

Prediction Model Length of Newborn Infants based on determinant factors



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Abstract— The height of prenatal is a risk factor for the Length of newborn infants. Other risks that may affect the Length of a newborn infant are the Body Mass Index (BMI), the age of prenatal during their early pregnancy, the low intake of energy and protein, and the history of chronic energy deficiency. The goal of the research is to determine the various factors related to the Length of newborn infants. The results were expected to provide the determinants of newborn infant length, which can be predicted before pregnancy until the date of labor. The result can be used as a basis to determine the appropriate intervention in the prevention of stunted children. The study design is cross-sectional, with a total sample of 46 prenatal. The Spearman correlation test showed that only three variables could be included in the prediction models with $p < 0.25$. It was the height of mothers before pregnancy (RS = -0,027; $p=0,060$), the energy intake of pregnant women with in the last month pregnancy (RS: 0,553; $p=0,00$), and protein intake of pregnant women with in the last month of pregnancy (RS=0,42; $p=0,002$). Prediction model produces in Multiple Linear Regression Line Equation is the length of newborn infant = $57.268 - \text{Protein intake } 0,075x \text{ average} - 0.079 \times \text{height before pregnancy} + 0.002 \times \text{intake of energy last one month} + 0.090 \times \text{intake Protein 1 last month}$. It is recommended that pregnant women with short stature need more energy intake during pregnancy, especially in the last month of pregnancy, so that newborn infants have a normal body length.

Keywords: height of prenatal, length of newborn infants, energy intake, the prediction model

INTRODUCTION

The priority of the National Plan for Health Development 2015-2019 (RPJMN) in the nutrition sector is still focused on overcoming stunting considering the current high prevalence of stunting. Based on the results of the Basic Health Research (Riskesdas 2010), the percentage of LBW in Indonesia was 8.8 percent, 35.6 percent for stunted children under five, 13.3 percent for underweight children, 17.9 percent for under-five children with malnutrition, and children under five are overnutrition by 12.2 percent. [1] Thus, Indonesia faces multiple nutrition problems, on the one hand experiencing malnutrition, on the other hand, experiencing excess nutrition. [2] The bad effects that can be caused by the aforementioned nutritional problems, in the short term [15], are disruption of brain development, intelligence, physical growth disorders, and metabolic disorders in the body. There are several bad consequences in the long term that can be caused. First is the decline in cognitive abilities and learning achievement. Second, decreased immunity so that you get sick easily. Third, there is a high risk for diabetes, obesity, cancer, stroke, disabilities in old age, heart, and blood vessel disease. McGregor (2007) identified early growth retardation in short children (with a height/age index, z-score < -2 SD) and absolute poverty as the most likely indicators of low development of cognitive, motor, and socio-emotional abilities. [3]

The most critical period in combating stunting starts from the time the fetus is in the womb until the child is two years old, which is called the golden period (the first thousand days of life). Therefore, nutrition improvement is prioritized in the first thousand days of life, namely 270 days during pregnancy and 730 days in the first life of the baby. Hizni's research (2009) shows that stuntedness, low

maternal education, and maternal employment status are risk factors for delays in children's motor development with risk (OR) of 3.59, 5.32, and 9.06 times, respectively. [4] However, Susanti and Margawati's (2012) research shows that there is a link between the lack of protein and energy intake in the long term with the development of fine motor ($p = 0.045$) and gross motoric ($p = 0.027$). Although there was no significant relationship between the degree of stunting and motor development ($p = 0.391$). [5]

Based on the description above, the problems of this research are:

1. Is there a relationship between height before pregnancy, BMI before pregnancy, maternal age, parity, upper arm circumference, energy, and protein intake, and the Length of newborn infants?
2. Can pre-pregnancy height, BMI before pregnancy, maternal age, parity, upper arm circumference, energy, and protein intake be used as predictors of newborn infants?

