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Education Level, Dietary Quality, Nutritional Status, Serum Ferritin, and Blood Hemoglobin Level of Pregnant Women in Bogor District

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ABSTRACT

This study aimed to determine the associations of education level, dietary intake, nutrition status, and serum ferritin level with blood Hemoglobin (Hb) level of pregnant women in Ciampea, Bogor district. Thirty pregnant women in their second and third trimester were included in this cross-sectional study. Dietary quality was estimated by energy and nutrient adequacy levels and Individual Dietary Diversity Scores (IDDS). Pre-pregnancy BMI was determined by self-reported body weight and direct height measurement. Nutrition intake was calculated for two 24-h recall. Blood Hb and serum ferritin levels were analyzed by spectrophotometry method and enzyme-linked immunosorbent assay method, respectively. Depending on data distribution, Spearman or Pearson correlation was performed to analyze correlations between variables. The results showed that most women had low education level (66.6%), low adequacy levels of energy, carbohydrate, protein, fat, and iron (96.7%; 96.7%; 100.0%; 53.3%; and 100%, respectively); and had moderate IDDS score (76.7%). About one-third of women were overweight or obese prior to pregnancy. About one-fourth of women were anemic (Hb<11.0 g/dl), and 66.7% were iron deficient. No significant associations were found between blood Hb and energy and nutrient adequacy levels, IDDS score, pre-pregnancy BMI, and serum ferritin level (p>0.05). Blood Hb was associated with education level (r=0.388; p=0.034). The results suggested that anemia among these pregnant women may be due to poor education levels. Improving education level as well as increasing iron intake are particularly important in reducing anemia problem among this group.

Keywords: anemia, education level, hemoglobin, nutrient adequacy, pregnant women

INTRODUCTION

Anemia in pregnant women (blood hemoglobin levels below 11 g/dl) continues to be a major nutrition problem in many developing countries. Globally, anemia affects 32.4 million (38.2%) of pregnant women (WHO 2015). Indonesia Basic Health Research in 2013 showed that the prevalence of anemia in pregnant women was 37.1%. The anemia prevalence in urban and rural areas was about the same, i.e., 36.4% and 37.8%, respectively (MoH RI 2013a). Anemia during pregnancy has negative consequences for both mother and their offspring. Anemic pregnant women have a higher risk of post-partum bleeding, maternal morbidity, and mortality. Furthermore, this condition will cause preterm birth and babies to be born with low birth weight (Figuerido *et al.* 2018; Kumari *et al.* 2019).

Anemia during pregnancy has a variety of contributing factors, which is nutritional factors (low vitamin C, folic acid, vitamin B12, and iron) and non-nutritional factors (medical disorders i.e., infections). These factors vary widely according to genetic factor, geographical factor , and dietary practices. Iron deficiency is thought to be the most common cause of anemia. An iron deficiency arises when the iron requirement is not met by iron absorption in the body. The maternal nutritional need for iron increases during pregnancy. Pregnant women need an additional 9–3 mg of iron during pregnancy to help the process of fetal growth in the womb (MoH RI 2013b). The addition of these nutrients is needed for the health of pregnant women, the development of the fetus, as well as nutrient reserve for breastfeeding to support infant growth and development (MoH RI 2011). Therefore, if this iron needs cannot be fulfilled during pregnancy, iron deficiency is likely to occur.

Measurement of iron store status in pregnant women is the most accurate test

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to diagnose iron-deficiency anemia during pregnancy. The serum ferritin level in the blood is a common biochemical marker to determine the iron store status in the body. However, data on serum ferritin among pregnant women in the Bogor district has not been widely reported in previous studies. This present study aimed to determine the associations of several potential causes of anemia during pregnancy (education level, nutrition intake and status, and serum ferritin level) with blood Hemoglobin (Hb) level of pregnant women in Ciampea, Bogor district.

METHODS

Design, location, and time

This study was a cross-sectional study conducted in two villages, i.e., Ciampea Village and Cibanteng Village, Bogor district, West Java province, Indonesia. The study was carried out from May to December 2019.

