[OAMJMS] Submission Acknowledgement

1 message

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Prof. Dr Mirko Spiroski

Dietary Intake as a Risk Factor of Anemia among Indonesian Pregnant Women: A Cross-sectional Study

Abstract

Background: Anemia during pregnancy causes several adverse effects. There are a lot of dietary restrictions during pregnancy in Indonesia. However, association between dietary intake and anemia during pregnancy is still limited. This study aimed to investigate the association between dietary intake and anemia among pregnant women.

Methods: This was as a cross-sectional descriptive study which involved 424 pregnant women. A written informed consent was obtained before collected data. A self-administered questionnaire was used to assess the dietary intake and demographic data. Hemoglobin concentration was measured using a haemoglobinometer. Data was analyzed using a descriptive statistical, Chi-Square, and Multiple Logistic Regression test.

Results: About half of respondents suffered from anemia (46.5%). Multiple Logistic Regression test results revealed that tea consumption (OR=5.075, $p<0.001$), liver consumption (OR=4.128, $p<0.001$), eggs consumption (OR=3.590, $p<0.01$), and iron supplementation (OR=3.837, $p<0.05$) had significant correlations with anemia among pregnant women.

Conclusions: Anemia was commonly experienced by Indonesian pregnant women. Health care providers should not only focus on reducing tea consumption but also increasing iron-rich food consumption and iron supplementation among pregnant women to prevent anemia.

Keywords: Anemia, Dietary Intake, Indonesian, Pregnancy

1. Introduction

Maternal mortality rate (MMR) is one of important indicators describing a country's social welfare [1]. MMR in Indonesia is considered to be the highest in Southeast Asia region [2]. Indonesian Demographic and Health Survey (IDHS) showed that MMR in Indonesia was 228 per 100,000 live births [3]. Based on the data from Information Center from the Ministry of Health of the Republic of Indonesia [1], antenatal bleeding was the major cause of maternal mortality during 2010-2013. In 2013, 30.3% of Indonesian women died after bleeding during the process of pregnancy, childbirth, and postpartum [1]. Risk factors of bleeding during childbirth are high risk maternal age, parity of > 3, poor birth history, prolonged labor, and anemia [4]. Anemia during pregnancy had a significant association with maternal death in both low-income and middle-income countries [5]. There was a significant association between anemia during pregnancy and the incidence of postpartum hemorrhage in Indonesia [6,7]. In addition, all Indonesian women who experienced postpartum hemorrhage suffer from anemia during pregnancy [8].

Anemia during pregnancy is a major health problem in Indonesia. Indonesian Basic Health Research showed that prevalence of anemia among pregnant women in Indonesia increased significantly from 37.1% in 2013 to 48.9% in 2018 [9]. It means that almost half of the Indonesian pregnant women recently suffer from anemia. Finding factors related to anemia among Indonesian pregnant women is very important.

Anemia during pregnancy may be associated with several factors. Anemia during pregnancy is related to drink more than three cups of tea per day before pregnancy, consuming clay or dirt during pregnancy, never consuming eggs or consuming eggs less than twice a week during pregnancy, consuming less beef [10], meal frequency, dietary diversity, and parity [11]. The major cause of anemia during pregnancy in Indonesia was iron deficiencies [12]. Dietary intake is the only iron source since physiologically human body may not excrete iron [13]. Studies about association between dietary intake and adverse effect on pregnancy were mostly conducted in Western [14–18] and other Asian countries [19,20]. This research topic has never been conducted before in Indonesia until now.

Cultural beliefs during pregnancy may contribute on pregnant women's dietary choice. Javanese people have a strong belief related to taboo food during pregnancy, such as beef, eggs, and fish which are rich of protein and iron that may influence the pregnant women's hemoglobin concentration [21]. The other Javanese culture is drinking tea after meal which may prohibit iron absorption and lead to iron deficiency anemia [22]. The recent studies

revealed that cultural beliefs among Javanese people have a dynamic changing, particularly among young generation [23]. In order to prevent anemia among pregnant women, in this context, it is essential to examine the association between dietary intake and anemia during pregnancy among pregnant women in Indonesia.

Some studies aimed to determine predictors of anemia during pregnancy have been conducted in Indonesia [12,24]. However, they only examined the correlation between infectious disease and sociodemographic factors with anemia. There are only a few studies on anemia among pregnant mothers which are conducted in Indonesia and need the up-to-date information related to the association between dietary intake and anemia among pregnant women in Indonesia. According to Indonesian Ministry of Health's report in 2018, Central Java Province had a high prevalence of anemia among pregnant women and teenage pregnancy. This study was intended to determine predictors of anemia among pregnant women in Central Java Province.

2. Method

2.1. Research design and participants

This study employed a descriptive cross-sectional survey conducted in Central Java Province. This study was conducted in the largest ethnic group [25] living in the most populous island in Indonesia. This study used Yamane's formula to calculate sample size $n=N/1+N(e^2)$ [26]. Population of pregnant women (N) was 29.464 [27], precision 0.05 with the confidence of interval is 95%. The researchers added more 10% respondents. Therefore, the required sample size in this study was 424 respondents.

This study involved 424 respondents selected using a multistage cluster random sampling method to get sample whom represent pregnant women from both rural and urban area, sub-districts, and health care facilities [28]. Sample of this study were recruited from 3 antenatal care clinics at the hospital and 7 primary health centers which selected randomly. In each health care facility, researchers categorized pregnant women into 3 groups according to their trimester, and then we randomly selected pregnant women from each trimester. Inclusion criteria of respondents were pregnant women with 4-38 weeks of gestation, routine antenatal care visit, and willing to participate in this study. Exclusion criteria included history of chronic bleeding, thalassemia, malaria, and chronic disease such as inflammatory bowel disease, autoimmune disease, cancer, chronic infection, chronic renal failure, solid tumor, chronic heart failure [29].

Data was collected using a set of questionnaires and hemoglobinometer. Sociodemographic data was collected using a self-developed questionnaire based on literature

review, including maternal age, gestational age, parity, education concentration, working status, family income, and abortion history. Dietary information was collected by answering consumption frequency of beef, liver, eggs, iron tablets, tea and milk. Beef, liver, milk and eggs were selected as they are rich of iron and protein as well as easily to find in Indonesia. The frequency of beef, liver, and eggs consumption were categorized into (1) never or less than once per week, (2) once to six times per week, and (3) daily [30]. Iron tablets are provided by health care providers to all pregnant women. Tea consumption is selected because most Javanese people drink tea after meal. The frequency of milk consumption was categorized into (1) never or less than a cup per week, (2) once to six cup per week, and (3) daily. The frequency of tea consumption was categorized into (1) 0-1 cup per day, (2) 2-3 cups per day, (3) 4-5 cups per day, and (4) ≥ 6 cups per day [19]. Preliminary questionnaire was reviewed by experts involved three maternity nurse and an obstetric and gynecologist, then tested in a piloting study to 15 respondents. Blood samples were collected from respondents' finger pricks while hemoglobin concentrations were measured using the EasyTouch®GCU (Chiuan Rwey Enterprise Co., Ltd., Taiwan). Then, respondents were categorized into having anemia (<11 g/dL) and non-anemia (≥11 g/dL) according to their hemoglobin concentrations [31].

2.2. Data collection

Data was collected from February to June 2018 by four research assistants graduated from the bachelor's degree of Nursing science and working as nurse practitioners and nurse educators. Researchers and research assistants have discussed the research purpose, ethics, informed consent, and data collection methods. The research assistants started collecting the data after receiving the ethical approval and permit from the Indonesian Ministry of Health and Government office. The research assistants started collecting the data after providing information to respondents related to research purpose, benefits, procedures, and required time. Respondents who are willing to participate in this study should sign in a written consent form to show that they had understood the research information and agreed to participate in this study.

2.3. Data analysis

Data was analyzed using descriptive statistics (mean, median, and frequency). Since it was a category-based data, Chi-Square test was used to analyze correlation between beef, liver, eggs, iron tablets, tea, milk consumption and anemia status. Variables with p value of more than 0.25 were included to a multivariate analysis. Then, Multiple Logistic Regression (with the backward Wald and 95% CI) was used to obtain odds ratio (ORs) and analyze the

predictive factors of anemia. The two-tailed p value of < 0.05 was used to indicate the statistical significance. SAS statistical software version 9.4 (SAS Institute Inc., Cary, NC, USA) was used to perform all the statistical analyses.

3. Results

3.1. Prevalence of anemia

The overall prevalence of anemia was 46.5%, with 86.29% of those anemic respondents having mild anemia and the rest (12.69%) having moderate anemia.

3.2. Respondents' Demographic characteristics

This study involved 424 respondents, with characteristics described in Table 1. Respondents' mean age in this study was 27.42 years old (*SD*=5.91) and respondents' mean gestational age was 24.32 weeks (*SD*=10.04). Most respondents were multiparous (72.2%), graduate from Senior High School (39.6%). Most respondents were housewives (65.6%) with the family income of USD 120 (83.3%). Most respondents had no abortion history (80.7%) and mean of hemoglobin concentration was 10.94 (*SD*=1.89). Most respondents consumed iron supplementation (78.3%) and eggs (68.6%) daily. Half of the respondents drank tea during pregnancy (50.5%). Most respondents did not consume liver (60.8%) as daily intake.

