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Effects of Maternal Nutrition Status, Maternal Education, Maternal Stress, and Family Income on Birthweight and Body Length at Birth in Klaten, Central Java

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ABSTRACT

Background: Birthweight and body length at birth are predictors of morbidity and mortality in children under five years old and adult age. Low birthweight increases the risk of morbidity and mortality in children under five. This study aimed to examine the effects of maternal nutrition status, maternal education, maternal stress, and family income, on birthweight and body length at birth in Klaten, Central Java.
Subjects and Method: This was an observational analytic study with case control design. The study was conducted at Manisrenggo and Bayat community health centers, Klaten District, Central Java, in April 2017. A total sample of 120 children aged 0 to 6 months and their mothers were selected for this study using fixed disease sampling. The dependent variables were birthweight and body length and birth. The independent variables were maternal nutrition status, maternal education, maternal stress, and family income. The data were collected by a set of questionnaire. Maternal nutrition status at pregnancy was measured by mid-upper arm circumference (MUAC). Data on birthweight and body length at birth were taken from mother and child health monitoring book. The data was analyzed using path analysis.
Results: Birthweight was directly and positively affected by maternal MUAC at pregnancy (b=0.50; SE=0.13; p<0.001), family income (b=0.11; SE=0.04; p=0.004), and maternal education (b=2.14; SE=0.88; p=0.016). Birthweight was directly and negatively affected by maternal stress (b=-1.81; SE=0.81; p=0.025). Body length at birth was directly and positively affected by maternal MUAC at pregnancy (b=0.16; SE=0.64; p=0.011) and family income (b=0.05; SE=0.18; p=0.005). Maternal MUAC at pregnancy was affected by maternal education (b=1.41; SE=0.58; p=0.014). Likewise, family income was affected by maternal education (b=5.28; SE=2.11; p=0.012).
Conclussion: Maternal MUAC at pregnancy, family income, and maternal education positively and directly affect birthweight. Maternal stressdirectly and negativelyaffects birthweight. Body length at birth is directly and positively affected by maternal MUAC at pregnancy and family income.

Keywords: birthweight, body length at birth, MUAC, maternal stress

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BACKGROUND

Gestation period gives consequence toward pregnancy product, that pregnancy is a prenatal environment that has an effect on linear growth of fetus. Linear growth is the addition of body cells over time which is marked by the increase of bone mass. The result of increasing bone mass is the increasing of fetal weight and body length. Optimal fetal growth affects the growth after birth (Par'i et al., 2016).

Growth parameters continue to be a concern and considered a relatively sensitive parameter to assess nutritional health.

Parameters that are often used are weight or body length (Sediaoetama, 2012). According to Sebayang et al. (2012), birth weight is an important indicator in projecting health in the future and the survival of newborns. Low birth weight represents more than 20 million births per year with an estimated 15%-20% of births in the world which is still a global health problem (WHO, 2014). In 2015, Central Java experienced a high percentage increase in low birth weight compared to the previous year. The percentage increase in 2015 was 5.1%, higher than the percentage of low birth weight in 2014 which was 3.9%. The percentage of low birth weight in Central Java tends to increase from 2011 to 2015. While the percentage of low birth weight in Klaten in 2015 also gives a high percentage by 11.52% (Central Java Provincial Health Office, 2015).

The impact of low birth weight is the increase of infant morbidity and mortality rate (WHO, 2014). Infant Mortality Rate (IMR) is a health problem related to several factors including maternal nutrition status, antenatal care, the success of the MCH program (Maternal and Child Health) and Family Planning and Birth Control, as well as environmental condition and socio-economic conditions. Birth rate in Central Java in 2015 was 10 per 1000 live births. There was insignificant decrease compared to the 2014 birth rate, which was 10.08 per 1000 live births. Birth rate in Klaten ranks 9th highest, which is 12.94 per 1000 live births from all districts in Central Java Province (Central Java Provincial Health Office, 2015).

Height or length of the body is used to assess a condition in past and present. In addition, body length is the second most important measure after weight (Supariasa et al., 2016).

According to Simbolon et al. (2015), in almost half of districts in Indonesia the prevalence of short birth length babies are more than 30%, which shows an alarming number and a serious problem. This is proof that stunting prevalence continues to be in the spotlight in public health, even if seen from the prevalence of stunting toddlers from Basic Health Research in 2010. It was stated that it decreased in 2007 by 32.7% to 31.4% in 2010 (Ministry of Health, 2010).