This study was approved by the Human Research Ethics Committee of the Bogor Agricultural University with record number 225/ IT3.KEPMSM-IPB/SK/2019.

Sampling

This study population was healthy pregnant women in their second and third trimester of pregnancy who attended the Community Health Centre (Puskesmas) for antenatal care in the two villages at the time of data collection. The list of pregnant women was obtained from the village midwives' records. Those who agreed to participate and signed the informed consent were examined by an ultrasound to estimate the gestational age. Blood samples were taken for biochemical analysis. Subjects were interviewed related to health and pregnancy history, as well as two days of 24-h dietary recall. After checking the completeness of the data, data from 30 subjects were included in the analysis

Data collection

Data collected included education level, dietary quality (energy and nutrient adequacy level and Individual Dietary Diversity Score / IDDS), pre-pregnancy Body Mass Index (BMI), and biochemical marker (blood Hb and serum ferritin level).

Education level. The education level of subjects was determined by self-report using the questionnaire. Education level was classified into five categories, which were no formal education, elementary school, junior high school, senior high school, and university.

Dietary quality. Dietary quality was determined by measuring the adequacy level and IDDS. Energy, protein, carbohydrate, fat, and iron adequacy levels were calculated from 2 days of 24-h recall. Energy and nutrient adequacy levels were determined by comparing the intake with the recommended daily intake. Energy adequacy level was categorized into severely deficient (<70%), deficient (70–<100%), adequate (100–<130 %), and excessive (≥130 %). Protein adequacy level was categorized into severely deficient (<80%), deficient (80–<100%), adequate (100–<120%), and excessive (≥120 %). Carbohydrate and fat adequacy levels were categorized into deficient (<80), adequate (80–<110%), and excessive (≥110%). The iron adequacy level was categorized into deficient (<77) and adequate (≥77%).

IDDS was analyzed according to the FAO guideline using the nine-item scale. The nine major food groups inquired about are starchy staples, dark green leafy vegetables, vitamin A-rich fruits and vegetables, other fruits and vegetables, organ meat, eggs, and legumes/nuts/seeds, as well as milk and milk products. Data from day 1 of 24-h food recall was used to calculate IDDS. A score of 1 was assigned to a food category consumed by the subject of more than 10 grams. Meanwhile, the score of 0 was assigned to a food category that was not consumed in the past 24 hours or a food category consumed by subject less than 10 grams. The maximum possible IDDS score in this study was 9 points. IDDS score then was categorized as poor (<3 points), moderate (3–5 points), and good (≥6 points).

Pre-pregnancy BMI. The nutritional status of the subject before pregnancy was measured by the pre-pregnancy Body Mass Index (BMI). BMI was calculated by dividing body weight (kilogram) by height (meter) squared. Bodyweight of the subject before pregnancy was determined by self-report and body height was directly measured using stature. Pre-pregnancy BMI was classified as underweight (<18.5 kg/m^2), normal (18.5–22.9 kg/m^2), overweight (23.0–24.9 kg/m^2), obese I (25–29.9 kg/m^2), and obese II (≥30 kg/m^2).

Biochemical marker. Peripheral blood samples were collected from the pregnant subjects to determine Hb and serum ferritin. Hb level was analyzed by spectrophotometry method on the same day of blood collection. Anemia was defined when the hemoglobin level was less than 11 g/dl. The serum ferritin level was analyzed by enzyme-linked immunosorbent assay method. Serum was obtained from blood samples after centrifugation. Iron deficiency was defined if the serum ferritin level was below 15 ng/ml or anemia with serum ferritin level below 40 ng/ml was detected.

Data analysis

Data were analyzed using SPSS version 16 for Windows. Spearman or Pearson correlation was used to analyze the correlation between variables. Statistical analyses were performed by correlating each variable (pre-pregnancy BMI, education level, dietary quality, and serum ferritin) and Hb level. A probability value of less than 0.05 was considered to indicate statistical significance.

RESULTS AND DISCUSSION

Education level

The education level of subjects is described in Table 1. The result showed that one-third of subjects finished their school up to elementary level. No subject of this study attended university. Thus, it can be concluded that the education level of subjects was generally low.