Table 1. here

Chi-Square testing results (Table 2) showed that liver consumption (χ^2=4.040, p<0.001), milk consumption (χ^2=1.255, p<0.05), eggs consumption (χ^2=4.052, p<0.001), tea consumption (χ^2=7.031, p<0.001), and iron supplementation (χ^2=3.420, p<0.001) had significant correlations with anemia risk.

Table 2. here

Multiple Logistic Regression using Backward (Wald) testing results revealed that pregnant women with lower liver consumption (OR=4.128, p<0.001), eggs consumption (OR=3.590, p<0.01), iron supplementation (OR=3.837, p<0.05) and higher daily tea consumption (OR=5.075, p<0.001) were significantly associated with higher anemia risk after adjusting to the respondents' characteristics.

Table 3. here

4. Discussion

Anemia is a condition where the hemoglobin concentration is lower than the normal limit [32]. This study confirmed that anemia among pregnant women is still high. About a half of respondents (46.5%) in this study were considered anemic. The result of this study is congruent with that of Indonesian Basic Health Research [9] data which revealed that 48.9% of Indonesian pregnant women aged 25-34 years old were anemic. In this study, pregnant

women with low education, multiparous, and low-income families were more likely to become anemic. It might be due to lack of anemia prevention knowledge, attitude, and financial problem among families with low education and low-income.

Consuming iron and protein-rich food may prevent pregnant women from anemia [33]. Results of previous studies provided inconsistent number of iron supplementation consumption among Indonesian pregnant women. Results of Indonesian Demographic and Health Survey showed that only 61.9% of pregnant women consume iron tablets [3]. Previous studies revealed that at least half of anemia cases during pregnancy were caused by iron deficiency [2],[34]. So, it is not surprising that iron supplementation during pregnancy may predict anemia among Indonesian pregnant women significantly. Mothers' compliance to consume iron tablet during pregnancy had a significant relationship with anemia among pregnant women [35] [36].

This study indicated that consuming liver during pregnancy was correlated with lower anemia risk. Most Indonesian people consume chicken liver and cow liver. Chicken liver contains 9.2 mg iron per 75 gram (2.5 oz) and cow liver contain 4.8 mg iron per 75 gram (2.5 oz) [37]. Consuming liver regularly may increase hemoglobin concentration and prevent from anemia [38]. Anemic status among Japanese people is also significantly correlated with low intake of animal products, iron, vitamin B-12, and folate [39].

A study conducted in Pakistan found that consuming eggs was significantly associated with hemoglobin concentration among pregnant women [10]. Most Indonesian people also consume eggs as their daily meals because they are cheap and easy to find and to prepare. Indonesian people consume eggs of 106.418 Kg/year [40]. It is surprising that results of this study revealed that eggs consumption did not predict anemia among the Indonesian pregnant women since egg is considered as a popular food. It may due to the local beliefs among Javanese which restrict pregnant women to consume fishy smell food such as fish and eggs [21].

Pregnant women who consumed beef had higher hemoglobin concentration when compared to those who did not consume beef as their daily diet [30]. However, beef consumption did not predict anemia in this study. Previous study conducted in Indonesia also found that only one third Indonesian pregnant women consume beef as their daily menu [41]. Average beef consumption among Indonesian people is only 0.469 Kg/year [40]. Low beef consumption among Indonesian may be due to beef's price which is considered expensive. A previous study conducted in Japan also found that there was no correlation between beef intake and anemia risk among Japanese people [39].

Milk and tea are well-known as an iron absorption inhibitor. This study result revealed that milk consumption did not have significant correlation with anemia among pregnant women. It may be due to Indonesian people perceive sweetened creamer as dairy, so they think it similar with milk. In fact, sweetened creamer lack of protein such as in milk. The clarification of sweetened creamer was not a milk has been made recently by the Indonesian Food and Drug association [42]. Tea consumption correlated with anemia among pregnant women. It was not surprising because drinking tea after meal is something common among Indonesian people as their daily life. Indonesia ranked the second highest number of tea consumption in South East area [43]. Almost half of Indonesian pregnant women drink tea every day as a habit [41]. Indonesian people strongly used culture as their lifestyle even sometimes it is not supported with evidence [23].

In this study, the highest prevalence of anemia was found among pregnant women in third trimester. According to Ward and Hisley [44], pregnant women have the lowest hemoglobin concentration at 30-34 weeks of pregnancy. The result of this study consistent with previous studies result which found that third trimester of pregnancy was associated with anemia [45] [46].

Strengths of this study are cover both rural and urban area and include local beliefs related to dietary intake. In addition, limitation in this study are the nature of a cross sectional study which may not reflect certain causal factors, respondent's recall bias, and hemoglobin measurement method. Researchers suggest future studies use better hemoglobin measurement method and recruit bigger sample size.

5. Conclusion

The current study showed that iron supplementation, iron-rich food consumption, and tea consumption had significant correlations with anemia among pregnant women. This study results suggest health care providers order should take into consideration of enhancing pregnant women intake during pregnancy particularly iron supplementation, iron-rich food consumption, and reducing tea consumption as a regular assessment and intervention at antenatal care. This was a cross-sectional study that the causality between risk factors and anemia during pregnancy could not be assumed.

Abbreviations

OR: Odds ratio; IDHS: Indonesian Demographic and Health Survey; MMR: Maternal mortality rate; RBC: Red Blood Cell.

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Authors' contributions
MDA: Project design, manuscript writing, data interpretation, project administration, supervision. AF: Data analysis, manuscript writing, review, and editing. SM: Data collection, writing-review, and editing. All authors have read and approved the final manuscript.

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Availability of data and materials
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate
In order to ensure the subjects' human rights, this study has already got an ethical approval from the Institutional Review Board Faculty of Medicine, *Universitas Jenderal Soedirman*, Indonesia No. 1184/KEPK/III/2018. The researchers have also received the permit to conduct this study from the Indonesian Ministry of Health and Government office. The researchers have also provided sufficient information related to the study including purpose, benefits, procedures, potential risks, required time, anonymity, confidentiality, the subjects' rights to withdraw themselves from this study anytime, and the researchers' phone numbers for further questions related to this study, if needed. Respondents signed a written consent after they stated understood the study's purpose, benefits, potential risks, required time, and procedures also willing to participate in this study. The researchers have saved the data using codes and only the researchers may access the data.

Consent for publication
Not applicable.
Competing interests
The authors declare that they have no competing interests.

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Table 1. The Research Respondents' Characteristics (*n* = 424)

Characteristics	Frequency	Percentage (%)	Mean (SD)
Age			
<20	32	9.9	
20-35	345	79.1	27.42 (5.91)
>35	47	11	
Gestational age			
4-12 weeks	104	24.5	24.32 (10.04)
13-24 weeks	126	29.7	
25-40 weeks	194	45.8	
Parity			
Primipara	118	27.8	-
Multipara	306	72.2	
Educational level			
Elementary	70	16.5	-
Junior High School	83	19.6	
Senior High School	168	39.6	
Diploma	41	9.7	
Bachelor	58	13.7	
Postgraduate	4	0.9	
Working status			
Employee	146	34.4	-
Housewife	278	65.5	
Family income			
< USD 120	71	16.7	-
≥ USD120	353	83.3	
Abortion history			
Yes	82	19.3	-
No	342	80.7	
Hb (g/dL)			
< 11	197	46.5	10.94 (1.89)
≥ 11	227	53.5	
Iron supplementation			
Yes	332	78.3	
No	92	21.7	
Liver consumption			
0	258	60.8	
1-6	152	39.2	
Beef consumption			
0	178	42	
1-6	246	58	
Eggs consumption			
0	41	9.7	
1-6	291	68.6	
>7	92	21.7	
Tea consumption			
0-1	210	49.5	
2-3	108	25.5	
4-5	88	20.8	
≥ 6	18	4.2	

Characteristics	Frequency	Percentage (%)	Mean (SD)
Milk Consumption			
0	148	34.9	
1-6	64	15.1	
≥7	212	50	

Table 2. The Correlation of Beef Consumption, Milk consumption, Liver Consumption, Eggs Consumption, Tea Consumption, and Iron Supplementation with Anemia among Pregnant Women (*n*=424)

Variables	χ^2	*p*
Beef consumption	1.012	0.953
Milk consumption	1.255	0.035
Liver consumption	4.040	<0.001
Eggs consumption	4.052	<0.001
Tea consumption	7.031	0.008
Iron supplementation	3.420	<0.001

Table 3. The Logistic Regression for Predictors of Anemia among pregnant women (*n*=424)

Variables	*B*	Wald	OR	95%CI	*p*
Liver consumption***	1.418	34.175	4.128	2.566-6.640	0.000
Eggs consumption**	1.278	8.594	3.590	1.527-8.437	0.003
Tea consumption***	1.624	27.831	5.075	2.776-9.279	0.000
Iron supplementation***	1.345	21.583	3.837	2.176-6.767	0.000

Values presented as odds ratio (95% of confidence interval).