METHOD

Research Design

The research design was observational with cross-sectional study design. The independent variables are the height of pregnant women, mother's age, BMI before pregnancy, parity, pregnant woman's upper arm circumference, protein, and energy intake. The dependent variable is the Length of newborn infants. This research was conducted in 3 working areas of Puskesmas Sukajadi, Puskesmas Puter, and Puskesmas Garuda, Bandung City, from April to December 2016. The population and sample of the study were pregnant women starting from the third trimester of pregnancy, visitors to Sukajadi Health Center, Puskesmas Puter, and Puskesmas Garuda, Bandung City. , with the following inclusion criteria:

1. Pregnant women have a pregnancy data record in the MCH Handbook
2. Gestational age 29 weeks - 32 weeks

Exclusion criteria:

- Labor is not spontaneous

The number of samples at the beginning of the study was 53 samples; until the third stage of the observation, there were only 46 samples—primary data: upper arm circumference, energy, and protein intake. The body length of newborn infants is measured directly by the birth attendant (midwife or obstetrician).

The data obtained were then analyzed analytically and tested using the Pearson product-moment correlation test. Multivariate analysis. Multiple Linear Regression Analysis, to create a predictive model for the body length of newborn infants using maternal height data, pregnant women LILA, energy intake and protein intake of pregnant women, with the following formula:

$$Y = a + b_1X_1 + b_2X_2 + \dots\dots\dots b_nX_n + e$$

Information :

Y = dependent variable (length of newborn infants)

a = intercept (estimated magnitude of the mean Y when the increase in the value of X = 0)

b = slope (the estimated amount of change in the value of variable Y if the value of variable X changes by one unit of measurement)

X = each mother's height, LILA, protein intake and energy intake of pregnant women

e = the error value (error) is the difference between the observed individual Y value and the actual Y value at a certain point X

Prediction models that are expected to be produced:

From the Multiple Linear Regression mathematical model, a predictive list can be made of the Length of newborn infants based on the data of the influencing determinants. By presenting the Prediction Model for the Length of newborn infants in this table, it is hoped that it can be used by the general public, especially pregnant women, with a high risk of pregnancy.

For example: with 140 pregnant women (short height), it is predicted that Length newborn infants will reach 35 cm (short PB)

Research Ethics

Ethical review permit from the Bandung Health Poltekkes Research Ethics Commission received on August 3, 2016,

RESULTS AND DISCUSSION

Univariate Analysis

1. Distribution and Frequency Characteristics of Respondents

Table 1. The following describes the education and occupation of pregnant women, which shows that most pregnant women have junior high and high school education backgrounds (80.4%), with the largest percentage not working, namely 80.4%.

Table 1. Distribution and frequency of respondents' education and occupation

Respondents' Education & Occupation	n	%
A. Educational sample		
1. No Education	1	2,2
2. Completed elementary school	2	4,3
3. Completed junior high & high school	37	80,4
4. Graduated from college	6	13,0
Total	46	100,0
B. Job		
1. Don't Have a Job	37	80,4
2. Have a Job	9	19,6
	46	100,0

A similar proportion was also found in Irawati's (2014) study, where 70.4% of the education in the study sample had junior high and high school education, and 98.2% of the respondents worked. [6] Mothers who do not work but have high education should have the opportunity to provide better nutritional care than mothers who work with low education.

2. Distribution and Frequency of Samples before Pregnancy

Allen (2001) and Achadi (2014) mention several risk factors for pre-pregnancy, which will affect the weight and Length of newborn infants. These factors are age at pregnancy, upper arm circumference and Body Mass Index (BMI), maternal height and pre-pregnancy weight [7] [8] [7] [8]

Table 2. shows some of the risk factors before pregnancy.

Table 2. Frequency Distribution of Sample Characteristics Before Pregnancy

Statistical Value	Age at Pregnancy (year, month)	Height before pregnancy (cm)	Weight before pregnancy (kg)	Circumference of the upper arm before pregnancy (cm)	BMI before pregnancy
Mean	28,7	153,9	54,1	26,5	22,9
Median	28,5	155,0	53,5	26,0	23,0
SD	5,0	5,9	10,2	2,8	4,5
Min	16	144,0	38,0	21,0	13,6
Max	39	167,0	33,9	33,0	33,9

The mother's age at first pregnancy can indicate mental and physiological readiness. The results showed that the average age of pregnant women was 29 years, six months. However, referring to the minimum age for marriage program promoted by the BKKBN, which is 21 years old, there is a minimum age for respondents who are still relatively young because they are 16 years old. Early age of marriage and pregnancy will increase the risk of childbirth and the health condition of newborn infants. Delivery to mothers under the age of 20 has contributed to the high rates of neonatal, infant, and under-five mortality. The results of the Indonesian Basic Health Survey (IDHS) in 2012 found that the neonatal, postneonatal, infant, and under-five mortality rates for mothers aged less than 20 years were higher than in mothers aged 20-39 years.