Education is a factor that is suggested to be positively correlated with anemia in pregnant women. The study results by Ullah *et al.* (2013) and Chowdhury *et al.* (2015) showed that the incidence of anemia will decrease along with the increase of mother's education status. Education may influence anemia through knowledge on health and socioeconomic status. Mothers who are highly educated are thought to have better knowledge on nutrition and health. The higher the level of education of the mothers was, the easier it became for them to receive information about nutrition and health. The good knowledge on nutrition and health would be possessed in the prevention of anemia in pregnancy (Heliyana *et al.* 2019).

Diet quality

Diet quality of subject was described by energy and nutrient adequacy levels and Individual Dietary Diversity Score (IDDS). The results are shown in Table 2. The adequacy levels of energy, carbohydrates, proteins, fats, and iron of pregnant subjects were lacking. These findings are quite alarming since pregnancy is a critical period for fetal growth and development. Fulfilling adequate nutrition during pregnancy is essential to overcome health and nutritional problem. Lack of nutrients during pregnancy is related to an incidence of anemia (Sinawangwulan *et al.* 2018). More efforts should be made through various strategies and/or programs to improve the nutrient intake quality of pregnant women.

The fulfillment of balanced nutrition was obtained not only by considering the amount of food but also the variety of food consumed. This study showed that most of the subjects had a moderate dietary diversity score (76.7%). Only a few subjects had a good dietary diversity score (20.0%) (Table 2). These findings implied that the variety of food groups consumed by subjects was lacking and needed to be improved.

Consuming a variety of foods is highly recommended during pregnancy to prevent nutritional deficiencies. A good dietary diversity of pregnant women also is suggested to be associated with better birth outcomes. Saaka (2012) showed that good dietary diversity of

Table 1. Education level of subjects

Education level category	Frequency	Percentage (%)
No formal education	1	3.3
Elementary school	9	30.0
Junior high school	10	33.3
Senior high school	10	33.3
University	0	0.0
Total	30	100.0

Tabel 2. Diet quality of subjects

Variable*	Frequency	Percentage (%)	Mean±SD
Energy adequacy level (% EAL)			
Severely deficient (<70)	24	80.0	54.8±18.1
Deficientt (70–<100)	5	16.7	
Adequate (100–<130)	1	3.3	
Excessive (≥130)	0	0.0	
Protein adequacy level (% NAL)			
Severely deficient (<80)	25	83.3	51.34±19.4
Deficient (80–<100)	5	6.7	
Adequate (100–<120)	0	0.0	
Excessive (≥120)	0	0.0	
Carbohydrate adequacy level (% NAL)			
Deficient (<80)	29	96.7	47.9±15.7
Adequate (80–110)	1	3.3	
Excessive (≥110)	0	0.0	
Fat adequacy level (%NAL)			
Deficient (< 80)	16	53.3	75.8±41.1
Adequate (80–110)	8	26.7	
Excessive (≥110)	6	20.0	
Iron adequacy level (% NAL)			
Deficient (<77)	30	100.0	
Adequate (≥77)	0	0.0	
IDDS (point)			
Poor (<3)	1	3.3	4.4±1.2
Moderate (3–5)	23	76.7	
Good (≥6)	6	20.0	
Total	30	100.0	

*EAL: Energy Adequacy Level; IDDS: Individual Dietary Diversity Score; NAL: Nutrient Adequacy Level

mother during pregnancy was positively related to infant birth weight. There was a decrease in the prevalence of low birth weight among mothers with a good dietary diversity score.

Pre-pregnancy BMI

Pre-pregnancy nutritional status is an important factor that must be considered by pregnant women. Body mass index is a common measurement used to analyze the nutritional status of an adult. The pre-pregnancy body mass index of this study is described in Table 3. Most subjects (60.0%) were overweight or obese prior to pregnancy and 10% were underweight. Thus, the nutritional status of pregnant women, especially obesity, is still a problem in the group of pregnant women in this study area.

