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Factors Associated with the Incidence of Anemia among Pregnant Women in Indonesia (IFLS 5 Secondary Data Analysis)

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Abstract

Anemia is a severe public health problem with the incidence of anemia among pregnant women in Indonesia at 46.2% based on data from the Indonesia Family Life Survey (IFLS) 5. This study aimed to determine the factors associated with the incidence of anemia among pregnant women in Indonesia. The cross-sectional design of the study was using secondary data from IFLS 5 which was conducted from September 2014 to March 2015 on 292 pregnant women out of 53,160 respondents based on inclusion and exclusion criteria. Chi-square analysis showed that maternal age, maternal occupation, smoking habit, food frequency, green vegetable consumption, vitamin C consumption, socioeconomic status and health service distance were not associated with the incidence of anemia among pregnant women in Indonesia. Whereas maternal education (p=0.006), nutritional status (p=0.003), gestational age (p=0.001), iron consumption (p=0.001), ANC examination (p=0.006) and protein consumption (p=0.012) were associated with the incidence of anemia among pregnant women in Indonesia. Multivariate analysis with multiple logistic regression showed maternal education (p=0.014), nutritional status (p=<0.001), gestational age (p=0.002), iron consumption (p=0.008) and protein consumption (p=0.038) were associated with the incidence of anemia among pregnant women in Indonesia. Gestational age was the most dominant variable associated with the incidence of anemia among pregnant women after controlling for maternal education, nutritional status, iron consumption and protein consumption (OR=3.029; 95% CI=1.520-6.038).

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INTRODUCTION

Anemia of pregnant women is a condition with hemoglobin (Hb) levels in the blood less than 11 g/dl. Based on the group of pregnant women with mild anemia, the Hb standard is 10.0-10.9 g/dl. While the Hb standard is 7.0-9.9 g/dl classified as moderate anemia in pregnant women. While pregnant women with Hb standard is less than 7.0 g/dl including severe anemia (WHO, 2011). The target of anemia control at the world level contained in the SDG's in 2012 with the aim of reducing 50% of the prevalence of anemia in women of productive age by 2030 (WHO, 2019). However, the fact is that the prevalence of anemia in pregnant women decreased from 41% to 36% between 2000 and 2019 (Daru, 2019). Thus, the decline is only around 7.2%, which is still far from the target of a 50% reduction in the prevalence of anemia in women of productive age, especially in pregnant women, so there is still a gap of 43%. The global prevalence of anemia among pregnant women is 36% and the prevalence of anemia among pregnant women in East and Southeast Asia is 27% (Stevens et al., 2022). Meanwhile, Indonesia as part of Southeast Asia has a prevalence of anemia among pregnant women of 44% (WHO & Statistics, 2019). Thus, the prevalence of anemia among pregnant women in Indonesia still exceeds 8% of the global prevalence rate of anemia among pregnant women and exceeds 17% of the prevalence of anemia among pregnant women in East and Southeast Asia.

The target of controlling the prevalence of anemia among pregnant women in Indonesia in 2019 is 28% which is contained in the RPJMN 2015-2019 Community Nutrition Status indicator (Kementerian Perencanaan Pembangunan Nasional RI, 2014). In fact, there was an increase in the prevalence of anemia among pregnant women beyond the target from 24.5% to 37.1 between 2007 and 2013 and increased again from 37.1% to 48.9% between 2013 and 2018 (Kemenkes RI, 2018b). Thus, the prevalence of anemia among pregnant women still exceeds 9.1-20.9% of the target of controlling the prevalence of anemia among pregnant women in Indonesia.

Anemia in pregnant women if left untreated will be the main cause of bleeding which is a factor in maternal mortality in Indonesia. There is a 1.38 times risk of mothers giving birth to low birth weight babies (Figueiredo et al., 2019). There is a 1.36-3.35 times risk of mothers experiencing placental abruption (Shi et al., 2022). Risk of 1.08-1.36 times of preterm birth (Shi et al., 2022). Risk of 1.45-15.65 times of maternal postpartum hemorrhage (Shi et al., 2022). Risk of 1.5-14.98 times the mother having increased shock (Shi et al., 2022). Risk of 1.08-2.88 maternal ICU admissions (Shi et al., 2022). 1.56 times risk of maternal death (Shi et al., 2022). Risk of 1.13-1.16 times the mother having a cesarean delivery (Shi et al., 2022). In addition to having an impact on the mother, anemia if not treated will also have an impact on the fetus. There is a 1.08 times risk of fetal stunted growth (Shi et al., 2022). There is a 1.15-1.62 times risk of fetal malformation (Shi et al., 2022). There is a 1.86 times risk of fetal stillbirth (Shi et al., 2022).

