DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 9, Nomor 1, Januari 2020

ASSOCIATION BETWEEN HEMOGLOBIN LEVEL AND BODY MASS INDEX IN THE FIRST TRIMESTER OF PREGNANCY WITH BIRTHWEIGHT IN TEMBALANG

Saniya Millatina[1*], Nurul Setiyorini[2], Vannya Dewi Puspitasari[2], Ani Margawati[3]
[1]Undergraduate of Medical Student, Faculty of Medicine, Diponegoro University
[2]The Lecturer Science of Obstetrics and Gynecology, Faculty of Medicine, Diponegoro University
[3]The Lecturer Science of Nutrition Science, Faculty of Medicine, Diponegoro University
Jl. Prof. H. Soedarto, SH, Tembalang-Semarang 50275, Tel. (024) 76928010
Corresponding author: Email :saniya.millatina@gmail.com

ABSTRACT

Background: Low birthweight babies (LBW) have a risk of death 10-20 times greater than normal birthweight babies. Data from Semarang Health Office in 2018, there were 24 cases of LBW in Tembalang. Low nutrional status, namely low body weight and anemia were the risk factor of LBW incident. **Objective:** To analyze the association features between hemoglobin levels and body mass index in the first trimester of pregnancy with LBW in Tembalang. **Methods:** This was a observational research with cross sectional analytic design. Respondents were mothers who met the criteria and randomly selected using simple random sampling. There were 44 respondents in this research. The independent variables are body mass index and hemoglobin levels in the first trimester with birthweight as dependent variables. Data is obtained from structured questionnaires and medical records or maternal KIA book. Chi-Square and logistic regression are used to analyze the data. **Result:** Respondents were mother, who did first trimester antenatal care at the Government's First Health Care Facility in the Tembalang. The majority are multiparity (56,8%), had normal midd-upper arm circumference (72,7%), had weight gain during pregnancy below recommendation (50%), had high compliance of blood vitamin consumption (68,2%), non-work status (59,1%), senior high school graduate (59,1%), and had good family income (52,3%). Analysis result showed there were no significant association between first trimester body mass index and birthweight (p=0,061), also between first trimester hemoglobin level and birthweight (p=1,000). Analysis from the two independent variables also showed no significat association with birthweight (p = 0,877). **Conclusion:** Most of the respondents had good nutritional status with hemoglobin level and body mass index features in the first trimester showed normal value. Average birthweight also in the normal value and the incidence of LBW is low. The research analyst showed no significant association between first trimester of body mass index and hemoglobin levels with birthweight.

Keywords: Birthweight, Body Mass Index, Hemoglobin

INTRODUCTION

Low birth weight babies (LBW) have a risk of death 10-20 times greater than normal birth weight.(1) In 2016, LBW became one of the most causes of neonatal deaths, which is 8.23% of total infant deaths in Semarang.(2) Based on the data of LBW incidence in 2018 by Semarang Health Office, there were 24 cases in Tembalang. (3) Low nutritional status of

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 9, Nomor 1, Januari 2020

the mother during pregnancy, for example have low body weight and low levels of hemoglobin (Hb) or anemia was the risk factor of LBW cases. (4)

Low levels of Hb in the first trimester will increase the risk of LBW, premature, and Small Gestasional Age (SGA).(5) Hemoglobin role on blood is to distribute Iron (Fe) which has high involvement as a cofactor on hemoprotein and involved in metabolism, cell proliferation, and organogenesis of fetus. Iron is needed by the embryo to grow in the earliest stages of pregnancy, as it's seen transfer to yolk sac before the development of fetal blood system in the first trimester by specific receptors.(6)

Low pre-pregnancy Body Mass Index (BMI) is closely related to the risk of malnutrition during pregnancy.(7) Underweight BMI also significantly associated with anemia and in labor this low body weight, will increase the incidence of breech presentation, low birth weight (LBW) and prematurity.(8) On many developing country data of pre-pregnancy BMI is difficult to find, because the majority of first performed pregnancy care was during the first antenatal care in first trimester.(7) Some studies suggest that the value of BMI in first antenatal care before 12 weeks' of gestation is still accurate as a pre-pregnancy BMI value.(9)

The aim of this study was to analyze the association features between Hb levels and BMI in the first trimester of pregnancy with the birthweight on Tembalang in 2018-2019.