-2 LLχ^2 = 459.72; Hosmer and Lemeshow test (χ^2) = 6.33 (p = 0.50); Cox and Snell R^2 = 0.257, Nagelkerke R^2 = 0.34.

*p<0.05, **p<0.01, ***p<0.001

[OAMJMS] Editor Decision

4 messages

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We have reached a decision regarding your submission to Open Access Macedonian Journal of Medical Sciences, "Dietary Intake as a Risk Factor of Anemia among Indonesian Pregnant Women: A Cross-sectional Study", Manuscript ID = OJS6066.

Our decision is: Revisions Required

Sincarely,
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Editor-in-Chief, OAMJMS

Sasho Stoleski

Reviewer D:
Recommendation: Revisions Required

Comments to the Author

> There were many inconsistent data with the updated references. Authors should submit the manuscript to a native person for proofreading the way authors write the manuscript. Please attach the certification of proofread service alongside the revised version submission. Re-write the whole texts are a must.

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Mon, Apr 26, 2021 at 8:18 AM

To: "MD, MSc, PhD, SRA Sasho Stoleski" <sstoleski@yahoo.com>

Food consumption as a Risk Factor of Anemia among Indonesian Pregnant Women: A Cross-sectional Study

Abstract

Background: Anemia during pregnancy causes several adverse effects. There are a lot of food restrictions during pregnancy in Indonesia. However, association between food consumption and anemia during pregnancy is still limited. This study aimed to investigate the association between food consumption and anemia among pregnant women.
Methods: This was as a cross-sectional descriptive study which involved 424 pregnant women. A written informed consent was obtained before collected data. A self-administered questionnaire was used to assess the food consumption and demographic data. Hemoglobin concentration was measured using a haemoglobinometer. Data was analyzed using a descriptive statistical, Chi-Square, and Multiple Logistic Regression test.
Results: About half of respondents suffered from anemia (46.5%). Multiple Logistic Regression test results revealed that tea consumption (OR=5.075, $p<0.001$), liver consumption (OR=4.128, $p<0.001$), eggs consumption (OR=3.590, $p<0.01$), and iron supplementation (OR=3.837, $p<0.05$) had significant correlations with anemia among pregnant women.
Conclusions: Anemia was commonly experienced by Indonesian pregnant women. Health care providers should not only focus on reducing tea consumption but also increasing iron-rich food consumption and iron supplementation among pregnant women to prevent anemia.

Keywords: Anemia, Food consumption, Indonesian, Pregnancy

1. Introduction

Maternal mortality rate (MMR) is one of important indicators describing a country's social welfare [1]. Indonesia is one of the countries that has high MMR in Asia region (WHO, 2021) https://asiapacific.unfpa.org/en/news/maternal-mortality-asia-pacific-5-key-facts. Indonesian Demographic and Health Survey (IDHS) showed that MMR in Indonesia was 177 per 100,000 live births (Unicef, 2017) [https://data.unicef.org/topic/maternal-health/maternal-mortality/]. Based on the data from Information Center from the Ministry of Health of the Republic of Indonesia [1], antenatal bleeding was the major cause of maternal mortality in 2019. One third (30.3%) of Indonesian women died after bleeding during the process of pregnancy, childbirth, and postpartum (ganti Profile kesehatan Indonesia, 2019). Risk factors of bleeding during childbirth are high risk maternal age, parity of > 3, poor birth history, prolonged labor, and anemia [4]. Anemia during pregnancy had a significant association with maternal death in both low-income and middle-income countries [5]. There was a significant association between anemia during pregnancy and the incidence of postpartum hemorrhage in Indonesia [6,7]. In addition, all Indonesian women who experienced postpartum hemorrhage suffer from anemia during pregnancy [8].

Anemia during pregnancy is a major health problem in Indonesia. Indonesian Basic Health Research showed that prevalence of anemia among pregnant women in Indonesia increased significantly from 37.1% in 2013 to 48.9% in 2018 [9]. It means that almost half of the Indonesian pregnant women recently suffer from anemia. Finding factors related to anemia among Indonesian pregnant women is very important.

Anemia during pregnancy may be associated with several factors. Anemia during pregnancy is related to drink more than three cups of tea per day before pregnancy, consuming clay or dirt during pregnancy, never consuming eggs or consuming eggs less than twice a week during pregnancy, consuming less beef [10], meal frequency, dietary diversity, and parity [11]. Tea contains tannin which well known as an iron absorption inhibitor, consuming tea after meal may cause a 60% of iron uptake decrease (J. Clifford, K. Niebaum, L. Bellows, 2015). In addition, serum iron and ferritin were significantly high in non-tea drinkers comparing to tea drinkers (Shah, Warsi, Laghari, 2020). The major cause of anemia during pregnancy in Indonesia was iron deficiencies [12]. Food consumption is the only iron source since physiologically human body may not excrete iron [13]. Studies about association between food consumption and adverse effect on pregnancy were mostly conducted in Western [14–18] and

other Asian countries [19,20]. A little study about correlation between food consumption and anemia among pregnant women among Javanese in Indonesia.

Cultural beliefs during pregnancy may contribute on pregnant women's food consumption's choice. Javanese people have a strong belief related to taboo food during pregnancy, such as beef, eggs, and fish which are rich of protein and iron that may influence the pregnant women's hemoglobin concentration [21]. Another Javanese culture is drinking tea with meal which may lead to iron deficiency anemia [22] because consuming tea after meal decreased absorption of non-heme iron (Regina Wierzejska, 2014). A randomized control study found that drinking tea with meal may decrease iron absorption while delaying drinking tea 1-h after meal may reduce the inhibitory effect of iron absorption (Fuzi, Koller, Bruggraber, Pereira, 2017). Some components of beverages directly affect iron bioavailability, such as ea may inhibit iron absorption (Lopez, Cacoub, Macdougall, Biroulet, 2016). However, a recent study revealed that cultural beliefs among Javanese people have a dynamic changing, particularly among young generation [23]. In order to prevent anemia among pregnant women, in this context, it is essential to examine the association between food consumption and anemia during pregnancy among pregnant women in Indonesia.

Some studies aimed to determine predictors of anemia during pregnancy have been conducted in Indonesia [12,24]. However, they only examined the correlation between infectious disease and sociodemographic factors with anemia. There are only a few studies on anemia among pregnant mothers which are conducted in Indonesia and need the up-to-date information related to the association between food consumption and anemia among pregnant women in Indonesia. According to Indonesian Ministry of Health's report in 2018, Central Java Province had a high prevalence of anemia among pregnant women and teenage pregnancy. This study was intended to determine predictors of anemia among pregnant women in Central Java Province.

2. Method

2.1. Research design and participants

This study employed a descriptive cross-sectional survey conducted in Central Java Province. This study was conducted among Javanese, the largest ethnic group [25], living in the most populous island in Indonesia. This study used Yamane's formula to calculate subject of research $n=N/1+N(e^2)$ [26]. Population of pregnant women (N) was 29.464 [27], and precision 0.05. Then, the researchers added more 10% respondents. Therefore, the required the subject of research in this study was 424 respondents.

This study involved 424 respondents selected using a multistage cluster random sampling method to get the subject of research whom represent pregnant women from both rural and urban area, sub-districts, and health care facilities [28]. The subjects of research were recruited from 3 antenatal care clinics at the hospital and 7 primary health centers which selected randomly. In each health care facility, researchers categorized pregnant women into 3 groups according to their trimester, and then we randomly selected pregnant women from each trimester. Inclusion criteria of respondents were pregnant women with 4-38 weeks of gestation, routine antenatal care visit, and willing to participate in this study. Exclusion criteria included history of chronic bleeding, thalassemia, malaria, and chronic disease such as inflammatory bowel disease, autoimmune disease, cancer, chronic infection, chronic renal failure, solid tumor, chronic heart failure [29].

Data was collected using a set of questionnaires and hemoglobinometer. Sociodemographic data was collected using a self-developed questionnaire based on literature review, including maternal age, gestational age, parity, education concentration, working status, family income, and abortion history. Food consumptions were collected using a food consumption frequency questionnaire (FCFQ) which developed by Zhao, Zhang, Li, Wang, Li, Xue, & Gao (2014). The frequency of milk and tea consumptions data were collected using a dietary history questionnaire (DHQ) which developed by Sasaki, Yanagibori, & Amano (1998). Preliminary questionnaire was reviewed by experts involved three maternity nurse and an obstetric and gynecologist, then tested in a piloting study to 15 respondents. Blood samples were collected from respondents' finger pricks while hemoglobin concentrations were measured using the EasyTouch®GCU (Chiuan Rwey Enterprise Co., Ltd., Taiwan). Then, respondents were categorized into having anemia (<11 g/dL) and non-anemia (≥11 g/dL) according to their hemoglobin concentrations. Furthermore, anemia among pregnant women may be categorized into mild (9-10.9 g/dL), moderate (7-8.9 g/dL), and severe anemia (<7 g/dL) [31].

2.2. Data collection

Data was collected from February to June 2018 by four research assistants graduated from the bachelor's degree of Nursing science and working as nurse practitioners and nurse educators. Researchers and research assistants have discussed the research purpose, ethics, informed consent, and data collection methods. The research assistants started collecting the data after receiving the ethical approval and permit from the Indonesian Ministry of Health and Government office. The research assistants started collecting the data after providing information to respondents related to research purpose, benefits, procedures, and required time.