The Basic Health Research results in 2013 showed the percentage of babies with short birth length (birth length <48) by 20.2% (Ministry of Health, 2013). Birth length will continue to influence growth. A study conducted by Anugraheni and Kartasurya (2012), proved that short birth lengths caused toddlers to have 2.8 times greater risk of stunting compared to babies who have normal birth lengths.

Birth size is a depiction of fetal growth (Simbolon et al., 2015). According to Supariasa et al. (2016) quoted from Soejiningsih (1998), genetic factors are the basis for achieving growth. However, the achievement of genetic potential is optimally influenced by the biophysopsychosocial environment from the time of conception to the end of life. The purpose of this study was to analyze the effect of maternal education, maternal nutritional status, maternal stress and family income during pregnancy on birth weight and body length at birth in Klaten.

SUBJECTS AND METHOD

1. Study Design

This study used an observational analytic method with a case-control approach. This study was conducted at Manisrenggo and Bayat community health centers, Klaten District, Central Java.

2. Population and Sample

The source population in this study was all mothers who had infants of 0 to 6 months of age who resided in Klaten. The sample was 120 study subjects with a comparison of 30 study subjects for the case group and 90 study subjects for the control group. The case group in this study was mothers who had babies aged 0 to 6 months with birth weight <2500 grams and birth length <48 cm. While the control group was the mother who had babies aged 0 to 6 months with birth weight ≥2500 grams and birth length lahir ≥48 cm. This study used fixed disease sampling.

3. Variable of the Study

The independent variables of this study were maternal education, maternal mid-upper arm circumference, maternal stress and family income, while the dependent variable was birth weight and birth length.

4. Operational Definition of Variables

Maternal education was education status from the highest school graduation achieved by the subject of the study based on the ownership of the last diploma at the time of the last child's pregnancy. Data collection were carried out using a questionnnaires. The measurement scale used was a categorical scale.

Maternal mid-upper arm circumference was a measurement of the mid-upper arm circumference to assess the nutritional status of the subject of the study using measure tape in units of cm. The measurement scale used was a continuous scale, for the needs of data analysis, it was converted into a dichotomy.

Family income was the total amount of family income derived from the income of the head of the family and the income of the mother, both from a fixed or a side income within one month in rupiah during the last child's pregnancy. The measurement scale used was a categorical scale.

Birth weight was data obtained from the recording of the MCH handbook as the delivery history of the last child of the study subject measured by health workers using baby scales in units of grams carried out in the first hour after delivery. The measurement scale used was a continuous scale, for the needs of data analysis, it was converted into a dichotomy.

Birth length was data obtained from the recording of the MCH handbook as the delivery history of the last child of the study subject measured by health workers using an infantometer in units of cm which was carried out in the first hour after delivery. The measurement scale used was a continuous scale, for the needs of data analysis, it was converted into a dichotomy.

5. Data Analisys

Data were analyzed by univariate analysis, bivariate analysis, and multilevel analysis was analyzed using path analysis used the IBM SPSS AMOS 22 program.

RESULTS

The characteristics of the study subjects were seen from maternal education, maternal mid-upper arm circumference, maternal stress, and family income.

Table 1. showed that most of mothers were highly educated (64.20%) with mid-upper arm circumference which showed non CED (83.30%), maternal stress from the study subjects showed a comparison with the same amount of high stress and low stress ie 50%, while for the family income of the study subjects most of them are ≥ UMR (Regional Minimum Wages) ie 70%.

The results of descriptive analysis in the form of continuous data independent and dependent variables that were showed in Table 2. explained that the maternal mid-upper arm circumference had an average by 25.57 with a standard deviation by 3.10, maternal stress showed an average by

221.82 with standard deviation 127.08, family income showed the average value by 19.43 with a standard deviation 11.35, the birtth weight had an average value by 2,840.29 with a standard deviation 516.48 and the birth length showed an average value by 47.79 with a standard deviation 2.30.