METHODS

This study used observational with cross sectional analytic design to observe and analyze BMI and Hb levels in first trimester as independent variables with birthweight as dependent variable. Some other factors were also observed are upper arm circumference, weight gain during pregnancy, compliance of consumption blood vitamin, and sociodemographic factors including age, parity status, work status, education, and family income. This study used primary data sources from the structured questionnaires and secondary data from medical records or KIA books.

The population are mothers, who performed antenatal care in the first trimester of pregnancy at the Government's First Health Care Facility in Tembalang on July to October 2018 and had given birth. The criteria of the sample are single intrauterine pregnancy, baby born alive at aterm pregnancy aged, mothers age 20-35

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 9, Nomor 1, Januari 2020

years old, had first antenatal examination ≤ 12 weeks, without a history of certain diseases, and had qualified data on medical records or KIA books. Data was analyzed by chi-square test and logistic regression test.

RESULT

The primary data was obtained from Rowosari Community Health Center and Kedungmundu Community Health Center. Antenatal records from the two community heath center found 344 mothers who matched the population sample of this study. There were 152 mothers who qualified based the criteria of the sample or respondent. Performed a simple random sampling method to randomly select 50 respondents as research subjects.

This study was conducted with a home visit for secondary data on 50 respondents. During collecting the data there were 6 respondents who subsequently did not meet the criteria of this study, so there were 44 respondents as research subject in this study.

Characteristics of the respondents showed most of them were multiparaous and had mid-upper arm circumference (MUAC) on normal size, which is ≥23,5 cm (Table 1). Based on.

Table 1. Charateristics of Respondents

Characteristics	N (N=44)	%
Parity		
Primiparity	19	43,2
Multiparity	25	56,8
MUAC		
Normal (≥23,5 cm)	32	72,7
Below Normal (<23,5 cm)	12	27,3
Weight gain during pregnancy (based on IOM recommendation)		
Below Recommendation	22	50
Fit Recommendation	18	40,9
Above Recommendation	4	9,1
Consumption of blood supplement		
Regulary (≥90 days)	30	68,2
Infrequently (<90 days)	8	18,2

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 9, Nomor 1, Januari 2020

No Consumption	6	13,6
Education level		
Primary School	2	4,5
Junior High School	6	13,6
Senior High School	26	59,1
Banchelor Degree	10	22,7
Working status		
Working	18	40,9
No-Working	26	59,1
Family Income		
(Based on minimum regional wage)		
Equal or above	23	52,3
Below	21	47,7

Institute of Medicine (IOM)(10) recommendation on weight gain during pregnancy, the majority of the respondents had weight gain below the recommendation, but the compliance of blood vitamin consumption were high. Most of the respondents were also graduated from senior high school, had non-working status and had family income equal or more than the value of regional minimum wage, which is Rp 2.500.000,-. (**Table 1**)

Distribution of characteristic of the respondents were also showed the average age was 28 years old and the mean of weight gain during pregnancy is 9,63 kg. (**Table 2**). There was normal value on the mean of MUAC, which is 26,3 cm. Also the mean value on BMI and levels, which is 22,6 kg/m^2 and 12,8g/dL, are on normal category. Birthweight had mean value 3122,6 grams, as well on normal category.

Table 2. Range, Mean, and Standard Deviation on Data Result

Characteristic	Range		Mean	Std. Deviation
	Minimum	Maximum		
Age	20	34	28	±4,280
MUAC	19 cm	35 cm	26,3 cm	±3,722
BMI in first trimester	14,3 kg/m^2	30,2 kg/m^2	22,6 kg/m^2	±4,357
Weight gain during pregnancy	0,9 kg	20 kg	9,63 kg	±4,447
Hb level in first trimester	9,7 g/dl	15,4 g/dl	12,8 g/dl	±1,222

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 9, Nomor 1, Januari 2020

Birthweight	2360 gram	3900 gram	3122,6 gram	±360.342

The research subject divided based on the birthweight, were consisted of 42 respondents in the normal birthweight category and 2 respondents in the LBW category (**Table 3**). The p-value obtained from the analysis of the association between characteristic of the respondents with birthweight used chi-square test. The result found that there was no difference in the features of parity status, size of MUAC, weight gain during pregnancy, compliance consumption of blood vitamin, education level, work status, and family income between the normal birthweight and LBW categories.