Conversely, there is a pregnant woman's age of 39 years (maximum value), which exposes pregnant women to a high risk of giving birth over 35 years of age. Childbirth over 35 years of risk for the baby to die or be disabled, even the mother died during labor, often occurs. According to Prasmusinto in Natali (2008), giving birth at the age of 35 years and over, babies born are prone to genetic disorders. At reproductive age (25-35 years), the risk of a baby having a genetic slack is 1: 1000, whereas in mothers over 35 years, the risk increases to 1: 4. [9]

The results also found that the average height of pregnant women was within normal limits, namely 153.9 cm, slightly above the ideal height, 150 cm, although some were 144 cm tall. Parameters of height, together with the mother's weight before pregnancy, can be an indication of the risk of pregnancy by looking at the Body Mass Index (BMI) before pregnancy. The results showed that the mean BMI of mothers before pregnancy was 22.9, which means that it was within normal limits, but it was found that mothers with BMI were 13.6 (thin) and BMI 33.9 (obese). The average normal BMI limit is also the finding of Kliranayungie's (2012) research, which is 22.1 and Irawati (2014), which is 20.6. [6] [10]

3. Sample Frequency Distribution according to Anthropometric Monitoring

Anthropometric monitoring, including body weight (BW) and upper arm circumference (LILA), is important to ensure the nutritional status of pregnant women is in the best condition, in preparation for delivery. The results of anthropometric monitoring are presented in table 3.

Table 3. Frequency Distribution of Body Weight and Lila in Pregnant Women on Average of the Last 3 Months and One Month

Statistical Value	Average Body Weight Last three months (Kg)	Pregnant Women Weight Last one month (Kg)	Average of Lila in the last three months (Cm)	Lila Pregnant for the last one month (Cm)
Mean	65,5	67,7	27,8	28,5
Median	66,1	68,0	27,2	28,5
SD	10,3	10,1	3,3	3,3
Min	48,7	51,0	17,3	22,5
Max	94,3	95,0	34,8	35,4

Table 3 shows the increase in anthropometric size between the average body weight in the last three months compared to the body weight in the last one month, namely from 65.5 kg to 67.7 kg, or an increase of 3.4%. This increase was relatively small; however, if compared with the pre-pregnancy body weight of 54.1 kg (Table 4.2), there was a significant increase in body weight, namely 13.6 kg, or an increase of 25.1%. The increase in body weight before pregnancy compared to the last one month before delivery of 13.6 kg exceeds the recommendation of the Institute of Medicine (1990), which suggests an increase in body weight during pregnancy of 11 kg.[12] It is even greater than the recommended increase in body weight during pregnancy in mothers with normal BMI before pregnancy, which is only recommended to increase between 9 to 12 kg (Bardosono, 2006). Likewise, the circumference of the upper arm (LILA), increased from an average of 27.8 cm over the last three months to 28.5 cm in the last one month, or an increase of 2.5%. If you compare the average upper arm circumference before pregnancy (26.5 cm) and after pregnancy, there is an increase of 2 cm or an increase of 7.5%. [11]

4. Sample Frequency Distribution according to Monitoring Energy and Protein Intake

a. Energy Intake during Pregnancy

A woman during pregnancy has increased energy needs. This energy is used for fetal growth, the formation of the placenta, blood vessels, and new tissue.[13]Also, additional calories are needed as fat reserves and for new tissue metabolic processes.[14] The measurement of energy intake in the study sample was carried out during the last three months before delivery. The results were then compared between the average intake for the last three months and the last month, as presented in Table 4. below

Table 4. Distribution of Sample Frequency According to Increase in Energy Intake During Pregnancy

Statistical Value	Energy intake for the last three months (cal)	Energy intake for the last one months (cal)	Increase in Energy Intake (cal)
mean	1717.5	2052,8	23,3
Median	1666.1	1992,0	325,9
SD	638.4	420,4	218
Min	618.0	1302,0	684,0
Max	3364.6	3356,2	-8,4