Table 1. Sample characteristics

Characteristic	n	%
Maternal education		
< Senior high school	43	35.8
≥ Senior high school	77	64.2
Maternal MUAC		
<23.5 cm	20	16.7
≥23.5 cm	100	83.3
Maternal Stress		
High stress (≥192)	60	50
Lo stress (<192)	60	50
Family Income		
< regional minimum wage (Rp 1,400,000)	36	30
≥ regional minimum wage (Rp 1,400,000)	84	70

Table 2. Univariate analysis of variables of the study

Variable	Mean	SD	Min.	Max.
Maternal MUAC	25.57	3.10	18	34.5
Maternal Stress	221.82	127.08	20	743
Family income	19.43	11.35	10	85
Birth weight	2840.29	516.48	1300	4000
Birth length	47.79	2.30	35	51

Bivariate analysis (Table 3 and Table 4) showed the effect of one independent variable on one dependent variable. Bivariate analysis method used were Pearson test with a confidence level of 95% (p <0.05).

Table 3 showed the positive or negative effects of maternal education, mid-upper arm circumference, stress and family income on the birth weight. Maternal education (r= 0.31; p= 0.001), maternal MUAC (r= 0.36; p< 0.001), and family income (r= 0.29; p= 0.002) were positively associated with birthweight. Maternal stress was negatively associated with birthweight (r= -0.21; p= 0.020).

Table 4 showed factors associated with birth length. Maternal education (r= 0.19; p= 0.030), maternal MUAC (r= 0.22; p= 0.010), and family income (r= 0.25; p= 0.007) were positively associated with birth length. Maternal stress was negatively associated with birth length (r= -0.19; p= 0.030).

Figure 1 showed the structural model of the path analysis of the birth weight of dependent variable that was estimated using the IBM SPSS AMOS 22 program to produce the values stated in the figure. The indicator that showed the goodness of fit measure, results in CMIN index fit of 0.40 with p value= 0.751 (> 0.05); NFI= 0.98 (≥0.90); CFI= 1.00 (≥0.90); GFI= 1.00 (≥0.90); RMSEA <0.001 (≤0.08) which meant that the model met the specified criteria and was in accordance with empirical data.

Table 3. Bivariate analysis of the influences of maternal education, nutritional status, maternal stress and family income on birth weight

Variabel	r	p
Maternal education	0.31	0.001
Maternal MUAC	0.36	<0.001
Maternal stress	-0.21	0.02
Family Income	0.29	0.002

Table 4. Bivariate analysis of the influences of maternal education, nutritional status, maternal stress and family income on birth length

Variables	r	p
Maternal education	0.19	0.030
Maternal MUAC	0.22	0.010
Maternal stress	-0.19	0.030
Family Income	0.25	0.007

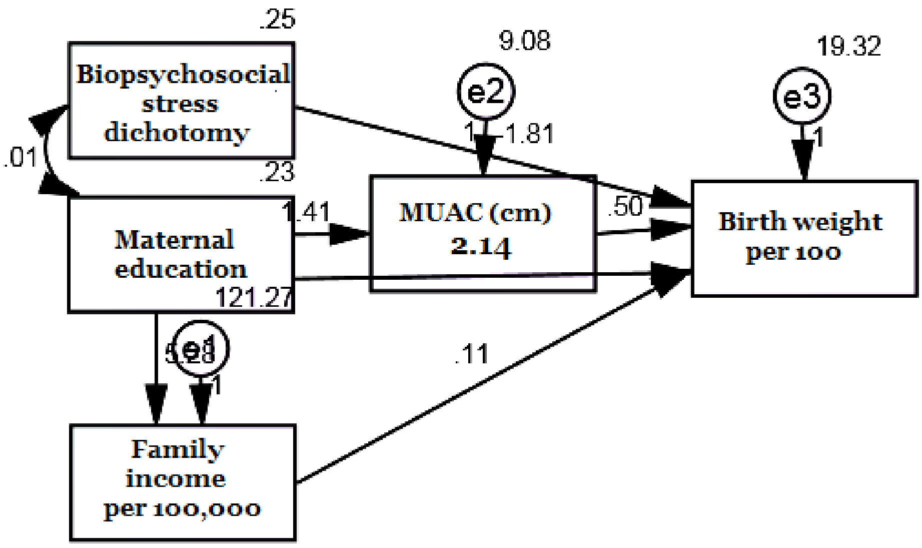

Figure 1. Structural model of path analysis on the determinants of birth weight

Table 5 showed that birth weight was influenced directly by maternal mid-upper arm circumference, stress, income and education. Each unit increase of the maternal mid-upper arm circumference (cm) would increase birth weight by 0.50 units (b= 0.50; SE= 0.13; p<0.001). Each unit increase of maternal stress will reduce birth weight by 1.81 units (b= -1.81; SE= 0.81; p = 0.025). Each increase in family income (x Rp 100,000) would increase birth weight by 0.11 units (b= 0.11; SE= 0.04; p = 0.004). Each unit increase of maternal education would increase the birth weight by 2.14 units (b = 2.14; SE = 0.88; p = 0.016).

