

NUTRITIONAL STATUS OF ADOLESCENT MOTHERS AND FACTORS RELATED TO BIRTH OUTCOMES: ANALYSIS OF CHILD GROWTH AND DEVELOPMENT COHORT DATA 2012-2018

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Abstract. Adolescent pregnancy is a public health problem that needs attention from various health stakeholders. Adolescents are still in growing phase, and they have more risks of reproductive health problems. This study aimed to determine the nutritional status of adolescent mothers and factors related to birth outcomes by using data from The Child Growth and Development Cohort Study which was collected between 2012 to 2018. We analyzed the dataset in the year 2018. The inclusion criteria were pregnant women aged 13-20 years and had complete data variables. From a total of 1,266 pregnant women, 119 met the inclusion criteria. The variables analyzed were pre-pregnancy body mass index (BMI), mid-upper arm circumference (MUAC), birth outcomes, and mother's characteristics (gestational age, mother's age, educational status, occupation status, history of parity, and history of preterm delivery). A Chi-square test was performed to identify respondents' characteristics based on pre-pregnancy BMI. Binary logistic regression was performed to determine which variables were associated with low birth weight and short birth length. From the data analysis, 3.4% of adolescent mothers experienced miscarriages, and 3.6% experienced neonatal deaths. Around one-fifth of mothers (20.2%) were wasting before pregnancy; 23.5% of mothers had a height of <150 cm, and 26.1% had low MUAC. In addition, 16.1% had prematurity, 9.8% had low birth weight (LBW) and 31.3% had short birth length (SBL). Factors associated with birth weight were prematurity (odds ratio (OR) = 67.6; 95% confidence interval (CI): 7.4-616.9; $p < 0.001$), and nutritional status before pregnancy (OR = 14.3; 95% confidence interval (CI): 1.3-159.6; $p = 0.031$). While birth length was only related to prematurity (OR = 8.2; 95% CI: 2.5-26.8; $p < 0.001$). We conclude that low birth weight and short birth length are related to prematurity and pre-pregnancy nutritional status of the mother.

Keywords: adolescent mother, prematurity, pre-pregnancy nutritional status, birth weight, birth length

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INTRODUCTION

Adolescent pregnancy is a public health problem that needs attention from various health stakeholders. In developing countries, every year almost 12 million young women aged 15-19 years and at least 777.000 young women under 15 years give birth with 10 million of them being the result of unwanted pregnancy (Woog and Kågesten, 2017). At the global level, complications during pregnancy and childbirth are the primary cause of death in adolescent girls aged 15-19 years (PLAN International, n.d.). The number of induced abortions was estimated around 73 million cases worldwide each year and around 45% of all abortions are unsafe and unsafe abortion results in maternal mortality and morbidity (WHO, 2021).

Pregnancy during adolescence is a vulnerable condition for young females who are in high-risk groups. Pregnant adolescents (10-19 years old) are at higher risk of developing eclampsia, endometrial infection after childbirth (puerperal endometritis) and systemic infections than women aged 20-24 years, and babies born are more at risk of low birth weight, premature birth and poor neonatal conditions (WHO, 2020). In Indonesia, the Indonesia Demographic and Health Survey (IDHS) 2017, data stated that 7% of women aged 15-19 years gave birth or bore the first pregnancy (National Population and Family Planning Board, 2018). The data mentioned both men and women participating in the survey first had sexual intercourse when they were 17 years old (19%). Also, 23% of women and 19% of men had friends who had an abortion, and 1% of them accompanied/influenced a friend to have an

abortion (National Population and Family Planning Board, 2018).

Pregnancy is the leading cause of maternal deaths in adolescents and contributes to the number of years loss in a healthy life (Aung *et al*, 2018). Adolescent pregnancies relate to premature deaths, diseases, or disability-adjusted life years (DALY's) in the world. Young women, especially those in their early adolescence, are vulnerable to pregnancy and birth problems as having undeveloped body functions. Obstetric fistula, eclampsia, puerperal endometritis, and systemic infections are some of the serious conditions they may face in the short and long term (UNICEF, 2021). For some adolescents, pregnancy and childbirth are not planned or desired. In countries where abortion is prohibited, adolescents usually choose to unsafe abortion, which endangers their lives. Previous report mentioned 3.9 million unsafe abortions were found in adolescents aged 15-19 years every year in developing countries (PLAN International, n.d.). Adolescent pregnancies affect not only physical health, but also adolescent mental health. From the psychological aspect, early marriage among adolescents causes anxiety and stress. Anxiety experienced by adolescents is associated with fear and family problems, while stress relates to depression due to a prolonged process of disappointment (SYALIS and Nurwati, 2020).