Table 3. Characteristics of Respondent based on Birthweight Category

Characteristics	Normal Birthweight (N=42)	Low Birthweight (N=2)	p-value*
Age	28 (20-34)	25 (23-26)	0,427
Parity			0,181
Primipara	17 (38.6%)	2 (4,5%)	
Multipara	25 (56,8%)	0 (0,0%)	
MUAC			0,476
Normal	31 (70,5%)	1 (2,3%)	
Below normal	11 (25,0%)	1 (2,3%)	
Weight gain during pregnancy (based IOM recommendation)			0,890
Below Recommendation	21 (47,7%)	1 (2,3%)	
Fit Recommendation	17 (38,6%)	1 (2,3%)	
Above Recommendation	4 (9,1%)	0 (0,0%)	
Consumption of blood supplement			0,613
Regulary	28 (63,6%)	2 (4,5%)	
Infrequently	8 (18,2%)	0 (0,0%)	
Not consumption	6 (13,6%)	0 (0,0%)	
Education level			0,694
Primary school	2 (4,5%)	0 (0,0%)	
Junior high school	6 (13,6%)	0 (0,0%)	
Senior high school	24 (54,5%)	2 (4,5%)	
Bachelor degree	10 (22,7%)	0 (0,0%)	
Work status			0,505

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 9, Nomor 1, Januari 2020

Working	18 (40,9%)	0 (0,0%)	
Not-working	24 (54,5%)	2 (4,5%)	
Family income (Based on minimum regional wage)			1,000
Equal or above	22 (50,0%)	1 (2,3%)	
Below	20 (45,5%)	1 (2,3%)	

*Chi-Square test

Chi-square test were also obtained between independent variables with dependent variable. The result found the p-value of the analysis between BMI in first trimester with birthweight is 0,061 (p>0,05), which conclude there was no significant association. (**Table 4**) The result from the analysis between Hb levels in the first trimester with birthweight as well had no significant association with p-value 1,000 (p>0,05). (**Table 5**)

Table 4. Association analyst between BMI in first trimester with Birthweight

BMI category	**Birthweight category**				**p-value**
	LBW		**Normal birthweight**		
	n	**%**	**N**	**%**	
Underweight	0	0,0%	10	22,7%	
Normal weight	2	4,5%	10	22,7%	0,061
Overweight	0	0,0%	22	50,0%	
Total	2	4,5%	42	95,5%	

Table 5. Association analyst between Hb level in first trimester with Birthweight

Hb levels category	**Birthweight category**				**p-value**
	LBW		**Normal birthweight**		
	n	**%**	**n**	**%**	
No Anemia	2	4,5%	37	84,1%	1,000
Anemia	0	0,0%	5	11,4%	
Total	2	4,5%	42	95,5%	

Analysis from both of the independent variables used logistic regression had p-value 0,877 (p>0,05), which also conclude there was no significat association between BMI and Hb levels in the first trimester of pregnancy with birthweight. (**Table 6**)

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 9, Nomor 1, Januari 2020

Table 6. Association analyst between BMI and Hb level in first trimester with Birthweight

Category of independent variables	Birthweight category				p-value
	LBW		Normal birthweight		
	n	%	n	%	
BMI					
Underweight	0	0,0%	10	22,7%	
Normal	2	4,5%	10	22,7%	
Overweight	0	0,0%	22	50,0%	0,877
Hb levels					
No Anemia	2	4,5%	37	84,1%	
Anemia	0	0,0%	5	11,4%	

DISCUSSION

Maternal nutritional status can be measured through MUAC size, per-pregnancy BMI, weight gain during pregnancy, and Hb levels.(11) Based on the characteristics of respondents and independent variable data in this study, it can be concluded that the average respondent had good nutritional state in early pregnancy. It can be seen from the mean value of MUAC size, BMI and Hb levels in the first trimester were on normal category.