Table 5 showed that birth weight was indirectly influenced by education through the maternal mid-upper arm circumference and family income. Each unit increase of maternal education would increase the maternal MUAC (cm) by 1.41 units (b = 1.41; SE = 0.58; p = 0.014). Each unit increase of maternal education would increase family income (x Rp 100,000) by 5.28 units (b = 5.28; SE = 2.11; p = 0.012).

Table 5. Path analysis results on the determinants of birth weight

Dependent Variable		Independent Variables	b*	SE	p	β**
Direct Influence						
Birth weight (x 100 g)	←	Maternal MUAC (cm)	0.50	0.13	<0.001	0.30
Birth weight (x 100 g)	←	Maternal stress	-1.81	0.81	0.025	-0.18
Birth weight (x 100 g)	←	Education ≥ Senior high school	2.14	0.88	0.016	0.20
Birth weight (x 100 g)	←	Income (x Rp100,000)	0.11	0.04	0.004	0.24
Indirect Influence						
Maternal MUAC (cm)	←	Education≥ Senior high school	1.41	0.58	0.014	0.22
Income (x Rp 100,000)	←	Education≥ Senior high school	5.28	2.11	0.012	0.22
Fit Model						
n observed =120						
CMIN(x^2) = 0.40		p = 0.751 > 0.05				
NFI = 0.98		(≥ 0.90)				
CFI = 1.00		(≥ 0.90)				
GFI = 1.00		(≥ 0.90)				
RMSEA < 0.001		(≤ 0.08)				

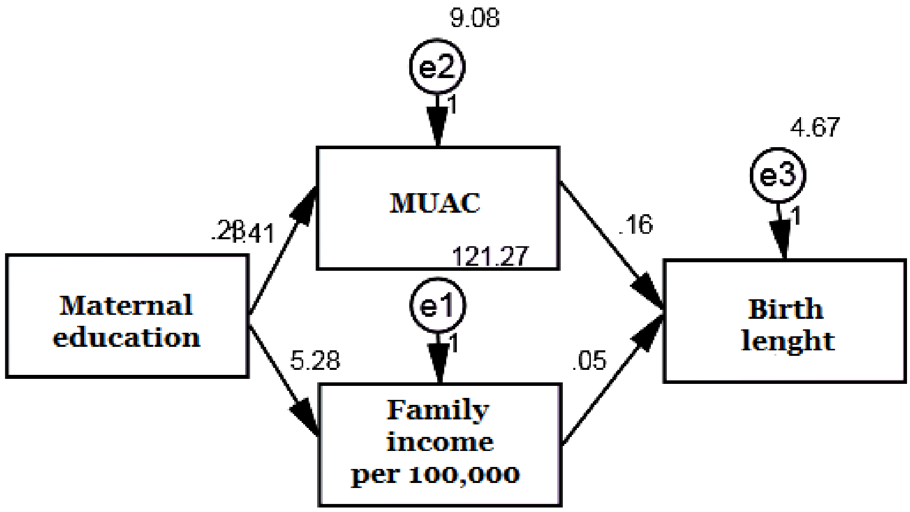

Figure 2. Structural model of path analysis on the determinants of birth length

Figure 2 showed a model of the structural analysis of the birth length dependent variable that estimated by using the IBM SPSS AMOS 22 program and producing the values stated in the image. The indicator that was showed the goodness of fit measure, resulted in CMIN index fit of 0.70 with p value = 0.497 (> 0.05); NFI = 0.95 (≥0.90); CFI= 1.00 (≥0.90); GFI = 0.99 (≥0.90); RMSEA <0.001 (≤0.08) meant that the model met the specified criteria and was in accordance with empirical data.