Risk factors that cause anemia in pregnant women are maternal age (Katmini & Yunita, 2020), maternal employment (Nuwabaine et al., 2024), maternal education (Yadav et al., 2021), nutritional status (Shitie et al., 2018), gestational age (Dodzo et al., 2022), iron consumption (Gebre & Mulugeta, 2015), ANC examination (Margawati et al., 2023), smoking habits (Kebede et al., 2018), meal frequency (Gibore et al., 2021), protein consumption (Anenga et al., 2022), green vegetable consumption (Osman et al., 2020), vitamin C consumption (Deriba et al., 2020), socioeconomic status (Abdallah et al., 2022) and health service distance (Mbule et al., 2013).

Research related to risk factors for anemia in pregnant women has the potential to use IFLS 5 secondary data. IFLS 5 secondary data is a survey that describes the health and socio-economic conditions of households in Indonesia on an ongoing basis. The IFLS 5 survey collected data from individual respondents, families, households and communities. The IFLS questionnaire is divided into several books. Four books are related to household-level information, usually from the household head or spouse,

namely books T, K, 1, and 2. The next four books are related to individual-level data from adult respondents (books 3A and 3B), ever-married female respondents (book 4), and children under the age of 15 (book 5). Individual measures of health status were recorded for each household member (book US). Household members above 7 years of age were asked to participate in a cognitive assessment of their general intelligence and their skills in math (EK book). The IFLS 5 survey was conducted in collaboration between RAND Corp (Santa Monica, California) and the Center for Population and policy Studies (CEPS) UGM. The advantages of research using IFLS 5 data are that the sample represents 83% of the territory in Indonesia, has a valid and standardized questionnaire, is easily accessible at no cost, and is longitudinal from 1993-2014 there have been 5 waves of surveys.

The purpose of this study is to determine what factors are associated with the incidence of anemia among pregnant women in Indonesia contained in the IFLS 5 data.

METHODS

This study uses longitudinal data from IFLS, specifically IFLS 5. IFLS is a longitudinal survey conducted by the RAND Corporation from 1993 to 2014 (Strauss et al., 2016). The data represents 83% of the Indonesian population and has a high number of contactable respondents (Strauss et al., 2016). 90.5% of IFLS 4 participants were successfully re-interviewed in IFLS 5 (Strauss et al., 2016). IFLS uses the 1993 National Socio-Economic Framework Survey (SUSENAS) (Strauss et al., 2016). The sampling scheme is stratified random sampling with provinces and rural or urban locations as strata and random samples within those strata. The IFLS sample consists of 13 out of 27 provinces considering cost-effectiveness and represents 83% of the Indonesian population (Strauss et al., 2016). Thus, the data is ideal for testing the hypothesis in this study, which is the relationship between factors and the incidence of anemia among pregnant women. There were 292 pregnant women from 53.160 respondents who met the inclusion and exclusion criteria. Pregnant women who were IFLS 5 respondents and pregnant women whose Hb levels were measured were the inclusion criteria. While the exclusion criteria include non-pregnant women, men or women aged <15 or >49 years, incomplete data and respondents who answered other and do not know.

The independent variables in this study were maternal age categorized into <20 or >35 years and 20-35 years (Ministry of Health RI, 2021). Maternal occupation is categorized into non-working mothers (housewives) and working mothers (Sulung et al., 2022). Maternal education was categorized into ≤SMP and >SMP (Yadav et al., 2021). Nutritional status was categorized into BMI <median 24,5 kg/m^2 and BMI ≥median 24,5 kg/m^2. Gestational age was categorized into at-risk (trimester II and III) and not at-risk (trimester I) (F. Safitri et al., 2021). Iron consumption is categorized into no and yes (Mostafa et al., 2022). ANC examination was categorized into inappropriate (<2T) and appropriate (≥2T) (IFLS, 2014). Smoking habit was categorized into yes and no (Taner et al., 2015). Meal frequency was categorized into <3 times/day and ≥3 times/day (Mostafa et al., 2022). Protein consumption was categorized into rare (< median 3 times) and frequent (≥ median 3 times), green vegetable consumption was categorized into no and yes (Widodo et al., 2023) while vitamin C consumption was categorized into rare (< median 1 time) and frequent (≥ median 1 time). Socioeconomic status was categorized into poor (≤level 3) and rich (>level 3) (Mbule et al., 2013) and health service distance was categorized into at-risk (≥median 1 km) and not at-risk (<median 1 km). Anemia of pregnant women was categorized as anemia and not anemia as the dependent variable.

