their products are 1.9 times more likely to experience anemia compared to those with adequate consumption. However, considering the CI of 0.968–3.655, statistical uncertainties might occur based on changes in sample size. The category of meat, poultry, and their products' consumption in SKI 2023 consists of red meats and white meats. Red meats are meats that come from mammals (cows, goats, sheep, and others), meanwhile white meats are meats that come from poultry (chickens, etc.). Myoglobin, a protein found in muscles, gives the red color found in red meats. Where the nutritional content is concerned, red meats were found to be higher in fats compared to white meats.[32] Meats, be it red or white, contain proteins with high bioavailability alongside a few other essential micronutrients which include iron, zinc, and vitamin B12. Protein plays an important role in the transport of iron in the body, in the case of a protein deficiency, the iron transport process will be inhibited, causing iron deficiency. [33] Iron is a crucial component in

erythropoiesis, and is commonly found in two forms: heme iron which is found in animal-based foods such as red meat, poultry, and fish; non-heme iron which is found in plant-based foods and a few animal-based products. Heme iron has a higher bioavailability (the amount of absorbed nutrients that becomes available for normal physiological functions or body storage) and absorption than non-heme iron.[5] Aside from iron, zinc deficiency could also lead to anemia. This is because zinc is known to be involved in growth and cell division, as well as for erythropoiesis.[26] For pregnant women, protein requirements were found easier to fulfill with adequate consumption of animal proteins, such as meats, poultry, and seafood.[34]

Consumption of fish, clams, shrimp, and their products were found to have an insignificant association with incidence of anemia in pregnant women (p-value > 0.05). A higher proportion of anemia were found in mothers with adequate consumption (30.6%) which could explain the insignificant association between the two variables, other than that there are more dominant factors that could affect the result of the study. In theory, fish and other seafood are rich in high bioavailability protein, heme iron, essential amino acids, and omega-3 which aids in fetal development,[23,35] though they are also high in calcium and phosphorus which inhibits the absorption of iron.[36] The consumption of eggs and products was also found to not have a significant association with incidence of anemia in pregnant women (p-value > 0.05), with a higher proportion of pregnant women with anemia being found in mothers with adequate consumption (31.7%) which could cause the insignificant association between the two variables. Other than that, the insignificant association could be caused by an inclination in mothers with inadequate consumption of eggs and its products to have adequate consumption of iron-folic acid tablets and supplementary foods. Even though

eggs, like other animal proteins, are high in protein, iron, essential fatty acids, vitamins A, D, E, K, and B12, which are ideal to preventing anemia, it also contains phosphite which is a known inhibitor of iron absorption, causing consumed iron to be bonded and neutralized.[36]

The two variables, fruit consumption, and vegetable consumption were found to have insignificant associations with incidence of anemia in pregnant women (p-value > 0.05). A higher proportion of pregnant women with anemia were found in women with routine vegetable consumption (28.4%) and routine fruit consumption (29.4%). Based on cross-tabulations, it was found that pregnant women who don't consume vegetables as a routine were also found to not consume fruits as a routine, and vice versa. Vegetables are plant-based foods high in non-heme iron, especially in green vegetables. However, it should be noted that plant-based foods including vegetables contain polyphenols and phytic acid which varies in concentration in various types of vegetables, these compounds are known to be iron absorption inhibitors.[37,38] Other than that, pregnant women who don't consume vegetables tend to have adequate animal-based food consumption, supplementary food consumption, and non-PEW, which results in an insignificant association that was influenced by other more dominant factors. Meanwhile, fruits are high in vitamins and minerals such as vitamin C which boosts iron absorption. However, the insignificant association with anemia incidence could be explained by the fact that fruits are not sources of iron, while anemia risk can be lowered through good nutritional status alongside adequate energy and iron intake from other foods.[38]

Within the gestation period factor, parity was found to be insignificantly associated with incidence of anemia in pregnant women (p-value > 0.05), with a higher proportion of anemia found in multipara pregnant women (31%). Although the association was insignificant, results

of cross-tabulations with other variables shows that multipara pregnant women were more inclined to have adequate consumption of animal-based foods, with a pregnancy interval that was not at risk which means the possibility of interventions that minimize or mitigate the risk of undernutrition, which affects the association.[39] This insignificant association could also be caused by other variables which have a more direct and dominant influence on incidence of anemia, such as pregnancy interval.[40]

A significant association was found between pregnancy interval and incidence of anemia in pregnant women (p-value = 0.033; OR = 2.402 CI: 1.062–5.436), with a higher proportion of pregnant women with anemia were found in mothers with an at risk pregnancy interval (45.8%), the odds ratio shows that pregnant women with an at risk pregnancy interval are 1,14 times more likely to have anemia. Compared to parity, pregnancy interval has a more direct impact and happens physiologically, which causes it to have a higher influence on anemia incidence during pregnancy. Maternal Depletion Syndrome Theory states that short pregnancy interval inhibits recovery, which causes undernutrition that negatively affects maternal and infant health,[41] meanwhile the Maternal Physiologic Regression hypothesis states that pregnancy after a long pause restores the body's mechanism back to primigravida which increases the risk of anemia and suboptimal pregnancies.[42] Therefore, the results of the analysis are in-line with both theories. A short pregnancy interval could be correlated to socioeconomic status, lifestyle, and access to contraceptives, which could be prevented by educational interventions such as the Keluarga Berencana (KB) program, meanwhile a longer pregnancy interval could be more difficult to control due to certain factors such as infertility, financial difficulties, employment status, or other health problems.[43]