Education level and family income can be factors of supporting health in pregnancy as the previous research the by Rohadi which found that good economic status will affect nutritional intake in the family.(12) Another research at the Mantrirejon Public Health Center, Yogyakarta mention that higher education mothers, who graduate senior high schools or had bachelor degree, can reduce the incidence of anemia in pregnancy.(13) Data in this study illustrate the high level of education and family income, so that it can be conclude the respondents had good support on health during pregnancy.

Based on result of the analysis data, there was no significant difference between BMI in the trimester features with birthweight with a p-value = 0.061 ($p < 0.05$). This is not in line with previous study in Japan, which showed that pre-pregnancy BMI can be a prediction of LBW incidence.(14) The association of BMI with birthweight can be explained by increased stimulation of insulin formation in mothers with high BMI so that there is an increase in lipogenesis and desposition from fat which can cause an increase in baby's weight.(15)

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 9, Nomor 1, Januari 2020

The results in this study were not in line with previous study, it is possible influenced by weight gain factor during pregnancy. A study in Brazil showed an indirect negative association between pre-pregnancy BMI with birthweight, due to low maternal weight gain during pregnancy and hypertension.(16) Analysis of the study mentioned a negative relationship due to mothers with high BMI will increase vigilance by consulting to control weight gain during pregnancy as a prevention of health complications.(16)

Analysis data on association between Hb level with birthweight also showed no significant association with a value of p = 1,000 (p> 0.05). These results are not in line with previous study in India, which found a significant increase in risk of LBW in women with anemia and underweight.(7)

Mismatch of the result on this this study is possible because in this study respondents who suffered from anemia had low severity with Hb levels above 10 g/dL. Based on the classification of WHO mild anemia in pregnancy is a Hb level of 10-11 g dL and moderate/ severe anemia has a Hb level <10g / dL.(17) A previous study in China also showed that mothers with Hb levels of 8-9.9 g/dL in the first trimester has a high risk of developing LBW, premature, and SGA compared to mothers who had Hb levels of 10-11.9 g / dL.(18)

In this study also found the compliance of blood vitamin consumption was high, which amounted to 68.2% of the respondents. Routine consumption of blood vitamin can have an effect on improving maternal Hb levels during pregnancy. Previous studies in the United States have shown that there is a decreasing number of the incidence of LBW and prematurity in maternal iron supplementation during pregnancy.(19)

The results of the analysis of the two independent variables, namely BMI and Hb levels in first trimester with birthweight also showed insignificant results, with p = 0.100 (p> 0.05). It can be concluded that there is no association between BMI and Hb levels in first trimester with birthweight.

One of the drawbacks in this study was there is no monitoring of maternal nutrition intake during pregnancy. During pregnancy the fetus is entirely dependent on its nutrient reserves, mainly fat and protein, so inadequate nutrition can have a negative impact on the fetus. From the results of a biochemical study, it was found that maternal lipid levels in late pregnancy

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 9, Nomor 1, Januari 2020

were associated with neonatal anthropometry. Increased serum lipids during pregnancy are very important for the optimal development of the fetus.(20)

In the further studies of the two respondents in the LBW category found that LBW risk factors on subject A were low size of MUAC, weight gain below the recommendation and TFU size at antenatal examinations were smaller than gestational age. LBW risk factors on subject B were low family income, frequency of ANC that was less than the latest WHO recommendations, and TFU size at antenatal examinations were smaller than gestational age.

Limitations in this study were also effect the result of this study, namely the homogeneity of respondents, by not analyzing the pattern of maternal nutrition intake, and by no standardization measurements of birthweight.

CONCLUSION

The features of BMI and Hb levels are on the normal category, also another characteristic of the respondents which can be concluded the average mothers in Tembalang had good nutritional status and good factors on supporting health in pregnancy. This features also explained the mean value of birthweight are on the normal category with low LBW incidence. Based on statistical analysis, there were no siginificat association between BMI and Hb level in first trimester with birthweight.