Food intake is one of the factors that can influence nutritional status. This study indicated that most of the mothers were overweight or obese before pregnancy, but the usual nutrient intake of these subjects before pregnancy was not measured. Therefore, we cannot conclude whether excess nutrient intake also occurs before

Tabel 3. Pre-pregnancy BMI of subjects

BMI category	Frequency	Percentage (%)	Mean±SD (kg/m^2)
Underweight	3	10.0	24.9 ± 3.5
Normal	9	30.0	
Overweight	7	23.3	
Obese I	9	30.0	
Obese II	2	6.7	
Total	30	100.0	

pregnancy. It is suggested that future studies can further elaborate on this factor.

Both pre-pregnancy underweight and overweight are recognized as being an important factor for pregnancy outcome. Pre-pregnancy underweight was considered as a risk factor for the adverse birth outcome, such as low birth weight that is a predictor of adverse brain development of the babies (Murai *et al.* 2017; Li *et al.* 2018). Besides, it is known that pre-pregnancy obesity increases the risk of various pregnancy complications, such as gestational diabetes, pre-eclampsia, gestational hypertension, cesarean birth, and neonatal death (Shen *et al.* 2018; Stubert *et al.* 2018).

Blood hemoglobin and ferritin

Hemoglobin and serum ferritin levels are showed in Table 4. This study found that about 26.7% of subjects were anemic and the majority of subjects had iron deficiency (66.7%) based on the serum ferritin level. Those who suffered from anemia also suffered from iron deficiency. The results indicated that iron deficiency anemia is still a significant problem in the group of pregnant women and therefore needs attention.

Based on the result of this study, iron deficiency was the most cause of anemia in pregnant women. Even though the government has launched the iron tablet supplementation program to prevent iron deficiency anemia in pregnant women, the implementation needs evaluation. The compliance of pregnant women in consuming iron tablet supplementation also needs to be further analyzed, since increasing compliance of subjects in consuming iron supplementation has effect on reducing the prevalence of anemic pregnant women. Previous studies also showed that anemia prevalence was lower in the group of pregnant women who consumed enough iron supplementation (Fitri *et al.* 2015; Sinawangwulan *et al.* 2018; Nursari 2018).

Variables related to blood hemoglobin level

Bivariate analyses were performed to assess the correlation among variables. Table 5 showed that there was a significant positive correlation between the education level and the hemoglobin level of subjects (p=0.034; r=0.388). The higher the education level of those subjects was, the higher the hemoglobin level becomes.

Table 4. Hemoglobin and serum ferritin levels of subjects

Variable	Frequency	Percentage (%)	Mean±SD
Hemoglobin level (g/dl)			
Anemia	8	26.7	11.5±1.2
Non-anemia	22	73.3	
Serum ferritin level (ng/ml)			
Iron deficiency*	20	66.7	23.8±29.8
Non-iron deficiency	10	33.3	

*less than 40 ng/ml in anemic subjects and less than 15 ng/ml in non-anemic subjects

Table 5. Associations of subjects' characteristics and nutrition status with hemoglobin level

Variable	p	r
Education level[a]	0.034*	0.388
Energy adequacy level[a]	0.982	-0.004
Carbohydrate adequacy level[b]	0.737	-0.064
Protein adequacy level[b]	0.320	0.188
Fat adequacy level p[b]	0.393	0.162
Fe adequacy level[a]	0.667	0.082
IDDS[a]	0.210	0.236
Pre-pregnancy BMI[b]	0.489	0.131
Serum ferritin level[a]	0.096	0.309

[a]Spearman test; [b] Pearson test; *Significant correlation at $p<0.05$; BMI: Body Mass Index; IDDS: Individual Dietary Diversity Score

Mekkonen *et al.* (2018) showed that anemia in pregnancy was significantly associated with women's education. The study by Chowdhury *et al.* (2015) also concluded that the level of education of mothers had a significant association with maternal anemia. The level of education influences a person in making decisions. Educated mothers will be more open to new information. It could have an impact on increasing the level of knowledge that in turn can influence positive attitudes towards nutritional fulfillment during pregnancy (Andriani *et al.* 2016).