Adolescent pregnancy was found to be associated with a suicide attempt (adjusted odds ratio (aOR) = 1.68; 95% confidence interval (CI): 1.06-2.72), and miscarriage was associated with a 2-fold increase in the likelihood of suicide (aOR = 2.12; 95% CI: 1.10–4.12) (Cioffi, Schweer-Collins and Leve, 2022). A meta-analysis study found that the common consequences of adolescent pregnancy were premature birth (OR: 2.12; 95% CI: 1.64-2.72; $p < 0.001$), premature rupture of membranes (OR: 1.49; 95% CI: 1.19-1.86; $p = 0.01$), anemia (OR: 2.60; 95% CI: 1.56-4.32; $p < 0.001$), low birth weight/ intrauterine growth retardation (OR: 1.38; 95% CI: 0.72-2.64; $p < 0.001$), and fetal distress (OR: 1.78; 95% CI: 1.22-2.59; $p < 0.001$) (Karaçam *et al*, 2021). The World Health Organization (WHO) posed a maternal and public health target between 2012 to 2025, *ie*, reducing 30% of low birth weight (LBW) rates globally by formulating programs for preventing LBW and premature birth (PTB) (WHO, 2019). This paper explained the nutritional status of

adolescent mothers and factors related to birth outcomes. It is expected to provide an overview of the risk factors of adolescent pregnancies and efforts to improve birth outcomes.

MATERIALS AND METHODS

Design and research location

The present research used a cross-sectional design utilizing the data from the Child Growth and Development Cohort Study conducted from 2012 to 2018 in five out of eleven urban villages in the city of Central Bogor, West Java Province, Indonesia.

Recruitment of respondents

The population of the study was pregnant women in the villages, and the samples were pregnant adolescents aged 13-20 years during the selection process. The total population of pregnant women recruited from 2012-2018 was 1,266 respondents. Based on the calculation of the sample size with a power of 90%, a minimum of 115 adolescent pregnant women was required. The total sample of adolescent pregnant women who met the research inclusion criteria was 119 respondents. So, we included all available samples in the analysis. The inclusion criteria of the study were having data of pre-pregnancy body mass index (BMI), gestational age, mother's age, educational status, occupation status, history of parity, history of preterm delivery, measurement data of mid-upper arm circumference (MUAC), and childbirth outcomes (birth weight, length of birth, and neonatal death) and willing to be research participants by signing informed consent forms.

Variables and data collection

The dependent variables of the study were birth outcomes including baby weight and length of birth. Meanwhile, the independent variables

were mothers' characteristics including mothers' weight and height during pre-pregnancy, mothers' gestational age, mothers' age, educational status, occupational status, MUAC, and history of premature birth. Data on mothers' characteristics were collected through an interview with a questionnaire, while the MUAC was collected through a standardized measurement. Data collection was carried out by enumerators who had nutrition or health education background and received training the research interview and MUAC measurements.

Data analysis

All variables were grouped into two categories, except the pre-pregnancy BMI. Mothers' age was grouped into 13-16 years and 17-20 years. The number of childbirths was classified into 1 and above 1. Education status was grouped into graduated from elementary school/junior high school and from high school/college or equivalent. Mothers' occupation was grouped into employed and unemployed categories. Pre-pregnancy BMI was divided into underweight ($\text{BMI} < 18.5 \text{ kg/m}^2$) and normal-overweight-obese ($\text{BMI} \geq 18.5 \text{ kg/m}^2$) categories. MUAC was grouped into low ($\text{MUAC} < 23.5 \text{ cm}$) and normal ($\text{MUAC} \geq 23.5 \text{ cm}$) categories. Miscarriage history was divided into intrauterine fetal death (IUFD) and neonatal death categories. Birth outcomes were divided into low birth weight ($< 2,500 \text{ grams}$) and normal ($\geq 2,500 \text{ grams}$) categories, while the birth length was comprised of short ($< 48 \text{ cm}$) and normal ($\geq 48 \text{ cm}$) categories. Chi-square analysis were performed for cross-data tabulation to identify pre-pregnancy BMI of adolescent mothers and mothers' characteristics (*ie*, age, education, occupation, parity, MUAC, height, and prematurity), and birth outcomes (birth weight and birth length). Binary logistic regression analyzes were performed to determine which variables associated with birth outcomes by looking at odds ratio (OR) and 95% confidence interval (CI); p -value < 0.05 was considered statistically significant. Wald test is used to compare models on best fit criteria in case of logistic regression. Data were analyzed on Statistical Package for the Social Sciences (SPSS) version 25 software (IBM Corporation, Armonk, NY).