Univariate analysis to determine frequency distribution, bivariate using Chi-square and Fisher's test (alternative test if Chi-square test is not met) using a confidence level of 0.05 (95% CI). Multivariate analysis with logistic regression to determine the variables most associated with the incidence of anemia among pregnant women in Indonesia. Before analysis, the data was first

cleaned and re-coded according to the researcher's operational definition to overcome incomplete or missing data

RESULTS AND DISCUSSION

Table 1. Characteristics of Research Respondents

Variable	Frequency (n)	Percentage (%)
Maternal Age		
<20 years	44	15,1
21-25 years	76	26,0
26-30 years	74	25,3
31-35 years	68	23,3
≥36 years	30	10,3
Maternal Occupation		
Non-working mother (housewife)	207	70,9
Working Mother	85	29,1
Maternal Education		
Elementary school/equivalent	48	16,4
Junior high school/equivalent	64	21,9
High school/equivalent	121	41,4
Higher Education	59	20,2
Nutrition Status		
BMI (<median 24,5 kg/m^2)	142	48,6
BMI (≥median 24,5 kg/m^2)	150	51,4
Gestational Age		
First Trimester	64	21,9
Second Trimester	112	38,4
Third Trimester	116	39,7
Iron Consumption		
No	79	27,1
Yes	213	72,9
ANC examination		
Not appropriate (≤median 2T)	43	14,7
Appropriate (>median 2T)	249	85,3
Smoking Habit		
Yes	5	1,7
No	287	98,3
Meal Frequency		
1 time/day	8	2,7
2 times/day	53	18,2
3 times/day	231	79,1
Protein Consumption		
Rarely (<median 3 times)	94	32,2
Often (≥median 3 times)	198	67,8
Green Vegetable Consumption		
No	27	9,2
Yes	265	90,8
Vitamin C Consumption		
Rarely (<median 1 times)	53	18,2
Often (≥median 1 times)	239	81,8
Socioeconomic Status		
Level 1: Poorest	8	2,7
Level 2	42	14,4
Level 3	148	50,7
Level 4	81	27,7
Level 5	12	4,1
Level 6: Richest	1	0,3
Health Service Distance		
<5 km	245	83,9
5-10 km	26	8,9
10-15 km	7	2,4

Variable	Frequency (n)	Percentage (%)
Health Service Distance		
15-25 km	6	2,1
25-35 km	1	0,3
>35 km	7	2,4
Incidence of Anemia		
Yes (Hb <11 gr/dl)	135	46,2
No (Hb ≥11 gr/dl)	157	53,8
Total	292	100

Table 1 shows that the average age of respondents was 21-25 years old (26%), not working or as a housewife (70.9%), most of the respondents had high school education (41.4%), BMI ≥24.5 kg/m^2 (51.4%) and pregnancy age was in the third trimester (39.7%). Most of the respondents consumed iron (72.9%) and had standardized ANC check-ups (85.3%). Most of the respondents had no smoking habit (98.3%) and had eaten with a frequency of ≥3 times/day (79.1%). On average, respondents did not consume protein (67.8%).

Most respondents consumed green vegetables (90.8%) and often consumed vitamin C (81.8%). The socioeconomic status level of the respondents was average (50.7%) and most respondents had a distance to health services <5 km (83.9%) and the majority of respondents who were not anemic were 53.8%.

Table 2 shows that maternal age is not associated with the incidence of anemia in pregnant women in this study because the p value = 0.810 > 0.05. This is not in line with research conducted by Katmini & Yunita (2020) which proves that there is a relationship between maternal age and the incidence of anemia in pregnant women (Katmini & Yunita, 2020). The finding that maternal age was not associated with the incidence of anemia in pregnant women could be due to the fact that most respondents were at the age of <20 or >35 years to develop anemia (48.4%). The tendency of anemia at a younger age is caused by lack of awareness, poor knowledge related to antenatal care, not seeking prenatal care early and taking care of oneself during pregnancy and the tendency of anemia with age is caused by increased body weakness, childbirth, and experiencing other diseases (Dodzo et al., 2022).