Table 5 also showed that there was no significant correlation between hemoglobin and dietary quality (energy adequacy level, carbohydrate adequacy level, protein adequacy level, fats adequacy level, Fe adequacy level, and IDDS). This result is the same as the previous study by Saaka *et al.* (2017) that explained that dietary diversity did not associate with the hemoglobin level among pregnant women in rural areas of Northern Ghana. Meanwhile, another study had reported a weak association between dietary diversity and anemia prevalence (Kubuga *et al.* 2016). The relationship between dietary diversity and anemia remains inconclusive, especially in environments where many other factors can contribute to anemia.

Pre-pregnancy BMI also did not significantly correlate with the hemoglobin level (Table 5). However, the research by Tan *et al.* (2018) showed different results. Tan *et al.* (2018) explained that nutritional status before pregnancy had a relationship with the hemoglobin level. Pregnant women who are underweight before pregnancy are more likely to develop anemia (Tan *et al.* 2018). There might be other strong factors that affect the hemoglobin level among pregnant women in this study area, such as education level or socioeconomic condition.

Ferritin serum did not significantly correlate with the hemoglobin level (Table 5). Tiwari *et al.* (2013) also showed the same result that ferritin serum did not correlate with the hemoglobin level in pregnant women. This result indicates that the low serum ferritin is not always followed by the low hemoglobin level of the subjects. In this study, there were some subjects who were not classified as anemic but had iron deficiency (low ferritin levels). Therefore, pregnant women in this study area need to increase their iron intake either from food or iron supplementation to prevent anemia.

CONCLUSION

This research suggested that iron deficiency anemia is still a common problem among pregnant women in this study area and that the low education level is a significant factor that contributes to the condition. Therefore, improving the education level as well as increasing iron intake is particularly important to reduce anemia problem in this group.

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AUTHOR DISCLOSURES

The authors have no conflict of interest.

REFERENCES

Andriani Y, Respati SH, Astirin OP. 2016. Effectiveness of pregnant woman class in the prevention of pregnancy anemia in Banyuwangi, East Java. Journal of Maternal and Child Health 1(4):230–241. https://doi.org/10.26911/thejmch.2016.01.04.04.

Chowdhury HA, Ahmed KR, Jebunessa F, Akter J, Hossain S, Shahjahan M. 2015. Factors associated with maternal anaemia among pregnant women in Dhaka city. BMC Women's Health 15(77):1–6. https://doi.org/10.1186/s12905-015-0234-x.

Figuerido ACMG, Gomes-Filho IS, Silva RB, Pereira PPS, Da-Mata FAF, Lyrio AO, Souza ES, Cruz SS, Pereira MG. 2018. Maternal anemia and low birth weight: A systematic review and meta-analysis. Nutrients 10(5):601. https://doi.org/10.3390/nu10050601.

Fitri YP, Briawan D, Tanziha I, Amalia L. 2015. Kepatuhan konsumsi suplemen besi dan pengaruhnya terhadap kejadian anemia pada ibu hamil di Kota Tangerang. J Gizi Pangan. 10(3):171–178. https://doi.org/10.25182/jgp.2015.10.3.%25p.

Heliyana H, Aritonang EY, Sanusi SR. 2019. The associations between maternal education, chronic energy deficit, and anemia in pregnant women: an evidence from Lhokseumawe, Indonesia. Journal of Maternal and Child Health 4(5):312–316. https://doi.org/10.26911/thejmch.2019.04.05.02.

Kumari S, Garg N, Kumar A, Guru PKI, Ansari S, Anwar S, Singh KP, Kumari P, Mishra PK, Gupta BK, *et al.* 2019. Maternal and severe anaemia in delivering women is associated with risk of preterm and low birth weight: A cross sectional study from Jharkhand, India. One Health 8:100098 https://doi.org/10.1016/j.onehlt.2019.100098 .

Kubuga C, Lee K, Song S, Song WO. 2016. The association between dietary diversity score and iron deficiency anemia among reproductive-aged women in Ghana. The FASEB Journal 30(1 Supplement): 899–911. https://doi.org/10.1096/fasebj.30.1_supplement.899.11.