Respondents who are willing to participate in this study should sign in a written consent form to show that they had understood the research information and agreed to participate in this study.

2.3. Dietary analysis

The variables of interest were the frequency of usual consumption (times/week) of red beef, eggs, liver, tea, milk, and the current hemoglobin level. The three FFQ items eggs, beef, liver, and milk were chosen because of their high consumption prevalence among Javanese and because they are sources of haem Fe. Tea was chosen because it is a popular beverage among Javanese and usually consumed after meal even though tea inhibits the absorption of Fe in the small intestine. Moreover, SF was preferred to Hb, which is a protein used as a biomarker of Fe stores and Fe nutrition.

The frequency of beef, liver, milk and eggs consumptions data were collected using a food consumption frequency questionnaire (FCFQ) which developed by Zhao, Zhang, Li, Wang, Li, Xue, & Gao (2014). The frequency of milk and tea consumptions data were collected using a dietary history questionnaire (DHQ) which developed by Sasaki, Yanagibori, & Amano (1998). The frequency of beef, liver, and eggs consumption were categorized into (1) never or less than once per week, (2) once to six times per week, and (3) daily [30]. This categorization based on the Indonesian nutrition guidelines (Kementrian kesehatan, 2017) http://bppsdmk.kemkes.go.id/pusdiksdmk/wp-content/uploads/2017/11/GIZI-DALAM-DAUR-KEHIDUPAN-FINAL-SC.pdf. The data was validated with 24-h recall of foods eaten the day before the survey.

Iron tablets are provided by health care providers to all pregnant women which should consume daily. Tea consumption is selected because most Javanese people drink tea after meal. The frequency of milk consumption was categorized into (1) never or less than a cup per week, (2) once to six cup per week, and (3) daily. The frequency of tea consumption was categorized into (1) 0-1 cup per day, (2) 2-3 cups per day, (3) 4-5 cups per day, and (4) ≥ 6 cups per day [19]. This categorization based on the Indonesian nutrition guidelines (Kementrian kesehatan, 2017) http://bppsdmk.kemkes.go.id/pusdiksdmk/wp-content/uploads/2017/11/GIZI-DALAM-DAUR-KEHIDUPAN-FINAL-SC.pdf. The data was validated with 24-h recall of foods eaten the day before the survey.

2.4. Data analysis

Data was analyzed using descriptive statistics (mean, median, and frequency). Since it was a category-based data, Chi-Square test was used to analyze correlation between beef, liver, eggs, iron tablets, tea, milk consumption and anemia status. Variables with *p* value of more than 0.25 were included to a multivariate analysis. Then, Multiple Logistic Regression (with the backward Wald and 95% CI) was used to obtain odds ratio (ORs) and analyze the predictive factors of anemia. The two-tailed *p* value of < 0.05 was used to indicate the statistical significance. SAS statistical software version 9.4 (SAS Institute Inc., Cary, NC, USA) was used to perform all the statistical analyses.

3. Results

3.1. Prevalence of anemia

The overall prevalence of anemia was 46.5%, with 86.29% of those anemic respondents had mild anemia and the rest (13.71%) had moderate anemia.

3.2. Respondents' Demographic characteristics

This study involved 424 respondents, with characteristics described in Table 1. Respondents' mean age in this study was 27.42±SD=5.9 years old and respondents' mean gestational age was 24.32±SD=10.04 weeks. Most of respondents were in their third trimester (44.3%) and multiparous (72.2%), graduate from Senior High School (39.6%). Most respondents were housewives (65.6%) with the family income of USD 120 (83.3%). Most respondents had no abortion history (80.7%) and mean of hemoglobin concentration was 10.94±SD=1.89 g/dl. Most respondents consumed iron supplementation (78.3%) and eggs (68.6%) daily. Half of the respondents drank tea during pregnancy (50.5%). Most respondents did not consume liver (60.8%) as daily intake.

Table 1. here

Chi-Square testing results (Table 2) showed that liver consumption (χ^2=4.040, p<0.001), milk consumption (χ^2=1.255, p<0.05), eggs consumption (χ^2=4.052, p<0.001), tea consumption (χ^2=7.031, p<0.001), and iron supplementation (χ^2=3.420, p<0.001) had significant correlations with anemia risk.

Table 2. here

Multiple Logistic Regression using Backward (Wald) testing results revealed that pregnant women with lower liver consumption (OR=4.128, p<0.001), eggs consumption (OR=3.590, p<0.01), iron supplementation (OR=3.837, p<0.05) and higher daily tea consumption (OR=5.075, p<0.001) were significantly associated with higher anemia risk after adjusting to the respondents' characteristics.

Table 3. here

4. Discussion

Anemia is a condition where the hemoglobin concentration is lower than the normal limit [32]. This study confirmed that anemia among pregnant women is still high. About a half of respondents (46.5%) in this study were considered anemic, with 86.29% of those anemic respondents had mild anemia and the rest (12.69%) had moderate anemia. The result of this study is congruent with that of Indonesian Basic Health Research [9] data which revealed that 48.9% of Indonesian pregnant women aged 25-34 years old were anemic. In this study, pregnant women with low education, multiparous, and low-income families were more likely to become anemic. It might be due to lack of anemia prevention knowledge, attitude, and financial problem among families with low education and low-income.

Consuming iron and protein-rich food may prevent pregnant women from anemia [33]. Results of previous studies provided inconsistent number of iron supplementation consumption among Indonesian pregnant women. According to Indonesian Health Profile which launched by Indonesian Ministry of Health (2020), only 64% of pregnant women consume iron tablets [3] (diganti dg data profil kesehatan Indonesia 2019). Previous studies revealed that at least half of anemia cases during pregnancy were caused by iron deficiency [2],[34]. So, it is not surprising that iron supplementation during pregnancy may predict anemia among Indonesian pregnant women significantly. Mothers' compliance to consume iron tablet during pregnancy had a significant relationship with anemia among pregnant women [35] [36].

This study indicated that consuming liver during pregnancy was correlated with lower anemia risk. Most Indonesian people consume chicken liver and cow liver. Chicken liver contains 9.2 mg iron per 75 gram (2.5 oz) and cow liver contain 4.8 mg iron per 75 gram (2.5 oz) [37]. Consuming liver regularly may increase hemoglobin concentration and prevent from anemia [38]. Anemic status among Japanese people is also significantly correlated with low intake of animal products, iron, vitamin B-12, and folate [39].

A study conducted in Pakistan found that consuming eggs was significantly associated with hemoglobin concentration among pregnant women [10]. Most Indonesian people also consume eggs as their daily meals because they are cheap and easy to find and to prepare. Indonesian people consume eggs of 106.418 Kg/year [40]. It is surprising that results of this study revealed that eggs consumption did not predict anemia among the Indonesian pregnant women since egg is considered as a popular food. It may due to the local beliefs among

Javanese which restrict pregnant women to consume fishy smell food such as fish and eggs [21].

Pregnant women who consumed beef had higher hemoglobin concentration when compared to those who did not consume beef as their daily diet [30]. However, beef consumption did not predict anemia in this study. Previous study conducted in Indonesia also found that only one third Indonesian pregnant women consume beef as their daily menu [41]. Average beef consumption among Indonesian people is only 0.469 Kg/year [40]. Low beef consumption among Indonesian may be due to beef's price which is considered expensive. A previous study conducted in Japan also found that there was no correlation between beef intake and anemia risk among Japanese people [39].

Milk and tea are well-known as an iron absorption inhibitor. This study result revealed that milk consumption did not have significant correlation with anemia among pregnant women. It may be due to Indonesian people perceive sweetened creamer as dairy, so they think it similar with milk. In fact, sweetened creamer lack of protein such as in milk. The clarification of sweetened creamer was not a milk has been made recently by the Indonesian Food and Drug association [42]. Tea consumption correlated with anemia among pregnant women. It was not surprising because drinking tea after meal is something common among Indonesian people as their daily life. Indonesia ranked the second highest number of tea consumption in South East area [43]. Almost half of Indonesian pregnant women drink tea every day as a habit [41]. Indonesian people strongly used culture as their lifestyle even sometimes it is not supported with evidence [23].

In this study, the highest prevalence of anemia was found among pregnant women in third trimester. According to Ward and Hisley [44], pregnant women have the lowest hemoglobin concentration at 30-34 weeks of pregnancy. The result of this study consistent with previous studies result which found that third trimester of pregnancy was associated with anemia [45] [46].

Strengths of this study are cover both rural and urban area and include local beliefs related to food consumption. In addition, limitation in this study are the nature of a cross sectional study which may not reflect certain causal factors, respondent's recall bias, and hemoglobin measurement method. Researchers suggest future studies use better hemoglobin measurement method and recruit bigger sample size.

5. Conclusion

The current study showed that iron supplementation, iron-rich food consumption, and tea consumption had significant correlations with anemia among pregnant women. This study

results suggest health care providers order should take into consideration of enhancing pregnant women intake during pregnancy particularly iron supplementation, iron-rich food consumption, and reducing tea consumption as a regular assessment and intervention at antenatal care. This was a cross-sectional study that the causality between risk factors and anemia during pregnancy could not be assumed.