REFERENCES

1. Urdiyana V. Gambaran Status Gizi Ibu Hamil Bedasarkan Indeks Massa Tubuh (IMT) di Puskesmas Mergangsan Kota Yogyakarta. J Sekol Tinggi Ilmu Kebidanan Jendral Ahmad Yani Yogyakarta. 2017;6:5–9.
2. Dinas Kesehatan kota semarang. Profil Kesehatan 2016 Kota Semarang. 2016;
3. Seksi Anak Bidang Kesga. Bayi Berat Badan Lahir Rendah Menurut Jenis Kelamin, Kecamatan, dan Puskesmas Kota Semarang 2018. Semarang; 2019.
4. Kementrian Kesehatan RI. Pedoman Gizi Seimbang. 2014;
5. Cunningham FG, Leveno KJ, Bloom SL, Spong CY, Dashe JS HB. William Obstetrics. 24th ed. United States: McGraw-Hill Education; 2014.
6. IE Z, Sarkar A. The visceral yolk sac endoderm provides for absorption of nutrients to the embryo during neurulation. Birth Defects Res A Clin Mol Teratol. 2010;88(8):593–600.

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 9, Nomor 1, Januari 2020

7. Prakash AA, Das PK, Gupta S, Hibberd PL, Pusdekar YV, Patel A. Maternal anemia and underweight as determinants of pregnancy outcomes: cohort study in eastern rural Maharashtra, India. BMJ Open. 2018;8(8):e021623.
8. Sebire N.J, Jolly M, Harris J, Regan L RS. Is maternal underweight really a risk factor for adversepregnancy outcome? A population-based study in London. Br J Obstet Gynaecol. 2001;108:61–6.
9. West DS, Cleves MA, DiCarlo M, Saylors ME, Krukowski RA, Shankar K, et al. Are early first trimester weights valid proxies for preconception weight? BMC Pregnancy Childbirth [Internet]. 2016;16(1):10–5. Available from: http://dx.doi.org/10.1186/s12884-016-1159-6
10. National Research Council. Weight Gain During Pregnancy: Reexamining The Guidelines. The National Academies Press. 2009;
11. Karima K, Achadi EL. Status Gizi Ibu dan Berat Badan Lahir Bayi. Kesmas Natl Public Heal J. 2016;7(3):111.
12. Price, Anderson S. Gangguan Sistem Hematologi. In: Patofisiologi : Konsep Klinis Proses-Proses Penyakit. 6th ed. Jakarta: EGC; 2015. p. 225–7.
13. Cintia. Faktor-Faktor Yang Berhubungan Dengan Kejadian Anemia Pada Ibu Hamil Di Puskesmas Mantrijeron. 2017;
14. Murai U, Nomura K, Kido M, Takeuchi T, Sugimoto M, Rahman M. Pre-pregnancy body mass index as a predictor of low birth weight infants in Japan. Asia Pac J Clin Nutr. 2017;26(3):434–7.
15. Han Z, Lutsiv O, Mulla S, Rosen A, Beyene J, McDonald S. Low gestational weight gain and the risk of preterm birth and low birthweight: a systematic review and meta- analyses. Acta Obs Gynecol Scand. 2011;90:935–54.
16. Lima RJCP, Batista RFL, Ribeiro MRC, Ribeiro CCC, Simões VMF, Neto PML, et al. Prepregnancy body mass index, gestational weight gain, and birth weight in the BRISA cohort. Rev Saude Publica. 2018;52:1–10.
17. World Health Organization. Nutrition in pregnancy and lactation; report of a WHO Expert Committee. World Heal Organ Tech Rep Ser. 1965;302:5–19.
18. Ren A, Wang J, Ye R., Li S, Liu J., Li Z. Low first- trimester hemoglobin

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 9, Nomor 1, Januari 2020

and low birth weight, preterm birth and small for gestational age newborns. Int J Gynecol Obstet [Internet]. 2007;98:124–8. Available from: https://doi.org/10.1016/j.ijgo.2007.05.011

19. Cogswell ME, Parvanta I, Ickes L, Yip R, Brittenham GM. Iron supplementation during pregnancy, anemia, and birth weight: A randomized controlled trial. Am J Clin Nutr. 2003;78(4):773–81.
20. Gala UM, Godhia ML, Nandanwar YS. Effect of Maternal Nutritional Status on Birth Outcome. Int J Adv Nutr Heal Sci. 2016;4(1):226–33.