Maternal employment was not associated with the incidence of anemia in pregnant women in this study because the p value = 0.326 > 0.05. This is not in line with research conducted by Katmini & Yunita (2020) which proves that there is a relationship between maternal employment and the incidence of anemia in pregnant women (Katmini & Yunita, 2020). The finding of maternal employment having no association with the incidence of maternal anemia could be due to the fact that working pregnant women are more likely to be in contact with various mothers related to social networks who can provide nutritional advice during pregnancy and visit health facilities where they get advice and iron tablets, unlike non-working pregnant women. Pregnant women who do not work or as housewives have a tendency to have limited information flow and interaction with the environment, thus affecting the transfer of knowledge information to be reduced when compared to pregnant women who work (Nuwabaine et al., 2024).

Maternal education is associated with the incidence of anemia in pregnant women in this study because the p value = 0.006 <0.05. This is not in line with research conducted in Nepal which proves that respondents with low education to experience anemia are still dominant compared to respondents with high education (Yadav et al., 2021). The finding that maternal education has a relationship with the incidence of anemia in pregnant women can be due to the fact that most respondents have a higher education background and experience anemia. Respondents with higher education tend to work and spend most of their time doing their work, so they do not have enough time to prepare quality food and eat enough food every day. Instead they rely on food sold at the workplace, which is mostly fast food with minimal diversity

Table 2. Bivariate Analysis of Factors Associated with the Incidence of Anemia among Pregnant Women in Indonesia

Variable	Anemia		*p-value*	PR (95% CI)
	Yes	No		
Maternal Age				
<20 or >35 years	30 (48,4%)	32 (51,6%)	0,810	1,060
20-35 years	105 (45,7%)	125 (54,3%)		(0,791-1,421)
Maternal Occupation				
Non-working mother (housewife)	100 (48,3%)	107 (51,7%)	0,326	1,173
Working Mother	35 (41,2%)	50 (58,8%)		(0,877-1,569)
Maternal Education				
≤ Elementary High School	13 (27,1%)	35 (72,9%)	0,006*	0,542
≥ Junior High School	122 (50,0%)	122 (50,0%)		(0,335-0,876)
Nutrition Status				
BMI (<median 24,5 kg/m^2)	79 (55,6%)	63 (44,4%)	0,003*	1,490
BMI (≥median 24,5 kg/m^2)	56 (37,3%)	94 (62,2%)		(1,156-1,921)
Gestational Age				
Second and Third Trimester	118 (51,8%)	110 (48,2%)	0,001*	1,948
First Trimester	17 (26,2%)	47 (73,4%)		(1,272-2,984)
Iron Consumption				
No	24 (30,4%)	55 (69,6%)	0,001*	0,583
Yes	111 (52,1%)	102 (47,9%)		(0,408-0,834)
ANC examination				
Not appropriate (≤2T)	11 (25,6%)	32 (74,4%)	0,006*	0,514
Appropriate (>2T)	124 (49,8%)	73 (50,2%)		(0,304-0,868)
Smoking Habit**				
Yes	3 (60,0%)	2 (40,0%)	0,665	1,305
No	132 (46,0%)	155 (54,0%)		(0,631-2,698)
Meal Frequency				
< 3 times/day	33 (54,1%)	28 (45,9%)	0,215	1,225
≥ 3 times/day	102 (44,2%)	129 (55,8%)		(0,933-1,610)
Protein Consumption				
Rarely (<median 3 times)	33 (35,1%)	61 (64,9%)	0,012*	0,681
Often (≥median 3 times)	102 (51,5%)	96 (48,5%)		(0,502-0,926)
Green Vegetable Consumption				
No	12 (44,4%)	15 (55,6%)	1,000	0,958
Yes	123 (46,4%)	142 (53,6%)		(0,616-1,488)
Vitamin C Consumption				
Rarely (<median 1 times)	20 (37,7%)	33 (62,3%)	0,223	0,784
Often (≥median 1 times)	115 (48,1%)	124 (51,9%)		(0,542-1,135)
Socioeconomic Status				
Poor (≤ level 3)	90 (45,5%)	108 (54,5%)	0,794	0,949
Rich (> level 3)	45 (47,9%)	49 (52,1%)		(0,732-1,232)
Health Service Distance				
Risky (≥median 1 km)	96 (45%)	111 (53,6%)	1,000	1,011
Not at Risk (<median 1 km)	39 (46,8%)	46 (54,1%)		(0,769-1,329)