Abbreviations
OR: Odds ratio; IDHS: Indonesian Demographic and Health Survey; MMR: Maternal mortality rate; RBC: Red Blood Cell.

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Authors' contributions
MDA: Project design, manuscript writing, data interpretation, project administration, supervision. AF: Data analysis, manuscript writing, review, and editing. RS: Data collection, writing-review, and editing. All authors have read and approved the final manuscript.

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Availability of data and materials
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate
In order to ensure the subjects' human rights, this study has already got an ethical approval from the Institutional Review Board Faculty of Medicine, *Universitas Jenderal Soedirman*, Indonesia No. 1184/KEPK/III/2018. The researchers have also received the permit to conduct this study from the Indonesian Ministry of Health and Government office. The researchers have also provided sufficient information related to the study including purpose, benefits, procedures, potential risks, required time, anonymity, confidentiality, the subjects' rights to withdraw themselves from this study anytime, and the researchers' phone numbers for further questions related to this study, if needed. Respondents signed a written consent after they stated understood the study's purpose, benefits, potential risks, required time, and procedures also willing to participate in this study. The researchers have saved the data using codes and only the researchers may access the data.

Consent for publication
Not applicable.
Competing interests
The authors declare that they have no competing interests.

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Table 1. The Research Respondents' Characteristics (n = 424)

Characteristics	Frequency	Percentage (%)
Age		
<20	32	9.9
20-35	345	79.1
>35	47	11
Parity		
Primipara	118	27.8
Multipara	306	72.2
Pregnancy trimester		
First	126	29.7
Second	110	25.9
Third	188	44.3
Educational level		
Elementary	70	16.5
Junior High School	83	19.6
Senior High School	168	39.6
Diploma	41	9.7
Bachelor	58	13.7
Postgraduate	4	0.9
Working status		
Employee	146	34.4
Housewife	278	65.5
Family income		
< USD 120	71	16.7
≥ USD120	353	83.3
Abortion history		
Yes	82	19.3
No	342	80.7
Hb (g/dL)		
< 11	197	46.5
≥ 11	227	53.5
Anemia level		
Mild	27	13.71
Moderate	170	86.29
Iron supplementation		
Yes	332	78.3
No	92	21.7
Liver consumption		
0	258	60.8
1-6	152	39.2
Beef consumption		
0	178	42
1-6	246	58
Eggs consumption		
0	41	9.7
1-6	291	68.6
>7	92	21.7
Tea consumption		
0-1	210	49.5
2-3	108	25.5

Characteristics	Frequency	Percentage (%)
4-5	88	20.8
≥ 6	18	4.2
Milk Consumption		
0	148	34.9
1-6	64	15.1
≥7	212	50

Table 2. The Correlation of Beef Consumption, Milk consumption, Liver Consumption, Eggs Consumption, Tea Consumption, and Iron Supplementation with Anemia among Pregnant Women (*n*=424)

Variables	χ^2	*p*
Beef consumption	1.012	0.953
Milk consumption	1.255	0.035
Liver consumption	4.040	<0.001
Eggs consumption	4.052	<0.001
Tea consumption	7.031	0.008
Iron supplementation	3.420	<0.001

Table 3. The Logistic Regression for Predictors of Anemia among pregnant women (*n*=424)

Variables	*B*	Wald	OR	95%CI	*p*
Liver consumption***	1.418	34.175	4.128	2.566-6.640	<0.001
Eggs consumption**	1.278	8.594	3.590	1.527-8.437	0.003
Tea consumption***	1.624	27.831	5.075	2.776-9.279	<0.001
Iron supplementation***	1.345	21.583	3.837	2.176-6.767	<0.001

Values presented as odds ratio (95% of confidence interval).
-2 LLχ^2 = 459.72; Hosmer and Lemeshow test (χ^2) = 6.33 (p = 0.50); Cox and Snell R^2 = 0.257, Nagelkerke R^2 = 0.34.
*p<0.05, **p<0.01, ***p<0.001

Dear Editor of Open Access Macedonian Journal of Medical Sciences,

We have revised the article based on the reviewer's suggestions.
I would like to let the journal Editor know that the article has been sent to the native speaker to proofread the article.
The proofread process takes about one week.
Thank you for your consideration.

Best regards,

Mekar Dwi Anggraeni
[Quoted text hidden]

Mekar Dwi Anggraeni <mekar.anggraeni@unsoed.ac.id> Mon, May 3, 2021 at 11:15 AM
To: "MD, MSc, PhD, SRA Sasho Stoleski" <sstoleski@yahoo.com>

Dear Editor of Open Access Macedonian Journal of Medical Sciences,

We have submitted revised article along with the response to the reviewer's suggestions and proofread certificate in the online journal system.
Attached the revised article, response to the reviewer's suggestions, and proofread certificate.
Please let me know if there is still any part of the article that needs to be improved.

Sincerely yours,
Mekar Dwi Anggraeni

On Tue, Apr 6, 2021 at 3:02 PM MD, MSc, PhD, SRA Sasho Stoleski via SFS - Journals (Scientific Foundation SPIROSKI - Journals), Skopje, Republic of Macedonia <noreply@publicknowledgeproject.org> wrote:
[Quoted text hidden]

3 attachments

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Sasho Stoleski <sstoleski@yahoo.com> Mon, May 3, 2021 at 4:07 PM
Reply-To: Sasho Stoleski <sstoleski@yahoo.com>
To: Mekar Dwi Anggraeni <mekar.anggraeni@unsoed.ac.id>

Dear Mekar,

Thank you for uploading the revised article and accompanied documents.
We have send the revised version, and expecting the reviewer's feedback.

Best regards,
Dr Sasho Stoleski

Stoleski Sasho, MD MSc PhD
Scientific Research Associate
Specialist in Occupational Medicine
Sub-specialist in Pulmology and Allergology
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[OAMJMS] Editor Decision

3 messages

MD, MSc, PhD, SRA Sasho Stoleski via SFS - Journals (Scientific Foundation SPIROSKI - Journals), Skopje, Republic of Macedonia <noreply@publicknowledgeproject.org> Wed, May 5, 2021 at 6:21 PM
Reply-To: "MD, MSc, PhD, SRA Sasho Stoleski" <sstoleski@yahoo.com>
To: Mekar Dwi Anggraeni <mekar.anggraeni@unsoed.ac.id>, Amin Fatoni <aminfatoni@unsoed.ac.id>, Rahmi Setiyani <rahmi.setiyani@gmail.com>

Mekar Dwi Anggraeni, Amin Fatoni, Rahmi Setiyani (Author):

We have reached a decision regarding your submission to Open Access Macedonian Journal of Medical Sciences, "Dietary Intake as a Risk Factor of Anemia among Indonesian Pregnant Women: A Cross-sectional Study", Manuscript ID = OJS6066.

Our decision is: Revisions Required

Sincarely,
Prof. Dr Mirko Spiroski,
Editor-in-Chief, OAMJMS

Sasho Stoleski

Reviewer A:
Recommendation: Resubmit for Review

Comments to the Author

> Good attempts to revise the manuscript, however, we still found improper structure and grammar writing in the text. Some contents in the method and results data showed vague results. Please re-write again the manuscript and submit again in the next round.

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3 attachments

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Mekar Dwi Anggraeni <mekar.anggraeni@unsoed.ac.id> Mon, May 24, 2021 at 10:17 AM
To: "MD, MSc, PhD, SRA Sasho Stoleski" <sstoleski@yahoo.com>

Dear Editor of Open Access Macedonian Journal of Health Sciences,

Thanks for your valuable suggestions in order to improve the article's quality.
We had revised the article based on the reviewer's suggestions.
Attached are the revised article, list of revisions, and we also upload the revised article in the journal website.

Best regards,
Mekar Dwi Anggraeni
[Quoted text hidden]

2 attachments

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Mekar Dwi Anggraeni <mekar.anggraeni@unsoed.ac.id> Mon, May 24, 2021 at 10:18 AM
To: amin.fatoni@gmail.com

Yah minta tolong diupload ke website jurnalnya
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Food consumption as a Risk Factor of Anemia among Indonesian Pregnant Women: A Cross-sectional Study among Javanese Ethnic Group

Abstract

Background: Anemia during pregnancy causes several adverse effects. Furthermore, in Indonesia this leads to restrictions among pregnant women. The, information on this situation is still limited, and more research needs to be conducted. Therefore, this study aims to investigate the association between food consumption and anemia among pregnant women.

Methods: This is a cross-sectional descriptive research which involved 424 pregnant women. Furthermore, a written informed consent was obtained from respondents before data collection. A self-administered questionnaire was used to assess the food consumption and demographic data. Hemoglobin concentration was further measured using a haemoglobinometer, and data was analyzed using a descriptive statistical Chi-Square, and a Multiple Logistic Regression test.

Results: It was found that half of the respondents suffered from anemia (46.5%). Furthermore, the Multiple Logistic Regression test showed that tea, liver, eggs, and iron consumption with values of (OR=5.075, $p<0.001$), (OR=4.128, $p<0.001$), (OR=3.590, $p<0.01$), and (OR=3.837, $p<0.05$) respectively, had significant correlations with anemia among pregnant women.