Li C, Zhu N, Zeng L, Dang S, Zhou J, Pei L, Watson V, Chen T, Wang D, Yan H. 2018. Effect of maternal pre-pregnancy underweight and average gestational weight gain on physical growth and intellectual development of early school-aged children. Sci Rep 8(12014):1–9. https://doi.org/10.1038/s41598018-30514-6.

Mekkonen FA, Ambaw YA, Neri GT. 2018. Socio-economic determinants of anemia in pregnancy in North Shoa Zone, Ethiopia. Plos One 13(8):1–9. https://doi.org/10.1371/ journal.pone.0202734 .

[MoH RI] Ministry of Health Republic of Indonesia. 2011. Makanan Sehat Ibu Hamil, Direktorat Bina Gizi Subdit Bina Gizi Klinik, Kementerian Kesehatan RI. Jakarta (ID): MoH RI.

[MoH RI] Ministry of Health Republic of Indonesia. 2013a. Riset Kesehatan Dasar 2013. Jakarta (ID): MoH RI.

[MoH RI] Ministry of Health Republic of Indonesia. 2013b. Peraturan Menteri Kesehatan Republik Indonesia No. 75 Tahun 2013 Tentang Angka Kecukupan Gizi yang Dianjurkan Bagi Bangsa Indonesia. Jakarta (ID): MoH RI.

Murai U, Naomi K, Kido M, Takeuchi T, Sugimoto M, Rahman M. 2017. Prepregnancy body mass index as a predictor of low birth weight infants in Japan. Asia Pas J Clin Nutr 26(3):434–437. http://dx.doi.org/10.6133/apjcn.032016.11.

Nursari S. 2018. Hubungan tingkat kepatuhan mengkonsumsi tablet Fe dengan kejadian anemia pada ibu hamil di Desa Purwasari wilayah kerja puskesmas Kuamang Kuning I tahun 2018. Scientia Journal 7(2):80–84. https://doi.org/10.5281/scj.v7i2.81.

Saaka M. 2012. Maternal dietary diversity and infant outcome of pregnant women in

Northern Ghana. Int J of Child Health and Nutr 1(2):148–156.
Saaka M, Oladele J, Larbi A, Hoeschle-Zeledon I. 2017. Dietary diversity is not associated with haematological status of pregnant women resident in rural areas of Northern Ghana. J Nutr Metab 2017(497892):1–10. https://doi.org/10.1155/2017/8497892.
Shen J, Zhang Z, Chen K, Lu M, Qian Q, Liu P, Gao Q, Zhang C. 2018. Pregnancy obesity status and risks on pregnancy outcomes in Shanghai: A prospective cohort study. Medicine 40:e12670. http://dx.doi.org/10.1097/MD.0000000000012670.
Sinawangwulan IP, Dewi YLR, Wekadigunawan CSP. 2018. Association between socio-demographic, nutrition intake, cultural belief, and incidence of anemia in pregnant women in Karanganyar, Central Java. JMCH 3(2):128–137. http://dx.doi.org/10.26911/thejmch.2018.03.02.05.
Stuber J, Reister F, Hartmann S, Janni W. 2018. The risk associated with obesity in pregnancy. Dtsch Arztebl Int 115(16):276–183. http://dx/doi.org/10.32238/artzbl/2018.0276.
Tan J, Qi YN, He GL, Yang HM, Zhang GT, Zou K, Luo W, Sun X, Liu XH. 2018. Association between maternal weight indicators and iron deficiency anemia during pregnancy: A cohort study. Chin Med J 131(21):2566-2574. http://dx.doi.org/10.4103/0366-6999.244109.
Tiwari M, Kotwal J, Kotwal A, Mishra P, Dutta V, Chopra S. 2013. Correlation of haemoglobin and red cell indices with serum ferritin in Indian women in second and third trimester of pregnancy. Med J Armed Forces India 69(1):31–36. http://dx.doi.org/10.1016/j.mjafi.2012.07.016.
Ullah I, Zahid M, Khan MI, Shah M. 2013. Prevalence of anemia in pregnant 343 women in district Karak, Khyber Pakhtunkhwa, Pakistan. IJB 3(11):77–83.
[WHO] World Health Organization. 2015. The Global Prevalence of Anemia in 2011. Geneva (CH): WHO.