**=p-value <0,05 **= Fisher Exact Test*

(Gibore et al., 2021). Research (Nuwabaine et al., 2024; Rezk et al., 2015) states that the incidence of anemia can be experienced by pregnant women who work. This is because pregnant women lack rest due to excessive workload, which causes the production of red blood cells to not be maximized and can lead to anemia. This situation caused by the busyness of working pregnant women. Pregnant women consume less protein and vegetables, consume iron tablets so that iron absorption isn't optimal, unlike mothers who don't work (Haryani & Purwati, 2022).

Nutritional status is associated with the incidence of anemia in pregnant women in this study because the p value = 0.003 <0.05. This is in line with research conducted in Ethiopia which proves that respondents with BMI <19.8 to experience anemia are still dominant compared to respondents with BMI ≥19.8 (Shitie et al., 2018). The finding of nutritional status associated with the incidence of anemia in pregnant women can be caused by most respondents with BMI

<24.5 kg/m^2 where malnourished pregnant women have a higher risk of micronutrient deficiencies, which can cause anemia. Pregnancy is the period with the highest nutritional needs in a woman's life. Therefore, pregnant women are advised to consume a more diverse diet than usual (Okube et al., 2016).

Gestational age was associated with the incidence of anemia in pregnant women in this study because the p value=0.001 <0.05. This is in line with research conducted in Ethiopia which proves that respondents with the second and third trimester of pregnancy are still dominant compared to the first trimester (Balis et al., 2022). The finding that age in the second and third trimester of pregnancy is higher for anemia is due to the fact that during pregnancy the need for calories and nutrients increases to support increased maternal metabolism, blood volume, and delivery of nutrients to the fetus. This will further increase in the second and third trimester of pregnancy.

Whereas in the first trimester there is a decrease in iron absorption, due to lower iron requirements and cessation of menstruation, thus saving an average of 0.56 mg Fe/day (160 mg/pregnancy). However, in the second trimester iron absorption from foods with very high iron bioavailability increases by 1.9 mg/day and in the last trimester increases to 5.0 mg/day (Lebso et al., 2017). In addition, as pregnancy progresses there is an increase in oxygen consumption by the mother and fetus with major hematological changes. In addition, for the development of the baby's red blood cells, iron is needed for fetal growth to increase gradually in proportion to fetal weight, and reaches its peak in the third trimester (Balcha et al., 2023). Similarly, a Nigerian study showed that the dilution effect of pregnancy and the increased fetal need for hematopoietic factors peaked after the first trimester (Olatunbosun et al., 2014).

Iron consumption was associated with the incidence of anemia among pregnant women in this study because the p value=0.001 <0.05. This is not in line with research conducted in Ethiopia which proved that respondents who did not consume iron were still dominant compared to those who consumed iron (Gebre & Mulugeta, 2015). The finding of anemic respondents who consumed iron in the study was due to the fact that first, the researchers' analysis did not consider adherence and duration of iron supplement use, both of which can affect the level of hematological response to the supplement. Second, most participants did not experience iron deficiency. Third, the results of this study were influenced by unique dietary factors that may affect iron absorption (Mohammed et al., 2019). Based on (Kemenkes RI, 2018a), the prevention of iron nutritional anemia in pregnant women is carried out by giving one blood supplement tablet (TTD) every day during pregnancy, with a total of at least 90 tablets. This supplement should be started as early as possible and continued until the postpartum period. In addition, as health workers working in remote health institutions do not have enough motivation to effectively distribute IFA tablets and improve adherence of pregnant women. Low adherence is mainly due to side effects associated with iron supplements (Viveki et al., 2012). Alternatively, pregnant women who do not take iron may have better knowledge, access to health care, and adherence to alternative iron-rich foods compared to pregnant women who choose to take iron supplements (Nuwabaine et al., 2024).