Conclusions: Anemia is commonly experienced by Indonesian pregnant women. Therefore, health care providers should focus on preventing anemia in pregnant women by reducing their tea intake and increasing the consumption of iron-rich foods or supplements.

Keywords: Anemia, Food consumption, Indonesian, Pregnancy

1. Introduction

Maternal mortality rate (MMR) is an important indicator when describing a country's social welfare [1]. Furthermore, Indonesia has one of the high MMR among countries in the Asia region [2]. In this country Demographic and Health Survey (IDHS) that MMR in the country was 177 per 100,000 live births [3]. According to data from the Ministry of Health, antenatal bleeding was the major cause of maternal mortality in 2019. Furthermore, one third (30.3%) of Indonesian women die from bleeding during pregnancy processes, childbirth, and postpartum [1].

The risk factors that cause bleeding during childbirth are high maternal age, parity less than 3, poor birth history, prolonged labor, and anemia [4]. Anemia during pregnancy has a significant relationship with maternal death in low and middle income countries [5]. Studies show that there was a significant relationship between anemia during pregnancy and postpartum hemorrhage in Indonesia [6,7]. In addition, women who experiencing postpartum hemorrhage had a history of suffering from anemia during pregnancy [8].

Anemia during pregnancy is a major health problem. Consequently, data from the Indonesian Basic Health Research showed that the prevalence of anemia among pregnant women in the country increased significantly from 37.1% in 2013 to 48.9% in 2018 [9]. This means that almost half of pregnant women currently suffer from this disease. Therefore, investigating factors that cause anemia in pregnant women is very important.

Anemia during pregnancy is also associated with several factors, such as drinking more than three cups of tea per day before pregnancy, ingestion of clay or dirt during pregnancy, reduced egg intake, consuming less beef [10], meal frequency, dietary diversity, and parity [11]. Tea contains tannin, which is well known as an iron absorption inhibitor, therefore, consuming tea after meals causes a 60% decrease in iron uptake [12]. Furthermore, serum iron and ferritin are significantly higher in non-tea drinkers compared to tea drinkers [13]. A research showed that the major cause of anemia during pregnancy in Indonesia is iron deficiency [14]. Consequently, humans obtain iron from food because their bodies do not produce it [15]. Studies about the adverse effects of food consumption on pregnancy were mostly conducted in Western [16–20] and other Asian countries [21,22]. Therefore, there is few information on the correlation between food consumption and anemia among Javanese pregnant women in Indonesia.

Cultural beliefs during pregnancy contributes to pregnant women's choice of food. This is because, Javanese people have a strong belief that eating foods such beef, eggs and fish is a taboo. However, these are foods rich in protein and iron which influence the pregnant women's hemoglobin concentration [23]. Another Javanese culture is drinking tea during meals, which causes a decrease in the absorption of non-heme iron, thereby leading to iron deficiency anemia [24] [25]. A randomized control study showed that drinking tea with meals decreases iron absorption. However, taking it after meals reduces the inhibitory effect on iron absorption [26]. Furthermore, components of beverages such as tea, directly affect iron bioavailability, and inhibit iron absorption [27]. A recent study showed that the cultural beliefs of Javanese people are are changing, particularly among the young generation [28]. Therefore, in order to prevent anemia in pregnant women, it is essential to examine the association between food consumption and this disease.

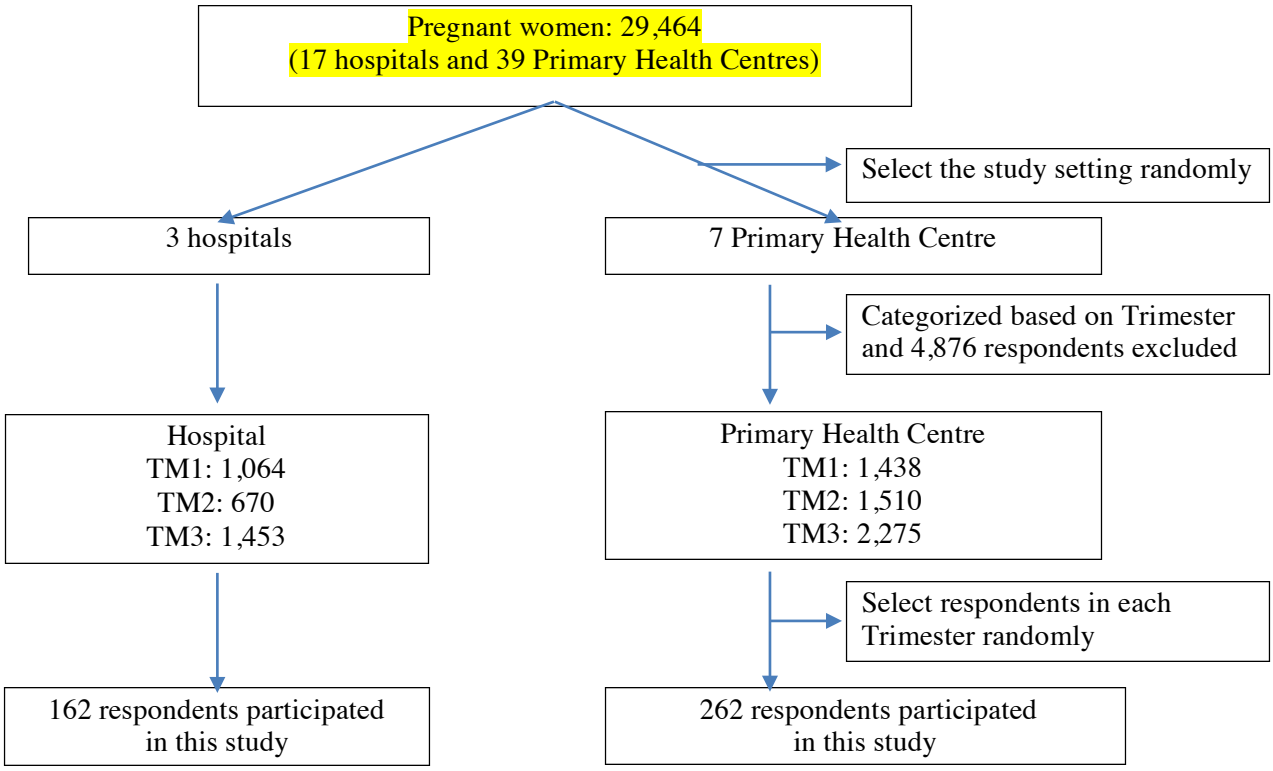
Studies aimed at determining the predictors of anemia during pregnancy have been conducted in Indonesia [14,29]. However, they only examined the correlation between infectious diseases and the sociodemographic factors of anemia. Studies on anemia in pregnant women need to be updated. According to the Indonesian Ministry of Health's report in 2018, the Central Java Province had a high prevalence of anemia among pregnant women and teenagers. Therefore, this study aimed to determine predictors of anemia among pregnant women in the Central Java Province.

2. Method

Research design and participants

This study used a descriptive cross-sectional design, which was conducted in the Central Java Province among Javanese people, the largest ethnic group [30], on the most populous island in Indonesia. The Yamane's formula was used to calculate subject of research $n = \frac{N}{1+N(e)^2}$ [31]. The population of pregnant women (N) was 29,464 [32], with a precision of 0.05. Furthermore, the research used 10% of this number as the respondents. Therefore, the required the subjects in this research was 424 respondents.

The research involved 424 respondents which were selected using a random multistage cluster sampling to obtain subjects that represent pregnant women from both rural/urban areas, sub-districts, and health care facilities [33]. These subjects were recruited from 3 antenatal care clinics at the hospital and 7 Primary Health Centres which were selected randomly from 17 hospitals and 39 Primary Health Centres. Furthermore, in each health care facility, pregnant women were categorized into 3 groups according to their trimester, after which some were randomly selected.



The inclusion criteria of respondents were pregnant women with 4-38 weeks of gestation, routine antenatal care visits, and willingness to participate in this research. Meanwhile, the exclusion criteria included history of chronic bleeding, thalassemia, malaria, and chronic diseases such as inflammatory bowel movement, autoimmune diseases, cancer, chronic infections and renal failure, solid tumors, chronic heart failure [34].

Data was collected using a set of questionnaires and a hemoglobinometer. Sociodemographic data was obtained using a self-developed questionnaire based on literature review, and included questions such as maternal and gestational age, parity, education concentration, working status, family income, and abortion history. Data on food consumption were collected using a set questionnaires and hemoglobin concentrations were measured using a hemoglobinometer.

Data collection

Data was collected from February to June 2018 by four research assistants with bachelor degrees in Nursing science. There was a discussion on the purpose, ethics, informed consent, and data collection methods. Data collection only started after receiving the ethical approval and permit from the Indonesian Ministry of Health and Government office and providing information to respondents related to the research purpose, benefits, procedures, and

required time. The respondent willing to participate in this research signed in a written consent form to show that they understood the research information and had agreed to participate.

