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Association Between Maternal Factors and Neonate Anthropometry: A Retrospective Cross-Sectional Study

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ABSTRACT
Mother's nutritional status during pregnancy can affect fetal growth and development. This study aimed to analyse the association between maternal factors and neonate anthropometry. This retrospective cross-sectional study involved 155 mothers of 12-23 months old children, who lived in Surabaya City, Indonesia. The independent variables were the mother's nutritional behaviour, food belief, BMI, ANC visits, educational level, and monthly income. While the dependent were neonate's birth weight and length. Data were gathered from questionnaire and MCH Handbook. Data were analysed using chi-square (P<0.05). Mother's body mass index (p=0.003; C=0.235), antenatal care visits (p=0.014; C=0.193), and educational level (p=0.048; C=0.241) were associated with neonate's birth weight. Mother's monthly income associated with neonate's birth length (p=0.022; C=0.181). Mother's condition during pregnancy correlated with neonate anthropometry. Health promotion to promote regular antenatal care visits were needed to ensure mothers' nutrition, to support optimal fetal development.

Keywords: Maternal Nutrition, Food Belief, Socio-Demographic Status, Antenatal Care, Neonate Anthropometry

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BACKGROUND

Neonate anthropometry is a crucial indicator for evaluating the nutritional status and predicting early and late risk of child's health (Escartín et al., 2014). Low birth weight (LBW) and short stature still be a major health concern, especially in developing countries. It is frequently related to child morbidity and mortality (Chrisman et al., 2016). Maternal nutritional condition and behavior during pregnancy can affect fetal growth and development (Padonou et al., 2019).

Previous studies revealed maternal factors such as weight, height, and weight gain during pregnancy determine child's birth weight (Mahumud, Sultana, & Sarker, 2017). In developing countries, where poverty among reproductive aged women is prevalent, malnutrition is a common factor that can substantially affect the body size of neonates at all gestational ages (Prendergast & Humphrey, 2014). Other determinants of child's birth weight include: 1) maternal factors such as race and genetics; 2) paternal factors such as paternal height; 3) environmental factors such as attitude, nutrition, and exercises; 4) physiological factors such as altered glucose metabolism, haemoglobin concentration and microvascular integrity; 5) pathologic factors such as uterine malformations, gestational diabetes mellitus, and pre-eclampsia (Tabrizi & Saraswathi, 2012; Ugwa, 2015).

Although this topic is widely described in the literature, in Surabaya City, few data exist on the maternal nutritional and health behaviour during pregnancy, and no study has highlighted the associations with the anthropometric measures of neonate. So, this study was aimed to analyse the association between maternal factors and neonate anthropometry.

METHODS

This study was used a retrospective study design with a cross-sectional approach, which took place in Surabaya City, East Java, Indonesia. Six public health centers were selected (Mulyorejo, Klampis Ngasem, Tenggilis, Ketabang, Dupak, and Sememi). There were 155 mothers of 12-23 months old children living in that area who were involved as samples using the quota sampling technique.

The independent variables in this study consisted of 1) the mother's nutritional behaviour; 2) food belief; 3) body mass index (BMI); 4) antenatal care (ANC) visits; 5) educational level; and 6) monthly income. The mother's nutritional behaviour was assessed using a questionnaire to get information about the mother's nutrition and supplementation adequacy during their latest pregnancy (Fitriah, Supariasa, Riyadi, & Bakri, 2018; Kemenkes RI, 2014; Ramage et al., 2015). It was divided into two categories: 1) good; and 2) not good. The mother's food belief was assessed using a questionnaire compiled based on the concept of socio-cultural values in foods related to the incidence of stunting in toddlers, including food taboo, food belief, and prelacteal feeding during infancy (Illahi & Muniroh, 2018). It was categorized as good and not good. Mother's BMI was measured at the beginning of their latest pregnancy (at the time of the first examination, less than ten weeks of gestation). It was divided into two categories: 1) underweight (<18.5); and 2) normal (≥18.5) (Nishida et al., 2004). ANC visits were divided into two categories: regularly (≥4 times) and irregularly (<4 times) (Kemenkes RI, 2014). Retrospectively, data about mother's BMI and ANC visits were gathered from the Maternal and Child Health (MCH) Handbook. Mother's educational level was divided into five categories: illiterate, attended elementary school, attended junior high school, attended senior high school, and attended diploma/university or higher (Has et al., 2020; Kementrian Kesehatan RI, 2018). Monthly income was used to define household' wealth index. It was categorized as low (<regional