ANC examination was associated with the incidence of anemia among pregnant women in this study because the p value = 0.006 < 0.05. This is not in line with research conducted by Margawati et al. (2023) which proved that respondents with ANC examinations that did not meet the requirements were still dominant to experience anemia compared to respondents with ANC examinations that met the requirements (Margawati et al., 2023). The finding of standardized ANC check-ups for anemic pregnant women in this study is due to the fact that ANC is viewed primarily as a cure, not prevention by pregnant women. Thus, these attitudes and misconceptions contribute to the high incidence of anemia in pregnant women (Mbule et al., 2013).

Smoking habits were not associated with the incidence of anemia in pregnant women in

this study because the p value = 0.665> 0.05. This is in line with research conducted in Ethiopia which proves that respondents who have smoking habits are still dominant to experience anemia compared to respondents who do not have smoking habits (Kebede et al., 2018). The finding of most respondents who have a smoking habit to experience anemia is due to the tar content contained in cigarette smoke and in a long time span can cause damage to the spinal cord, where the organ that produces erythrocytes and the presence of lead in the blood will interfere with heme biosynthesis which causes low hemoglobin levels or anemia in pregnant women (Safitri & Syahrul, 2015).

The frequency of meals was not associated with the incidence of anemia in pregnant women in this study because the p value = 0.215 > 0.05. This is in line with research conducted in Tanzania which proves that respondents who eat <3 times per day are still dominant to experience anemia in pregnant women compared to respondents who eat ≥3 times per day (Gibore et al., 2021). The finding that most respondents experienced anemia who had a meal frequency of <3 times per day, which is a marker of food insecurity that can increase the likelihood of anemia, which affects food diversity practices that cause nutritional inadequacy and result in anemia in pregnancy (Gibore et al., 2021).

Protein consumption is associated with the incidence of anemia in pregnant women in this study because the p value = 0.012 <0.05. This is not in line with research conducted in Nigeria which proves that respondents who do not consume protein to experience anemia are still dominant compared to respondents who consume protein (Anenga et al., 2022). The finding of respondents who often consume protein and experience the incidence of anemia in pregnant women in this study can be caused by the possibility of inadequate protein quality, where even though they often consume protein but do not meet the daily nutrition of pregnant women, the risk of anemia is greater.

Green vegetable consumption was not associated with the incidence of anemia in pregnant women in this study because the p value = 0.000 > 0.05. This is not in line with research conducted in Ethiopia which proved that respondents who did not consume green vegetables were still dominant to experience anemia compared to respondents who consumed green vegetables (Babah et al., 2024). The finding of respondents who experienced anemia by consuming green vegetables in this study could be due to the possibility of inadequate quality of green vegetables, where although consuming green vegetables but not sufficient daily nutrition of pregnant women, the possibility of a greater risk of anemia. Thus, although pregnant women consume green vegetables every day but do not meet the daily iron needs of the mother will result in anemia.

Vitamin C consumption was not associated with the incidence of anemia in pregnant women in this study because the p value = 0.223 > 0.05. This is in line with research conducted by Eteffa et al. (2022) which proved that respondents who did not consume vitamin C to experience anemia were still dominant compared to respondents who consumed vitamin C (Eteffa et al., 2022). The findings of most respondents who often consume vitamin C, which is 48.1%, where the variety of fruits containing vitamin C is only limited to 3 types of fruit, namely bananas, papayas and mango, experience anemia. With limited variations in the types of fruit containing vitamin C, it is possible that the quality of vitamin C is not adequate, where even though mothers often consume vitamin C in the form of 3 types of fruit but do not meet the daily needs of pregnant women, the risk of anemia will be greater. This is because if you consume vitamin C absorption of non-heme iron by changing the form of ferric to ferrous which is easily absorbed by the small intestine (Deriba et al., 2020).

Socioeconomic status was not associated with the incidence of anemia among pregnant women in this study because the p value = 0.794 > 0.05. This is in line with research conducted in Rwanda which proved that respondents with rich socioeconomic status were still dominant to experience anemia compared to respondents with poor socioeconomic status (Nuwabaine et al.,

2024). The finding of anemic respondents with rich socioeconomic status could be due to negative perceptions about taking iron supplements during pregnancy and poor food choices, where too much unhealthy food is consumed (Nuwabaine et al., 2024).