Dietary analysis

The variables needed in this research were the frequency of (times/week) red beef, eggs, liver, tea, milk consumption, and the current hemoglobin level. The items such as eggs, beef, liver, and milk were chosen because of their high consumption prevalence among Javanese and their high Fe content. Tea was also chosen because it is a popular beverage and it is usually drinking after meals even though tea inhibits the absorption of Fe in the small intestine. The food consumption frequency questionnaire (FCFQ) and dietary history questionnaire (DHQ) were examined for content validity, language and cultural suitability by a panel of 3 experts consisting 2 faculty members from Department of Nutrition, Universitas Jenderal Soedirman and a faculty member from Department of Nursing, Universitas Jenderal Soedirman. Then, the reliabilities of instruments were performed with 25 pregnant women. All details of Content Validity Indices (CVI) and reliabilities were explained in each scale.

The back translation process was performed based on Hilton and Skrutkowski guideline (2002). The original questionnaires were translated from English into Bahasa Indonesian version. Next, the questionnaires were translated back from Bahasa Indonesian version into English version. The process was carried out by 3 bilingual lecturers in Health Sciences with master's degrees from countries where English is the main language. Last, a native English speaker evaluated the original and back-translated questionnaires.

The data on the frequency of beef, liver, and eggs consumptions was collected using a food consumption frequency questionnaire (FCFQ) developed by Zhao, Zhang, Li, Wang, Li, Xue, & Gao (2014). These frequency data was categorized into (1) never or less than once per week, (2) once to six times per week, and (3) daily [35]. The categorization is also in accordance with the Indonesian nutrition guidelines [36]. Meanwhile data was validated with 24-h recall of foods eaten the day before the survey. The CVI of the questionnaire was 0.97 and reliability testing using a Pearson correlation was 1.

Furthermore, data on the frequency of milk and tea consumption was collected using a dietary history questionnaire (DHQ) created by Sasaki, Yanagibori, & Amano (1998). The frequency of milk intake was categorized into (1) never or less than a cup per week, (2) once to six cup per week, and (3) daily. Meanwhile, that of tea consumption was categorized into (1) 0-1 cup per day, (2) 2-3 per day, (3) 4-5 daily and (4) ≥ 6 cups daily [21]. This categorization

is also in accordance with the Indonesian nutrition guidelines [36]. The data was validated with 24-h recall of foods eaten the day before the survey. The CVI of the questionnaire was 0.98 and reliability testing using a Pearson correlation was 0.99.

Blood samples were collected from finger pricks, while hemoglobin concentrations were measured using the EasyTouch®GCHb (Bioptik Technology Inc., Taiwan), with measuring range of 7-26 g/dL [37] . The respondents were then categorized into anemia (<11 g/dL), and non-anemia (≥11 g/dL) according to their hemoglobin concentrations. Furthermore, pregnant women with anemia were categorized into mild (9-10.9 g/dL), moderate (7-8.9 g/dL), and severe (<7 g/dL) [38].

Data analysis

The data was analyzed using descriptive statistics mean, median, and frequency. The Chi-Square test was used to analyze the correlation between beef, liver, eggs, iron tablets, tea, milk consumption and anemia status. Variables with a *p* value of more than 0.25 were included to a multivariate analysis. Then, Multiple Logistic Regression (with the backward Wald and 95% CI) was used to obtain odds ratios (ORs) and analyze the predictive factors of anemia. Furthermore, the two-tailed *p* value of < 0.05 was used to indicate the significance. The SAS software version 9.4 (SAS Institute Inc., Cary, NC, USA) was used to perform all the statistical analyses.

3. Results

Prevalence of anemia

The overall prevalence of anemia was 46.5%, with 86.29% and 13.71% of these anemic respondents having mild and moderate anemia respectively.

Respondents' Demographic characteristics

This research involved 424 respondents, each having characteristics described in Table 1. The mean of respondents' age and gestational age were 27.42±SD=5.9 years and 24.32±SD=10.04 weeks, respectively. Most respondents were in their third trimester (44.3%), multiparous (72.2%), and had graduated from Senior High School (39.6%). They were also housewives (65.6%) with a family income of USD 120 (83.3%). 80.7% had no abortion history and most had a mean hemoglobin concentration of 10.94±SD=1.89 g/dL. Most respondents consumed iron supplementation (78.3%) and eggs (68.6%) daily, half drink tea during pregnancy (50.5%). While the others not consume liver (60.8%) as daily intake.

Table 1. The Research Respondents' Characteristics (n = 424)

Characteristics	Frequency	Percentage (%)
Age		
<20	32	9.9
20-35	345	79.1
>35	47	11
Parity		
Primipara	118	27.8
Multipara	306	72.2
Pregnancy trimester		
First	126	29.7
Second	110	25.9
Third	188	44.3
Educational level		
Elementary	70	16.5
Junior High School	83	19.6
Senior High School	168	39.6
Diploma	41	9.7
Bachelor	58	13.7
Postgraduate	4	0.9
Working status		
Employee	146	34.4
Housewife	278	65.5
Family income		
< USD 120	71	16.7
≥ USD120	353	83.3
Abortion history		
Yes	82	19.3
No	342	80.7
Hb (g/dL)		
< 11	197	46.5
≥ 11	227	53.5
Anemia level		
Mild	27	13.71
Moderate	170	86.29
Iron supplementation		
Yes	332	78.3
No	92	21.7
Liver consumption		
0	258	60.8
1-6	152	39.2
Beef consumption		
0	178	42
1-6	246	58
Eggs consumption		
0	41	9.7
1-6	291	68.6
>7	92	21.7
Tea consumption		
0-1	210	49.5
2-3	108	25.5

Characteristics	Frequency	Percentage (%)
4-5	88	20.8
≥ 6	18	4.2
Milk Consumption		
0	148	34.9
1-6	64	15.1
≥7	212	50

The Chi-Square testing results (Table 2) showed that liver, milk, egg, tea, and iron consumption with values of (χ^2=4.040, p<0.001), (χ^2=1.255, p<0.05), (χ^2=4.052, p<0.001), (χ^2=7.031, p<0.001), and (χ^2=3.420, p<0.001) respectively, had significant correlations with anemia risk.

Table 2. The Correlation of Beef Consumption, Milk consumption, Liver Consumption, Eggs Consumption, Tea Consumption, and Iron Supplementation with Anemia among Pregnant Women (n=424)

Variables	χ^2	p
Beef consumption	1.012	0.953
Milk consumption	1.255	0.035
Liver consumption	4.040	<0.001
Eggs consumption	4.052	<0.001
Tea consumption	7.031	0.008
Iron supplementation	3.420	<0.001

Multiple Logistic Regression and Backward (Wald) testing results revealed that pregnant women with low liver (OR=4.128, p<0.001), and eggs consumption (OR=3.590, p<0.01), iron supplementation (OR=3.837, p<0.05) and higher daily tea consumption (OR=5.075, p<0.001) were significantly associated with higher anemia risk after analyzing the respondents' characteristics.

Table 3. The Logistic Regression for Predictors of Anemia among pregnant women (n=424)

Variables	B	Wald	OR	95%CI	p
Liver consumption***	1.418	34.175	4.128	2.566-6.640	<0.001
Eggs consumption**	1.278	8.594	3.590	1.527-8.437	0.003
Tea consumption***	1.624	27.831	5.075	2.776-9.279	<0.001
Iron supplementation***	1.345	21.583	3.837	2.176-6.767	<0.001

Values presented as odds ratio (95% of confidence interval).
-2 LLχ^2 = 459.72; Hosmer and Lemeshow test (χ^2) = 6.33 (p = 0.50); Cox and Snell R^2 = 0.257, Nagelkerke R^2 = 0.34.
*p<0.05, **p<0.01, ***p<0.001

4. Discussion

Anemia is a condition were a person's hemoglobin blood concentration is lower normal [39]. This research confirmed that anemia among pregnant women is still high. Furthermore, half of respondents (46.5%) had this condition, with 86.29% of them having mild anemia, while

the remaining (12.69%) had moderate. The result is consistent with data from the Indonesian Basic Health Research [9] which showed that 48.9% of pregnant women aged 25-34 years old were anemic. In this research, pregnant women with low education, multiparous, and low-income families were more likely to become anemic. This is due to lack of anemia prevention knowledge, attitude, and financial problems among families with low education and income.

Intake of iron and protein-rich foods help prevent pregnant women from developing anemia [40]. The result of this study provided consistent data comparing to previous study result on the frequency of iron supplement consumption among pregnant Indonesian women. According to Triharini and Armini (2020), only 52.1% of pregnant women make use of iron tablets [41]. Previous studies showed that at least half of anemia cases during pregnancy are caused by iron deficiency [42],[43]. Therefore, it was concluded that iron supplementation could prevent anemia among Indonesian pregnant women. Mothers' compliance in consuming iron tablets had a significant effect on anemia within pregnant women [44] [45].

The results show that eating liver during pregnancy correlates with lower anemia risk. Most Indonesian people consume chicken liver and cow liver, which contain 9.2 and 4.8 mg of iron per 75 gram (2.5 oz) respectively [46]. Eating liver regularly increases hemoglobin concentration and prevents anemia [47]. The anemic status among Japanese is also significantly correlated with the low intake of animal products containing iron, vitamin B-12, and folate [48].