The results of the path analysis of birth length could be seen in Table 6 which showed that birth length was directly affectted by the maternal MUAC and family income. Each unit increase of the maternal mid-upper arm circumference (cm) would increase the birth length by 0.16 units (b = 0.16; SE = 0.64; p = 0.011). Every increase in family income (x Rp. 100,000) would increase birth length by 0.05 units (b= 0.05; SE= 0.18; p = 0.005). Birth length was indirectly influenced by maternal education through the maternal MUAC and family income (Table 6). Each unit increase of maternal education would increase the maternal MUAC (cm) by 1.41 units (b= 1.41; SE= 0.58; p = 0.014). Each unit increase of maternal education would increase income (x Rp 100,000) by 5.28 units (b = 5.28; SE = 2.11; p = 0.012).

Table 6. Results of path analysis on the determinants of birth length

Endogenous Variables		Exogenous Variables	b*	SE	p	β**
Direct Influence						
Birth weight (x 100 g)	←	Maternal MUAC (cm)	0.16	0.64	0.011	0.22
Birth weight (x 100 g)	←	Income (x Rp 100,000)	0.05	0.18	0.005	0.25
Indirect Influence						
Maternal MUAC (cm)	←	Education ≥ High School	1.41	0.58	0.014	0.22
Income (x Rp 100,000)	←	Education ≥ High School	5.28	2.11	0.012	0.22
Model Fit						
n observed =120						
CMIN(x^2) = 0.70		p = 0.497 > 0.05				
NFI = 0.95		(≥ 0.90)				
CFI = 1.00		(≥ 0.90)				
GFI = 0.99		(≥ 0.90)				
RMSEA < 0.001		(≤ 0.08)				

DISCUSSION

A. The effect of maternal education, maternal nutrition status, maternal stress and family income on birth weight

1. The effect of maternal education on birth weight

This study showed that there was a direct positive and statistically significant effect of maternal education on birth weight. In addition, there was also a positive indirect and statistically significant effect of maternal education on birth weight through the maternal MUAC and family income during pregnancy. This study is in line with the results of Basic Health Research that stated that the higher the education, the lower the prevalence of babies born with low birth weight (Ministry of Health, 2013).

This is confirmed by Kader and Perera (2014) which stated that maternal education level is the most important determinant of birth weight and low birth weight. This study is also supported by other studies conducted by Muula et al. (2011) which stated that women who did not go to school (formal education) were more likely to give birth to low birth weight babies, compared to women who only take basic education.

Birth weight is indirectly influenced by maternal education through maternal mid-upper arm circumference status and family income. This study is the same as previous study which revealed that the risk of low birth weight events will be higher if mothers do not have education or illiteracy (low education) and with low economic status (Abbasi et al., 2015; Demelash et al., 2015). Muula et al. (2011) explained that the process related to low birth weight apart from low education factors was also possible because of poor food consumption patterns resulting from low income and low expertise in daily food management.

2. The effect of maternal MUAC on birth weight

This study showed the results of path analysis that there was a direct positive and statistically significant effect of maternal mid-upper arm circumference on birth weight. The results of this study are supported by previous studies which stated that pregnant women with maternal mid-upper arm circumference <23.5 cm or CED have a risk of 3.95 times greater to give birth to babies with low birth weight compared to mothers without CED (Syarifuddin et al., 2011). A study conducted by Ekayani (2014) stated that pregnant women with CED had 5 times greater risk to give birth to low birth weight babies (OR = 5.54; 95% CI= 2.65- 11.60) compared to mothers without CED.

3. The effect of biopsychosocial stress on birth weight

The results of path analysis in the previous study showed that there was a negative direct and statistically significant effect of maternal stress on birth weight. This study is in line with study conducted by Rondo et al. (2003) which stated that maternal psychological factors were associated with low birth weight (RR = 1.97, p = 0.019) and premature babies (RR = 2.32, p = 0.015). Stressful conditions on mother who cannot be controlled can cause depression on mother. Mothers who give birth to babies with low birth weight have 2.8 times greater proportion of depressive symptoms than mothers who give birth to babies with normal weight (Hapisah et al., 2010).

Maternal stress during pregnancy was significanly associated with the increased risk of low birth weight. Financial stress included in biopsychosocial stres and it is independently associated with low birth weight in non-Hispanic black mothers. Whereas, in non-Hispanic white mothers, stress are arised from relationships with partners and they are the factors of biopsychosocial stress that significantly associated with low birth weight (Alonge, 2012).