Distance to health services was not associated with the incidence of anemia among pregnant women in this study because the p value = 0.000 > 0.05. This is not in line with research conducted in Uganda, proving that respondents who have a distance of ≥3 km to health services to experience anemia are still dominant compared to respondents who have a distance of <3 km to health services (Mbule et al., 2013). The finding of anemic respondents with a distance of <1 km to health services in this study was caused by unsatisfactory service and medicine factors which led to low ANC checks by pregnant women at the nearest health facility (Nuwabaine et al., 2024). In addition, distance to health services is closely related to ANC check-ups performed during pregnancy, where there are misconceptions related to ANC being viewed primarily as curative rather than preventive by pregnant women. Thus, these attitudes and misconceptions contribute to the high incidence of anemia among pregnant women (Mbule et al., 2013).

Furthermore, multivariate analysis was performed using logistic regression test. The logistic regression test was performed on variables that had a p value <0.25 with the aim of determining the variables that had the most influence on the incidence of anemia among pregnant women. Based on the results of multivariate analysis contained in Table 3, it can be seen that the variables that have the most influence on the incidence of anemia in pregnant women are maternal education, nutritional status, gestational age, iron consumption and protein consumption. The mother's education variable has an OR value of 0.402 which means that after controlling for other variables, pregnant women who have high education are at risk of anemia compared to pregnant women who have low education. The nutritional status variable has an OR value of 2.761 which means that after controlling for other variables, pregnant women who have a BMI <24.5 kg/m^2 have a 2.761 times greater risk of experiencing anemia compared to pregnant women who have a BMI ≥24.5 kg/m^2. The gestational age variable has an OR value of 3.029 which means that after controlling for other variables, pregnant women who have gestational age in the second and third trimesters have a 3.029 times greater risk of anemia compared to mothers who have gestational age in the first trimester. The iron consumption variable has an OR value of 0.440, which means that after controlling for other variables, pregnant women who consume iron are at risk of anemia compared to pregnant women who do not consume iron. The protein consumption variable has an OR value of 0.559, which means that after controlling for other variables, pregnant women who often consume protein are at risk of anemia compared to pregnant women who rarely consume protein.

The results of multivariate analysis in table 3 show that the logistic regression equation is: y = -1.000 - 0.911 (maternal education ≤SD) + ...

Table 3. Multivariate Analysis of Factors Associated with the Incidence of Anemia among Pregnant Women in Indonesia

Variabel	B	Wald	*p-value*	Exp (B)	95% CI
Maternal Education	-0,911	5,983	0,014	0,402	0,194-0,834
Nutritional Status	1,016	14,548	<0,001	2,761	1,638-4,652
Pregnancy Age	1,108	9,918	0,002	3,029	1,520-6,038
Iron Consumption	-0,820	6,927	0,008	0,440	0,239-0,811
Protein Consumption	-0,581	4,284	0,038	0,559	0,323-0,970
Constant	-1,000	6,452	0,011	0,368	

Tabel 4. Probability calculation results in several scenarios

Respondens	Maternal Education	Nutritional Status	Pregnancy Age	Iron Consumption	Protein Consumption	Probability of Anemia in Pregnant Women
Respondent 1	≥SMP	BMI<24,5	TM I	No	Often	69,0%
Respondent 2	≥SMP	BMI <24,5	TM I	No	Rarely	79,9%
Respondent 3	≥SMP	BMI <24,5	TM I	Yes	Rarely	63,7%
Respondent 4	≥SMP	BMI ≥24,5	TM I	No	Often	86,0%
Respondent 5	≥SMP	BMI <24,5	TM II&III	Yes	Rarely	63,2%
Respondent 6	≤SD	BMI ≥24,5	TM I	Yes	Often	87,0%
Respondent 7	≤SD	BMI <24,5	TM I	Yes	Often	70,9%
Respondent 8	≤SD	BMI <24,5	TM II&III	Yes	Often	55,3%
Respondent 9	≤SD	BMI <24,5	TM II&III	No	Often	57,5%
Respondent 10	≤SD	BMI <24,5	TM I	No	Rarely	90,8%
Respondent 11	≥SMP	BMI ≥24,5	TM I	Yes	Often	73,1%
Respondent 12	≥SMP	BMI <24,5	TM I	Yes	Often	50,4%
Respondent 13	≥SMP	BMI <24,5	TM II&III	Yes	Often	75,4%
Respondent 14	≥SMP	BMI <24,5	TM II&III	No	Often	57,5%
Respondent 15	≥SMP	BMI <24,5	TM II&III	No	Rarely	56,8%
Respondent 16	≤SD	BMI <24,5	TM II&III	No	Rarely	76,6%
Respondent 17	≤SD	BMI ≥24,5	TM II&III	No	Rarely	90,0%
Respondent 18	≤SD	BMI ≥24,5	TM I	No	Rarely	96,4%
Respondent 19	≤SD	BMI ≥24,5	TM I	Yes	Rarely	92,3%
Respondent 20	≥SMP	BMI ≥24,5	TM II&III	No	Rarely	78,4%
Respondent 21	≥SMP	BMI <24,5	TM II&III	No	Often	90,9%
Respondent 22	≥SMP	BMI ≥24,5	TM II&III	No	Often	67,0%
Respondent 23	≥SMP	BMI ≥24,5	TM I	No	Rarely	91,6%
Respondent 24	≥SMP	BMI ≥24,5	TM I	Yes	Rarely	82,9%
Respondent 25	≥SMP	BMI ≥24,5	TM II&III	Yes	Often	52,6%