Ethical consideration

Ethical permission was approved for conducting The Child Growth and Development Cohort Study from the Ethics Committee of the Indonesian Ministry of Health, with letter number: KE.01.05/EC/394/2012; LB.02.01/5.2/KE 215/2013; LB.02.01/5.2/KE.143/2014; LB.02.01/5.2/KE.135/2015; LB.02.01/5.2/KE.042/2016; lb.02.01/2/KE.108/2017; lb.02.01/2/KE.076/2018. The respondents filled out consent forms to participate in the study.

RESULTS

Respondents' characteristics

This study involved all adolescent mothers (119 people) from the cohort study of child development, and they were aged 13-20 years. Table 1 shows the respondents' characteristics based on pre-pregnancy nutritional status. A total of 20.2% of adolescent mothers had an underweight status before pregnancy. The average age (mean $\pm$ SD) of adolescent mothers was 18 ± 1.5 years, and 10.9% of adolescent mothers were between 13-16 years old. For other characteristics, 95.8% did not have a job, and more than half of the adolescent mothers graduated from junior high school education (60.5%).

Table 1
Respondents' characteristics based on pre-pregnancy body mass index

Variables	Results from a total of 119 respondents	Pre-pregnancy BMI		<i>p</i> -value
		Underweight (<18.5 kg/m ²) N = 24	Normal (≥18.5 kg/m ²) N = 95	
Age group (years), <i>n</i> (%)				
13-16	13 (10.9)	2 (8.3)	11 (11.6)	0.649
17-20	106 (89.1)	22 (91.7)	84 (88.4)	
Average age (years), mean ± SD	18 ± 1.548			

Table 1 (cont)

Variables	Results from a total of 119 respondents	Pre-pregnancy BMI		<i>p</i> -value
		Underweight ($<18.5 \text{ kg/m}^2$) N = 24	Normal ($\geq 18.5 \text{ kg/m}^2$) N = 95	
Occupation, <i>n</i> (%)				
Unemployed	114 (95.8)	23 (95.8)	91 (95.8)	0.992
Employed	5 (4.2)	1 (4.2)	4 (4.2)	
Education, <i>n</i> (%)				
Junior high school and below	72 (60.5)	15 (62.5)	57 (60.0)	0.823
Senior high school	47 (39.5)	9 (37.5)	38 (40.0)	
Mother's height, <i>n</i> (%)				
<150 cm	28 (23.5)	4 (16.7)	24 (25.3)	0.375
≥ 150 cm	91 (76.5)	20 (83.3)	71 (72.6)	
Average height (cm), mean $\pm$ SD	153 $\pm$ 5.304			
MUAC, <i>n</i> (%)				
Low (<23.5 cm)	88 (73.9)	14 (58.3)	17 (17.9)	<0.001
Normal (≥ 23.5 cm)	31 (26.1)	10 (41.7)	78 (82.1)	
Average MUAC (cm), mean $\pm$ SD	25.4 $\pm$ 3.364			
Gestational age, <i>n</i> (%)				
Prematurity (<37 weeks)	18 (16.1)	2 (8.3)	16 (18.2)	0.244
Normal (≥ 37 weeks)	94 (83.9)	22 (91.7)	72 (81.8)	
Average gestational age (weeks), mean $\pm$ SD	37.9 $\pm$ 2.387			
Parity, <i>n</i> (%)				
1 pregnancy	95 (79.8)	22 (91.7)	73 (76.8)	0.106
2 or more pregnancies	24 (20.2)	2 (8.3)	22 (23.2)	
Average parity, mean $\pm$ SD	1.24 $\pm$ 0.536			