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minimum wage) and high (≥regional minimum wage), the regional minimum wage of Surabaya City by 2020 was 4.200.479,19 IDR.

The dependent variables in this study were neonate's birth anthropometry includes birth weight and length. Neonate's birth anthropometry was gathered from The Maternal and Child Health (MCH) Handbook. Neonate's birth weight was divided into two categories: 1) low (<2500 gr); 2) normal (≥2500 gr) (WHO, 2011). Neonate's birth length was divided into two categories: 1) short (<48 cm); 2) normal (≥48 cm) (Kemenkes RI, 2020).

Percentage was used to describe the study population characteristics. Bivariate analysis by using chi-square was conducted to analyse the correlation between maternal factors and neonate anthropometry. Statistical significance was set at the 95% confidence level (P<0.05).

Written informed consent was obtained from all participants. Each participant had the right to withdraw at any time during the study. This study's protocol was reviewed correctly and granted by the ethics committee of The Faculty of Nursing, Universitas Airlangga, Indonesia.

RESULTS

A total of 155 mothers of 12-23 months old children were enrolled in the study. Table 1 provides an overview of the maternal factors. More than half (51.6%) of mothers have good nutritional behaviour during pregnancy. Most mothers (84.5%) have a not good food belief related to stunting in toddlers. Mothers BMI at the early stage of their latest pregnancy mostly was normal (87.1%). Most mothers (87.7%) do ANC visits regularly during their latest pregnancy. Many of them had attended and graduated from senior high school (62.6%). Furthermore, more than a half of mothers (59.4%) have a low monthly income. Table 2 shown the neonates anthropometry, including birth weight and length. Most neonates have a normal birth weight (86.5%) and a normal birth length (80.0%).

Table 1 Maternal factors (n=155)

Factors	n	%
Nutritional behaviour during pregnancy		
Good	80	51.6
Not Good	75	48.4
Food belief		
Good	24	15.5
Not Good	131	84.5
BMI		
Normal	135	87.1
Underweight	20	12.9
ANC visits		
Regular	136	87.7
Irregular	19	12.3
Educational level		
Illiterate	1	0.6
Elementary school	18	11.6
Junior high school	15	9.7
Senior high school	97	62.6
Dip/University or higher	24	15.5

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Monthly income		
High	63	40.6
Low	92	59.4

Tabel 2 Neonate's anthropometry (n=155)

Anthropometry	n	%
Neonate's birth weight		
Normal	134	86.5
Low	21	13.5
Neonate's birth length		
Normal	124	80.0
Short	31	20.0

Table 3 The association between maternal factors and neonate's anthropometry

Maternal factors	Neonate's birth weight				Neonate's birth length			
	Normal		Low		Normal		Short	
	n	%	n	%	n	%	n	%
Nutritional behaviour during pregnancy								
Good	69		11		62		18	
Not good	65		10		62		13	
	(p=0.940; C=0.006)				(p=0.422; C=0.064)			
Food belief								
Good	21		3		20		4	
Not good	113		18		104		27	
	(p=0.870; C=0.013)				(p=0.657; C=0.036)			
BMI								
Normal	121		14		110		25	
Underweight	13		7		14		6	
	(p=0.003; C=0.235)				(p=0.231; C=0.096)			
ANC visits								
Regular	121		15		112		24	
Irregular	13		6		24		7	
	(p=0.014; C=0.193)				(p=0.050; C=0.155)			
Educational level								
Illiterate	1		0		1		0	
Elementary school	12		6		12		6	
Junior high school	13		2		11		4	
Senior high school	89		8		79		18	
Dip/Uni or higher	19		5		21		3	
	(p=0.048; C=0.241)				(p=0.457; C=0.151)			
Monthly income								
High	55		8		112		24	
Low	79		13		24		7	
	(p=0.798; C=0.021)				**(p=0.022; C=0.181)**			