1.016 (BMI status <24.5 kg/m^2) + 1.108 (second and third trimester gestational age) - 0.820 (no iron consumption) - 0.581 (infrequent protein consumption).

The equation above can be used to calculate the probability of anemia among pregnant women using the formula:

$$p = \frac{1}{(1 + exp^{(-y)})}$$

Based on the results of the probability calculation in table 4 above, mothers with education ≤ elementary high school, having BMI ≥24.5 kg/m², in the first trimester of pregnancy, not consuming iron and rarely consuming protein have a probability of anemia in pregnant women of 96.4%. Whereas mothers with education ≥ junior high school, having BMI <24.5 kg/m², in the first trimester of pregnancy, consuming iron and often consuming protein had a probability of anemia in pregnant women of 50.4%. The variables that became risk factors for anemia among pregnant women based on multivariate analysis of IFLS 5 data were gestational age and nutritional status. Based on the results of the probability calculation, respondents in the same condition but in the second and third trimester had a probability of 90% to experience anemia, while respondents in the same condition but with gestational age in the first trimester had a probability of anemia of pregnant women of 75.4%. The difference in probability between respondents in the second and third trimesters and in the first trimester is 14.6%. Meanwhile, based on the results of the probability calculation, respondents in the same condition but with BMI <24.5 kg/m² had a probability of 90.8% to experience anemia, while respondents in the same condition but with BMI ≥24.5 had a probability of anemia of pregnant women of 73.1%. The difference in probability between respondents with BMI <24.5 and ≥24.5 kg/m² was 17.7%.

This study showed the effect of several risk factors, especially gestational age, on the incidence of anemia among pregnant women. However, this study did not identify the factors of ANC check-ups measuring LILA, management and appointments and the vitamin C consumption variable was limited to 3 types of fruit namely banana, papaya and mango. Associating anemia among pregnant women with a complete 10 T ANC examination and a wider range of vitamin C fruits may show different results.

CONCLUSIONS

The conclusion of this study is that maternal education, nutritional status, gestational age, iron consumption, ANC examination and protein consumption are associated with the incidence of anemia among pregnant women in Indonesia. Whereas maternal age, maternal occupation, smoking habit, food frequency, green vegetable consumption, vitamin C consumption, socioeconomic status and health service distance are not associated with the incidence of anemia among pregnant women in Indonesia. The most dominant factor in the incidence of anemia among pregnant women is gestational age. Mothers with education ≤ elementary high school, having BMI ≥24.5 kg/m², in the first trimester of pregnancy, not consuming iron and rarely consuming protein have a greater chance of experiencing anemia.

Therefore, it is expected to be able to develop a prevention program for the incidence of anemia in pregnant women prioritized for pregnant women with education ≤ elementary high school, having BMI ≥24.5 kg/m², in the first trimester of pregnancy, not consuming iron and rarely consuming protein so that the prevention of anemia in pregnant women can be detected early for policy makers in the field of family health at the Ministry of Health of the Republic of Indonesia and can expand the research by adding more diverse variables of protein and vitamin C types to determine the relationship with the incidence of anemia in pregnant women in Indonesia for researchers in the field of epidemiology of anemia in pregnant women.

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