A study conducted by Robinson et al. (2016) identified certain types of psychosocial stress experienced by women from minorities (Asia, Arab, Africa and Latin America). The findings of this study indicated that women from minority ethnic groups are more likely to experience symptoms of depression, anxiety, inadequate social support, and emotional and physical health problems during pregnancy than white women. Women from ethnic minority experienced greater psychosocial stress during pregnancy than white women.

4. The effect of family income during pregnancy on birth weight

This study showed that there was a positive direct and statistically significant effect of family income during pregnancy on birth weight. This study is supported by Khatun and Rahman (2008) which stated that sociodemographic factors, one of which is economic status, causes the birth of low birth weight babies. The low economic status of the mother or family has 3.27 times greater risk to give birth to babies low birth weight (Mumbaree et al., 2012). It also similar to the study of Hapisah et al. (2010) which stated that the risk of low birth weight is 2 times greater in mothers with less socio-economic families. According to Sebayang et al. (2012) families in the category of poor and very poor families have a 32% and 44% higher chance of having a low birth weight when compared to rich families.

B. The Effect of Maternal Education, Maternal Nutrition Status, Maternal Stress and Family Income on Birth Length

1. The effect of maternal education on birth length

Based on the results of path analysis, this study showed that there was a statistically significant and positive indirect effect of maternal education history on birth length through maternal mid-upper arm circumference and family income during pregnancy. This study was supported by Basic Health Research results which showed that the higher the education, the lower the percentage of short-born children (Ministry of

Health, 2013). Basically maternal education has an influence on birth length. Although the effect given is indirectly positive for birth length, education directly affects the nutritional status of the mother and family income, which in turn will affect the birth length.

Previous study revealed the same thing that the higher education, the lower the prevalence of short birth length (Simbolon et al., 2015). According to Silva et al. (2010), low maternal education levels were also associated with fetal growth delays with a greater influence on fetal head growth, followed by thigh bone growth (femur) and abdominal growth, causing differences in weight and length at birth. Whereas according to Amin and Julia (2014), maternal education was not a risk factor for the incidence of stunting in infants.

2. The effect of maternal MUAC on the birth length

The results of the path analysis showed that there was a direct positive and statistically significant effect of the maternal mid-upper arm circumference on birth length. This study is in line with the study conducted by Najahah (2014), which stated that mothers who suffer from CED have a risk of 6.2 times to give birth to a baby with short birth length compared to mothers without CED. The same thing was stated by Simbolon et al. (2015), infants with short birth lengths were more common in mothers with CED (5.5%) compared to mothers without CED (2.8%).

Birth length can be used as a risk factor for stunting in children under five. The study conducted by Swathma et al. (2016), stated that short-born body lengths have a risk of stunting 4,078 times greater than babies who have normal birth lengths. According to Par'i (2016), mothers with CED during pregnancy will give birth to malnourished and easily to get sick children characterized by low body weight and length compared to the standard of growth of children who are healthy and live in a healthy environment.

3. The effects of biopsychosocial stress on birth lengths

In general, maternal pregnancies throughout the world are influenced by several stressful triggers, including low material resources, uncomfortable working conditions, lack of household responsibilities, pregnancy complications and intimate relationships in families that are full of tension (Schetter and Tanner, 2012). In contrast to this study, biopsychosocial stress has no effect on birth length both directly and indirectly.

4. The effects of family income during pregnancy on body length

This study shows that there is a statistically significant and direct positive effect between family income during pregnancy on birth length. This study was supported by Yongki (2007), which stated that the anthropometric size of infants with short birth length was <46 cm from mothers with high socioeconomic status having a greater body weight, head circumference, abdominal circumference and chest circumference than babies with short birth lengths from mothers with low socio-economic status. Furthermore, the average length of babies with short birth lengths from mothers with high socioeconomic status shows a greater value compared to a short birth length baby from mothers with low economic status. In contrast, the study conducted by Simbolon et al. (2015) stated that factors from low socioeconomic were not significantly associated with the prevalence of short birth length ($r = -0.087$; $p = 0.156$).

Based on the results of the study it can be concluded that birth weight can be directly affected by maternal education, maternal MUAC, maternal stress and family income during pregnancy. Birth length can be directly affected by the maternal MUAC and family income, while education indirectly affects birth weight and birth length through the maternal mid-upper arm circumference and family income during pregnancy.

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