Consumption of iron-folic acid tablets was found to have an insignificant association with incidence of anemia in pregnant women (p-value > 0.05), with a higher proportion of anemia found in pregnant women with inadequate iron-folic acid tablet consumption (31.1%). This insignificant association could be caused by other more dominant factors compared to iron-folic acid tablet consumption, such as consumption of foods that are known inhibitors and enhancers of iron absorption. The efficacy of iron-folic acid tablets is influenced by the rate of iron absorption, especially in pregnant women with poor eating habits.[44] On the other hand, adherence to iron-folic acid tablet consumption in Indonesia has also been a persistent challenge among women of childbearing age and pregnant women.[45] The Indonesian Ministry of Health has established the mandatory consumption of iron-folic acid tablets containing 60 mg of elemental iron and 0,4 mg of folic acid for pregnant women with a recommended dose of 90 tablets during pregnancy. Consumption below the set dose during pregnancy could result in detrimental effects on both maternal and infant health due to inadequate iron intake.[23] According to the 2023 Indonesian Health Survey Data, common reasons for non-compliance in consuming iron-folic acid tablets include forgetting to take the tablets (25%), vomiting due to pregnancy (12,6%), and experiencing side effects such as nausea and darkened stool (7,7%).

In contrast, supplementary food consumption was found to have a significant association with the incidence of anemia in pregnant women (p-value = 0.001; OR = 2.153 CI: 1.393–3.329), with a higher proportion of anemia found in mothers who do not consume supplementary foods (29.6%), said group is 2,15 times more likely to have anemia compared to pregnant women who consume their supplementary foods. These results are in-line with

the theory that states that pregnant women have higher nutritional requirement compared to women of childbearing age who are not pregnant due to changes in physiology, such as an increase in metabolism and hemodilution which could cause anemia if not given supplements and/or nutritional requirement aren't met.[4]

Indonesia has implemented the supplementary food program as an effort to improve the nutritional status of pregnant women and toddlers. For pregnant women, the supplementary foods are provided if they are at risk of or have PEW nutritional status, as well as for pregnant women who are at risk of or have PEW nutritional status along with anemia. The supplementary foods provided to pregnant women and toddlers can be in the form of biscuits or local foods. Currently, based on the 2023 Technical Guidelines for Supplementary Feeding (Petunjuk Teknis PMT 2023) by The Ministry of Health Republic of Indonesia, supplementary foods are given in the form of homemade foods made by local produce. This is to utilize food resources in local areas and to achieve more effective as well as efficient nutritional fulfillment compared to PMT biscuits.[46]

The last independent variable studied is protein energy wasting (PEW) status, which in the bivariate analysis wasn't found to have a significant association with anemia incidence in pregnant women (p-value > 0.05). A higher proportion of pregnant women with anemia was found in mothers with PEW (28.9%). Based on the cross-tabulations with other independent variables, it was found dan PEW has a significant association with consumption of meat, poultry, and their products' consumption, where pregnant women with PEW were more inclined to not consume those products. This finding is in-line with the theory that states that animal-based foods including meats, poultry, and their products are high in proteins which

prevents and minimizes risk of PEW when consumed adequately.[33] The insignificant association between PEW and anemia in pregnant women could be caused by more dominant variables such as food consumption.

This study utilizes secondary data from the 2023 Indonesian Health Survey (SKI). With that in mind, the variables used are limited to adjust to the available data. The variable of food consumption could not be analyzed to every specific type of food available due to the food types already being grouped, especially for meat, poultry, and their products; fish, shrimp, clams, and their products; and eggs, and their products. However, the available food category may describe the food intake factors. Categorization limitations regarding these factors are already stated under the Method section. Variables such as age could not be analyzed due to it not being questioned in the 2023 Indonesian Health Survey Individual Questionnaire, this is the same with tea and coffee consumption alongside ANC visits for the current pregnancy. During analysis of a few other variables, the sample size was adjusted to include respondents with complete data, causing it to be smaller if there is incomplete data, which affects the results of the analysis.

Conclusion

This study explores factors associated with anemia in pregnant women from sociodemographic, lifestyle, food consumption, and gestation period factors. The results confirm the association between consumption of meats, poultry, and their products; pregnancy interval; and supplementary food consumption with the incidence of anemia in pregnant women, further proving that food consumption and gestational factors play the

utmost important roles in determining anemia status during pregnancy. These findings drive the urgency to strengthen nationwide community nutrition programs, with special attention to supplementary feeding by ensuring standard nutritional quality practices, monitoring compliance through health workers or Posyandu cadres, and emphasizing the importance of supplementary food consumption. Collaboration between health and education sectors are also needed to increase community knowledge on nutrition and ultimately to mitigate risks of anemia incidence during pregnancy, especially for teenage girls and women of childbearing age. Further research should aim to use alternative methods of study to explore other factors such as socioeconomic factors that may have an association with incidence of anemia in pregnant women.

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Conflict of Interest

There is no conflict of interests in this publication.

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