BMI: body mass index; cm: centimeters; kg/m^2 : kilograms/square meter; SD: standard deviation

The average height (mean $\pm$ SD) of adolescent mothers was 153 ± 5.3 cm; 23.5% of adolescent mothers had short height (<150 cm), and 73.9% of adolescent mothers had chronic energy deficiency (MUAC <23.5 cm). The average gestational age (mean $\pm$ SD) was 37.9 ± 2.4 weeks; 16.1% of adolescent mothers experienced premature pregnancies (<37 weeks) and 20.2% of adolescent mothers gave birth to more than one baby.

Pre-pregnancy nutritional status, MUAC values, and birth outcomes of adolescent mothers

Fig 1 shows that 20.2% of adolescent mothers were underweight before pregnancy, and 26.1% had an upper arm circumference of less than 23.5 cm. Miscarriage was experienced by 3.4% of adolescent mothers, and history of prematurity was found in 16.1% of adolescent mothers. The pregnancy outcomes, *ie*, low birth weight (<2,500 g) and short birth length (<48 cm) were found in 9.8% and 31.3% of adolescent mothers, respectively. Meanwhile, neonatal deaths were found in 3.6% of adolescent mothers.

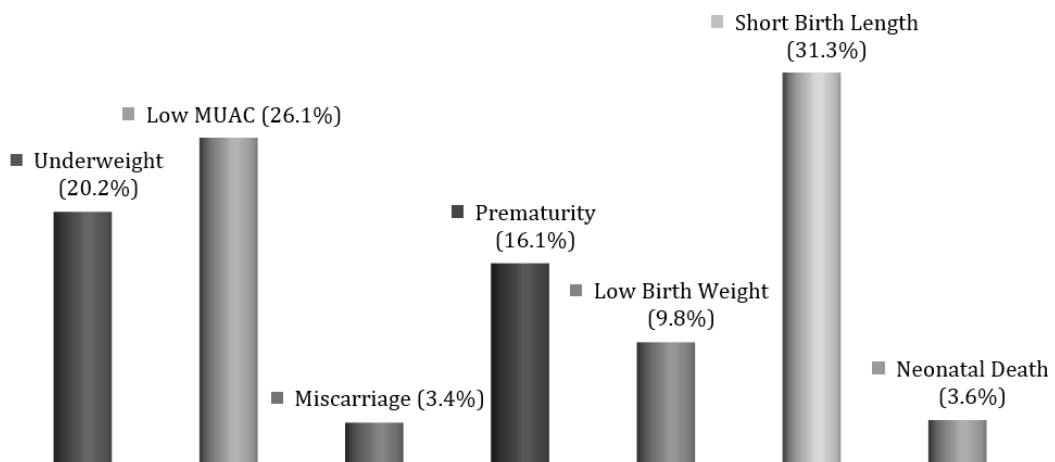


Fig 1 - Pre-pregnancy BMI, MUAC and birth outcomes among pregnant adolescents

BMI: body mass index; MUAC: mid-upper arm circumference

Table 2 demonstrates data on LBW and SBL babies born to adolescent mothers. Almost all mothers aged 17-20 years (97.1%) gave birth babies with SBL. About one fifth of adolescent mothers with short stature (<150 cm) gave birth to LBW babies (27.3%), and 31.4% of adolescent mothers delivered SBL babies. More than one-third of adolescent mothers with wasting status in early pregnancy gave birth to LBW babies (36.4%), and about one-fifth of adolescent mothers delivered SBL babies (20.6%). More than one-third of mothers with low MUAC gave birth to LBW babies (36.4%), and less than one-third of adolescent mothers delivered SBL babies (28.6%). This study also showed 72.7% of adolescent mothers with history of prematurity gave birth to LBW babies and 37.1% to SBL babies.