From table 4, it can be seen that the comparison of the average energy intake of pregnant women during the last three months and the last one month shows an increase of 23.3 calories or an increase of 13.6%. The National Widyakarya on Food and Nutrition 2004 recommends an increase of 300 kcal/day for pregnant women in the third trimester. Thus in one day, the energy intake of pregnant women in the third trimester can reach 2300 kcal/day. If you look at the average energy intake of the sample, the adequacy of the sample is still below the recommended, except in some samples, including the maximum intake which reached 3,364.6 calories in the last three months but decreased by 8.4 calories, to 3,356.2 calories in the last one month.

b. Protein Intake during Pregnancy

During pregnancy, there is an increase in protein requirements caused by an increase in blood volume and the growth of new tissue. The amount of protein that must be available until the end of pregnancy is 925 g. These proteins will be buried in the tissues of the mother, placenta, and fetus. As with the measurement of energy intake, protein intake was measured during the last three months. The results are as presented in table 5. below

Table 5. Distribution of Sample Frequency According to Increase in Protein Intake During Pregnancy

Statistical Value	Protein intake for the last three months(g)	Protein intake for the last one months (g)	Increase in Protein Intake (g)
Mean	57.6	62,7	5,1
Median	54.3	61,6	7,3
SD	23.6	14,9	8,7
Min	28.1	35,0	6,9
Max	139.4	91,3	-47,1

Table 5. shows the average increase in protein intake over the last three months, compared to the intake in the last one month that experienced wear of 5.1 grams, or an increase of 8.9%. Widyakarya Food and Nutrition VIII 2004 recommends an additional 17 grams for pregnancy in the third trimester or about 1.3 g / kg/day. Thus, in one day, protein intake can reach 67-100 grams. The sample protein intake seems to be still below recommendation, except for samples with the maximum intake, which reached an average of 139.4 grams in the last three months, although then it fell to 47.1 grams in the last one month, to 91.3 grams.

5. Frequency Distribution of Gynecological Age at Childbirth and Length of newborn infants

The enumerator uses an infantometer to measure the Length of newborn infants. The results are as presented in Table 6

Table 6. Frequency Distribution of Samples according to Gynecological Age and Anthropometry

Statistical Value	Gynecological Age at Labor (Week)	Length of newborn infants(cm)
Mean	36.0	49,9

Median	36.0	50,0
SD	2.4	1,5
Min	33.0	46,0
Max	39.0	54,0

The mean age at delivery was recorded at 36 weeks, with an age range of 33 - 39 weeks. Of the 47 samples which were observed until delivery, 1 sample gave birth to twins, but not quite months (prematurely), so that it was excluded from the study. Until the total babies who were observed to be born were 46 babies.

Babies are born with a normal length of up to 48 cm, meaning that less than that size will be categorized as short babies. [1] The average body length of newborn infants in the normal category, with a length of 49.9cm. But there is still a baby that reaches 46 cm in Length. The Length of newborn infants included in the category of babies with short birth length. Meanwhile, babies are born with a maximum length of 54 cm. This result is not much different from the research by Klirayanungie (2012), which found that the average Length of babies born was 48.5 cm, with a length range of babies between 43 - 54 cm. [10]

C. Multivariate Analysis of Multiple Linear Regression

Multiple Linear Regression Analysis is used to construct a predictive model of the determinants of the Length of newborn infants using the Backward method.

1. Bivariate Selection Stage

The first stage of this analysis carried out the selection of bivariate variables that will be included in the initial multiple linear regression modeling for the dependent variable of body length of newborn infants. Table 7 is the p-value for each independent variable analyzed

Table 7. Results of Bivariate Selection for Dependent Variables Body Length for Birth Babies

VARIABLE	<i>p-value</i>
height of the mother before pregnancy	0,223
Upper arm circumference for the last one month (before parturition)	0,159
Energy intake for the last one month	0,001
Protein intake for the last one month	0,003
Parity	0,818

From table 7 above, there are four variables, namely maternal weight before pregnancy, Lila for the last one month, energy intake for the last one month and protein intake for the last one month which were candidates for entry into modeling, because the p-value was <0.25.

Table 8 Model Summary

MODEL	R	R Square	Adjusted R Square	Std. An error of the Estimate
1	0,720	0,518	0,429	1,148

2	0,716	0,512	0,437	1,140
3	0,711	0,506	0,444	1,133
4	0,700	0,490	0,440	1,137

Table 8 shows the Model Summary, which produces an R-Square value (coefficient of determination) of 0.490, meaning that the regression model obtained can explain 49% of the variation in the dependent variable of the Lengthof newborn infants. In other words, the variable mean protein intake, height before pregnancy, energy intake for the last one month, and protein intake for the last one month can only explain the variation in the variable Length of newborn infantsby 49%.