A research conducted in Pakistan found that consuming eggs has an effect on hemoglobin concentration among pregnant women [10]. Most Indonesian people also eat eggs in their daily meals because they are cheap, easy to find, and prepare. Furthermore, they consume eggs at the rate of 106.418 Kg/year [49]. However the results showed that egg consumption did not prevent anemia among the Indonesian pregnant women, since egg is considered as a popular food. This is due to the local beliefs among the Javanese which restrict pregnant women from eating foods such as fish and eggs [23].

Those that eat beef as part of their daily diet had higher hemoglobin concentrations when compared to others did not [35]. However, beef consumption did not predict anemia among pregnant women in this research. It was found that only one third of Indonesian pregnant women eat beef as part of their daily menu [50]. The average beef consumption among Indonesian people is only 0.469 Kg/year [49]. This low intake is due to beef's price which is considered expensive. A research conducted in Japan also found that there was no correlation between beef intake and anemia risk among Japanese people [48].

Milk and tea are well-known as an iron absorption inhibitors . The results showed that milk consumption did not have significant correlation with anemia among pregnant women. This is because Indonesian people believe sweetened cream to be a dairy product, when it is not. In fact, sweetened cream lacks proteins present in milk. This observation was recently made by the Indonesian Food and Drug association [51]. Tea consumption correlated with anemia among pregnant women, because they drink it during their meals. Indonesia ranked second in tea consumption among countries in the South East area [52]. Almost half of Indonesian people, including pregnant women drink tea every day as a habit, [50] and a part of their culture even though it is not supported with evidence [28].

In this research, the highest prevalence of anemia was found among pregnant women in third trimester. According to Ward and Hisley (2009), these women have the lowest hemoglobin concentration at 30-34 weeks of pregnancy [53]. The results are consistent with others which found that the third trimester of pregnancy was associated with anemia [54] [55].

The scope of this research covered both rural and urban areas and included local beliefs related to food consumption. Meanwhile, its limitations were respondent's recall bias, research assistants, and hemoglobin measurement method. Consequently, future studies should use better hemoglobin measurement methods, recruit nutritionists as a research assistant, and recruit bigger sample sizes.

5. Conclusion

This research showed that consumption of iron supplements, iron-rich foods, and tea had significant correlations with anemia among pregnant women. The results suggest that health care providers should consider enhancing the diet of women during pregnancy. This is done by increasing the intake of iron-rich foods and supplements, reducing tea consumption, regular assessment and intervention at antenatal care. In this cross-sectional study, a relationship was found between risk factors and anemia during pregnancy.

Abbreviations

OR: Odds ratio; IDHS: Indonesian Demographic and Health Survey; MMR: Maternal mortality rate; RBC: Red Blood Cell.

Acknowledgements

The authors are grateful to the participants of the research, and the health providers for generously providing their experience. The authors also thank Nina Setiawati, Waluyo Sejati, Slamet Turah, and Tuti Hartini for their assistance in data collection.

Authors' contributions

MDA: Project design, manuscript writing, data interpretation, project administration, supervision. AF: Data analysis, manuscript writing, review, and editing. RS: Data collection, writing-review, and editing. All authors have read and approved the final manuscript.

Funding
This research was supported by the Directorate General of Higher Education (DGHE, DIKTI) and Universitas Jenderal Soedirman, through a "Riset Unggulan Perguruan Tinggi" grant No. 068/SP2H/LT/DRPM/IV/2017.

Availability of data and materials
The datasets used and/or analysed during this researchare available from the corresponding author on reasonable request.

Ethics approval and consent to participate
In order to ensure the subjects' human rights, this research obtained an ethical approval from the Institutional Review Board Faculty of Medicine, *Universitas Jenderal Soedirman*, Indonesia No. 1184/KEPK/III/2018. The authors also received a permit from the Indonesian Ministry of Health and Government office to conduct this research. They, have also provided sufficient information related to the research such as purpose, benefits, procedures, potential risks, required time, anonymity, confidentiality, the subjects' rights to withdraw themselves from this research anytime, and the authors' phone numbers for further questions related to this research, if needed. The respondents signed a written consent after stating that they understood the purpose, benefits, potential risks, required time, and procedures were willing to participate. The authors have saved the data using codes, and only the them have to access this data.

Consent for publication
Not applicable.
Competing interests
The authors declare that they have no competing interests.

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[OAMJMS] Editor Decision

1 message

Assoc. Prof. Dr Sasho Stoleski, MD, PhD via SFS - Journals (Scientific Foundation SPIROSKI - Journals), Skopje, Republic of Macedonia <noreply@publicknowledgeproject.org>

Sat, Jun 5, 2021 at 12:28 AM

Reply-To: "Assoc. Prof. Dr Sasho Stoleski, MD, PhD" <sstoleski@yahoo.com>
To: Mekar Dwi Anggraeni <mekar.anggraeni@unsoed.ac.id>, Amin Fatoni <aminfatoni@unsoed.ac.id>, Rahmi Setiyani <rahmi.setiyani@gmail.com>

Mekar Dwi Anggraeni, Amin Fatoni, Rahmi Setiyani (Author):

We have reached a decision regarding your submission to Open Access Macedonian Journal of Medical Sciences, "Dietary Intake as a Risk Factor of Anemia among Indonesian Pregnant Women: A Cross-sectional Study", Manuscript ID = OJS6066, submitted {$submission}

Our decision is to:

SciRev (https://scirev.org/) offers you the possibility to share your experience with the scientific review process with your colleagues (left search engine) and to select an efficient journal for submitting your manuscripts (right search engine). Because we would like to increase the quality of the review process, please register and submit your experience with the review process of your article published in Open Access Macedonian Journal of Medical Sciences in the SciRev (https://scirev.org/questionnaire/macedonian-journal-of-medical-sciences/).

Sasho Stoleski

Reviewer A:
Recommendation: Accept Submission

Comments to the Author

The Authors have responded the revision request completely

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[OAMJMS] Editor Decision

1 message

Prof. Dr Mirko Spiroski via SFS - Journals (Scientific Foundation SPIROSKI - Journals), Skopje, Republic of Macedonia <noreply@publicknowledgeproject.org>
Reply-To: "Prof. Dr Mirko Spiroski" <mspiroski@id-press.eu>
To: Mekar Dwi Anggraeni <mekar.anggraeni@unsoed.ac.id>, Amin Fatoni <aminfatoni@unsoed.ac.id>, Rahmi Setiyani <rahmi.setiyani@gmail.com>

Sun, Jun 27, 2021 at 11:50 AM

Mekar Dwi Anggraeni, Amin Fatoni, Rahmi Setiyani (Author):

We have reached a decision regarding your submission to Open Access Macedonian Journal of Medical Sciences, "Dietary Intake as a Risk Factor of Anemia among Indonesian Pregnant Women: A Cross-sectional Study", Manuscript ID = OJS6066, submitted {$submission}

Our decision is to: Accept your revised manuscript for publication in OAMJMS.

SciRev (https://scirev.org/) offers you the possibility to share your experience with the scientific review process with your colleagues (left search engine) and to select an efficient journal for submitting your manuscripts (right search engine). Because we would like to increase the quality of the review process, please register and submit your experience with the review process of your article published in Open Access Macedonian Journal of Medical Sciences in the SciRev (https://scirev.org/questionnaire/macedonian-journal-of-medical-sciences/).

[OAMJMS] Proofreading Request (Author)

1 message

Teodora Fildishevska via SFS - Journals (Scientific Foundation SPIROSKI - Journals), Skopje, Republic of Macedonia <noreply@publicknowledgeproject.org>
Reply-To: Teodora Fildishevska <tfildishevska@id-press.eu>
Tue, Jul 27, 2021 at 6:18 PM
To: Mekar Dwi Anggraeni <mekar.anggraeni@unsoed.ac.id>

Dear Mekar Dwi Anggraeni:

Your submission "Dietary Intake as a Risk Factor of Anemia among Indonesian Pregnant Women: A Cross-sectional Study" to Open Access Macedonian Journal of Medical Sciences now needs to be proofread by folllowing these steps.
1. Click on the Submission URL below.
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Username: Mekar Dwi Anggraeni

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[OAMJMS] Editor Decision

1 message

Teodora Fildishevska via SFS - Journals (Scientific Foundation SPIROSKI - Journals), Skopje, Republic of Macedonia <noreply@publicknowledgeproject.org> Tue, Jul 27, 2021 at 6:18 PM
Reply-To: Teodora Fildishevska <tfildishevska@id-press.eu>
To: Mekar Dwi Anggraeni <mekar.anggraeni@unsoed.ac.id>, Amin Fatoni <aminfatoni@unsoed.ac.id>, Rahmi Setiyani <rahmi.setiyani@gmail.com>

Mekar Dwi Anggraeni, Amin Fatoni, Rahmi Setiyani (Author):

The editing of your submission, "Dietary Intake as a Risk Factor of Anemia among Indonesian Pregnant Women: A Cross-sectional Study," Manuscript ID = OJS6066 is complete. We are now sending it to production.

Submission URL: https://oamjms.eu/index.php/mjms/authorDashboard/submission/6066