Analysis of factors associated with low birth weight

Table 3 presents the results of the binary logistic regression test between history of prematurity, MUAC, pre-pregnancy BMI, and mothers' height to birth outcomes. It was found that prematurity dominantly contributed to low birth weight followed by pre-pregnancy BMI. This indicated that the risk of prematurity in mothers with early age of pregnancies was 67.6 times greater than that in mothers with normal or adequate gestational age of ≥ 37 weeks (OR = 67.6; 95% CI: 7.4-616.9; $p < 0.001$). Regarding pre-pregnancy BMI factor, adolescent mothers who were underweight 14.3 times more at risk of delivering LBW babies compared to those with normal pre-pregnancy BMI (OR = 14.3; 95% CI: 1.3-159.6; $p = 0.031$).

Analysis of factors associated with short birth length

Table 4 demonstrates the results of the binary logistic regression test between prematurity, MUAC, pre-pregnancy BMI, and mothers' height. Prematurity dominantly caused short birth length. It gave 8.2 times possibilities for adolescent mothers to have babies with short birth length (OR = 8.2; 95% CI: 2.5-26.8; $p < 0.001$).

Table 2
Correlation of respondents' characteristics and birth outcomes

Variable	Birth weight		<i>p</i> -value	Birth length		<i>p</i> -value
	<2,500 g	≥2,500 g		<48 cm	≥48 cm	
Age group (years), <i>n</i> (%)						
13-16	0 (0)	12 (11.9)	0.226	1 (2.9)	11 (14.3)	0.070
17-20	11 (100)	89 (88.1)		34 (97.1)	66 (85.7)	
Mother's height, <i>n</i> (%)						
<150 cm	3 (27.3)	24 (23.8)	0.796	11 (31.4)	16 (20.8)	0.222
≥150 cm	8 (72.7)	77 (76.2)		24 (68.6)	61 (79.2)	
Pre-pregnancy BMI, <i>n</i> (%)						
Underweight (<18.5 kg/m ²)	4 (36.4)	20 (19.8)	0.204	7 (20.0)	17 (22.1)	0.804
Normal (≥18.5 kg/m ²)	7 (63.6)	81 (80.2)		28 (80.0)	60 (77.9)	
MUAC, <i>n</i> (%)						
Low (<23.5 cm)	4 (36.4)	25 (24.8)	0.404	10 (28.6)	19 (24.7)	0.663
Normal (≥23.5 cm)	7 (63.6)	76 (75.2)		25 (71.4)	58 (75.3)	
Gestational age, <i>n</i> (%)						
Prematurity (<37 weeks)	8 (72.7)	10 (9.9)	0.000	13 (37.1)	5 (6.5)	<0.001
Normal (≥37 weeks)	3 (27.3)	91 (90.1)		22 (62.9)	72 (93.5)	

Table 2 (cont)

Variable	Birth weight		<i>p</i> -value	Birth length		<i>p</i> -value
	<2,500 g	≥2,500 g		<48 cm	≥48 cm	
Parity, <i>n</i> (%)						
1 pregnancy	10 (90.9)	79 (78.2)	0.332	27 (77.1)	62 (80.5)	0.682
2 or more pregnancies	1 (9.1)	22 (21.8)		8 (22.9)	15 (19.5)	

BMI: body mass index; cm: centimeters; g: grams; kg/m²: kilograms per square meter; MUAC: mid-upper arm circumference

Table 3
Results of the binary logistic regression test on low birth weight

Variables	B	SE	Wald	<i>p</i> -value	Exp(B)	95% confidence interval for Exp(B)
Prematurity	4.214	1.128	13.966	<0.001	67.656	7.420 - 616.903
MUAC	0.555	0.926	0.359	0.549	0.574	0.093 - 3.526
Pre-pregnancy BMI	2.655	1.233	4.633	0.031	14.225	1.268 - 159.593
Height	0.204	0.954	0.046	0.831	1.226	0.189 - 7.955
Constant	-4.571	1.061	18.578	<0.001	0.010	

B: beta coefficient; BMI: body mass index; Exp(B): Exponential/odds ratio; MUAC: mid-upper arm circumference; SE: standard error