Table9 Analysis of Variants

MODEL	Sum of Squares	df	Mean Square	f	Sig
1 Regression	53,818	7	7,668	5,831	0,000
Residual	50,108	38	1,319		
Total	103,926	45			
2 Regression	53,225	6	8,871	6,824	0,000
Residual	50,701	39	1,300		
Total	103,926	45			
3 Regression	52,576	5	10,515	8,191	0,000
Residual	51,350	40	1,284		
Total	103,926	45			
4 Regression	50,882	4	12,720	9,832	0,000
Residual	53,044	41	1,294		
Total	103,926	45			

Table 9 shows the F test, with p-value = 0,000, which means that at $\alpha = 5\%$, it can be stated that the regression model fits the existing data, meaning that the four variables can significantly predict the Length of newborn infants.

2. Final Modeling Stage

After going through the bivariate selection stage, the next stage is to perform multiple linear regression analysis. This analysis was carried out on the determinant factors, namely the body length of the newborns that had passed the bivariate selection. The goal is to get the final modeling of body length prediction for babies born. Table 10. is the initial model of multiple regression analysis, predictive model for infant body length based on the determinant factors.

Table 9. Initial Model of Multiple Linear Regression Analysis Model of length Prediction of newborn infantsBased on Determinant Factors

Model	Non-Standard Coefficient		Standard Coefficient	t	Sig
	B	Std.Error	Beta		
	Constanta	57,268	4,602		
Average protein intake	-0,075	0,024	-0,750	-3,086	0,004
Height before pregnancy	-0,079	0,030	-0,308	-2,592	0,013

Energy intake for the last one month	0,002	0,000	0,483	3,723	0,001
Protein intake for the last 1 month	0,090	0,25	0,885	3,585	0,001

The results of the final modeling in Table10 show the regression line equation:

PB of infants = 57.268 - 0.075 x mean protein intake - 0.079 x height before pregnancy + 0.002 x energy intake for the last 1 month + 0.090 x protein intake for the last 1 month.

It means that the body length of newborn infants will be reduced by 0.075 cm and 0.079 cm with a history of low average protein intake and height of the mother before pregnancy. However, it will increase after being controlled with variable energy intake and protein intake in the last one month. The effect of the mother's height on Length of newborn infants was also found in Kliranayungie's (2012) study, but the result was that the increase in the mother's height was 0.071 cm and the gender of the born baby also influenced it. [10]

Also obtained a Beta value of 0.885, which means that the role of the most dominant variable in influencing Length of newborn infants, meaning that the variable protein intake for the last one month has the greatest influence on determining the body length of newborn infants. In another study (Kliranayungie, 2012) found a Beta value of 0.237 on the mother's height, which means that the mother's height has more influence in determining the Length of newborn infants than the sex of the baby. [10]

CONCLUSIONS AND SUGGESTIONS

CONCLUSIONS

1. There is a relationship between the height of pregnant women and the Length of newborn infants ($p = 0.026$). There is a relationship between energy intake in the last month and the body length of newborn infants ($p = 0.002$). There is a relationship between protein intake in the last month and the body length of newborn infants ($p = 0.004$). There was a relationship between the mean protein intake in the last three months and the Length of newborn infants ($p = 0.004$). There was no relationship between BMI, age, parity and upper arm circumference of pregnant women and body length of the newborn ($p = 0.181$), ($p = 0.404$), ($p = 0.249$), ($p = 0.225$).
2. Maternal height before pregnancy, energy intake for the last month, protein intake for the last month and the average protein intake for the last month can be a predictor of body length for babies born with the PB regression equation for babies = $57.268 - 0.075x$ Average Protein Intake - $0.079 x$ height before pregnant + $0.002 x$ energy intake for the last one month + $0.090 x$ protein intake for the last one month

SUGGESTION

Pregnant women with a high risk of stunting should pay more attention to protein and energy intake, especially in the last 3 to 1 month before delivery. Ante-Natal Care (ANC) checks are very important to do regularly to minimize the impact of pregnancy risks faced by pregnant women.

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