Table 4
Results of the binary logistic regression test with short birth length

Variables	B	SE	Wald	p-value	Exp(B)	95% confidence interval for Exp(B)
Prematurity	2.106	0.603	12.196	<0.001	8.212	2.519 - 26.772
MUAC	-0.148	0.571	0.067	0.796	0.862	0.218 - 2.643
Pre-pregnancy BMI	0.259	0.601	0.185	0.667	1.295	0.399 - 4.204
Height	0.651	0.525	1.536	0.215	1.917	0.685 - 5.364
Constant	-1.381	0.324	18.209	<0.001	0.251	

B: beta coefficient; BMI: body mass index; Exp(B): Exponential/odds ratio; MUAC: mid-upper arm circumference;
SE: standard error

This paper presented the nutritional status of adolescent mothers and the factors associated with birth outcomes. It showed that a few adolescent mothers were underweight before pregnancy (20.2%) and had low MUAC during pregnancy (26.1%). Few adolescent mothers had miscarriages (3.4%) and experienced prematurity (16.1%). Few mothers had babies with LBW (<2,500 g) (9.8%) and SBL (<48 cm) (31.3%), and some experienced neonatal deaths (3.6%). Most of neonatal deaths (75%) were found in adolescent mothers who gave birth premature babies.

DISCUSSION

The findings in this study are similar to the results of study by (Kassa *et al*, 2019) in Northwest Ethiopia where adolescent mothers had a higher chance of giving birth premature babies and LBW babies. Research by (Marković *et al*, 2020) also found that the incidence of premature birth was higher in adolescent mothers than in adult mothers; it is likely to happen because, in women younger than 20 years, the reproductive organs are not yet in optimal condition to undergo the pregnancy process, coupled with pressure or stress can increase the risk of prematurity, miscarriage, low birth weight, malnutrition, anemia and infection (Lestari *et al*, 2018; Ningrum *et al*, 2017).

Maternal nutritional status has an impact on pregnancy outcomes where underweight mothers have a higher risk of giving birth to babies with low birth weight. Premature birth rates and infant mortality rates are also higher in mothers who are underweight (Rolfes *et al*, 2012). A study in Ghana also found that pregnant adolescents with low MUAC had a lower chance of having LBW babies (OR = 0.2; 95% CI: 0.1-0.8; $p = 0.017$) compared to those with normal MUAC (Gyimah *et al*, 2021) but other research studies also show that the nutritional status of pregnant women as described by the MUAC is influenced by not attending antenatal care (ANC), poor dietary diversity, poor nutrition knowledge, poor dietary practice (aOR = 3.25; 95% CI: 1.91-5.54) and poor perceived self-efficacy (Diddana, 2019). A meta-analysis research in Canada found that, as compared to adult mothers, adolescent

mothers had a higher prevalence of LBW babies, stillbirth, and premature birth (DeMarco *et al*, 2021). The National Family and Health Survey in India found that children born to adolescent mothers had lower Z scores for birth length and birth weight than children born to adult mothers (Nguyen *et al*, 2019). The combination of severe adverse maternal outcome (SMO) and severe adverse neonatal outcome (SNO) was three times more likely to occur in adolescent mothers compared to younger mothers (OR = 3.56; 95% CI: 1.67-7.59). SNO, either alone or in combination with SMO, was more likely found in adolescents aged 12 to 16 than in younger mothers (OR = 1.27 and 4.87, respectively) (Suárez-López *et al*, 2022).

Generally, the findings of this analysis state that maternal nutritional status before pregnancy is associated with preterm birth. This also has an impact on the low quality of human resources, even poor maternal nutritional status before and during pregnancy is associated with suspected neurodevelopmental delays in children aged 24 months (Veena *et al*, 2016; Neves *et al*, 2020) and even one of five adolescent mothers underwent the second or third pregnancy. Thus, a holistic approach is needed to address adolescent pregnancies focusing not only on changing behavior and the underlying reasons for adolescent pregnancies (Kiani *et al*, 2019).

In summary, the LBW and SBL as birth outcomes are associated with pre-pregnancy nutritional status and prematurity experienced by adolescent mothers (aged 13-20 years). It is necessary to improve adolescent knowledge about nutritional status needed before pregnancy, the importance of delaying pregnancy and how to maintain pregnancy to prevent prematurity. Therefore, health facilities need to improve access to maternal and child services related to adolescent pregnancy.

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CONFLICT OF INTEREST DISCLOSURE

We declare that there is no conflict of interest in the preparation of this manuscript.

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