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In the bivariate analysis by using chi-square, maternal factors that were **associated** with neonate's birth weight were mother's BMI (p=0.003; C=0.235), ANC visits (p=0.014; C=0.193), and educational level (p=0.048; C=0.241). Mother's BMI has a weak positive association with neonate's birth weight. With the increasing maternal BMI there was increase in the birth weight of a neonate. Mother's ANC visits have a very weak positive association with neonate's birth weight. As mother's performing ANC visits regularly, their neonate's tend to have a normal birth weight. Mother's educational level has a weak positive association with neonate's birth weight. The higher the mother's educational level, they deliver a neonate with normal birth weight. The maternal factors associated with neonate's birth length was the mother's monthly income (p=0.022; C=0.181). It has a very weak positive association with neonate's birth length. As mother's monthly income increases, they tend to have a neonate with normal birth length.

DISCUSSION

The present study was designed to analyse the association between maternal factors and neonate's birth anthropometry. The results revealed that mother's BMI, ANC visits, and educational level were associated with neonate's birth weight. While only the mother's monthly income associated significantly with neonate's birth length.

The study found that mother's BMI were associated with neonate's birth weight. Previous study has similar findings (He et al., 2018; Kader & Perera, 2014; Padonou et al., 2019; Ugwa, 2015). Pregnant women with normal weight gain gave birth to 3.3 kg babies, while pregnant women with low gestational weight gain gave birth to neonates with a lower mean birth weight of 2.5 kg (Tabrizi & Saraswathi, 2012). Study conducted in Spain also revealed that underweight women showed increased adjusted risk of low birth weight (LBW) babies (Galán et al., 2012). Mother's weight gain during pregnancy is one of modifiable factors influencing infant birth outcomes. Indeed, a low BMI and suboptimal weight gain during pregnancy are long-recognized risk factors of delivering a small for gestational age infant (Ota et al., 2011).

This study identified that as mothers performing ANC visits regularly, their babies born with a normal birth weight. This finding is similar with the result of other research (Acharya et al., 2018; Kader & Perera, 2014). Study in South Africa stated that mother who attend less than five ANC visits were 1.30 times at risk to have a LBW baby (Tshotetsi, Dzikiti, Hajison, & Feresu, 2019). ANC provides a series of medical check up for weight, height, gestational weight gain, hypertension, and related health conditions. It also provides nutritional education and counseling to reduce the incidence of LBW and adverse pregnancy conditions (Wado, Afework, & Hindin, 2014).

Mother's educational level significantly associated with neonate's birth weight. This result is consistent with the literature (Acharya et al., 2018; Silvestrin et al., 2013). The neonate's birth weight is greatly influenced by mother's level of education and having some kind of maternal education (oppose to no education), it has a protective effect against LBW. It is likely that women with less education may have less knowledge and practice poor health habits (e.g., smoking, drug or substance uses, etc.). Additionally they may be very poor and lacks access to adequate healthcare resources (e.g., antenatal care, iron supplements, etc.) which consequently may influence fetal growth (Kader & Perera, 2014).

This study mentioned that mother's monthly income significantly associated with neonate's birth length. Previous study revealed that there were no correlation between monthly income and neonate's birth length (Padonou et al., 2019). However, it is rational as

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mother with higher monthly income will have more access to healthy food and health checkup during pregnancy. So that, the fetal can grow optimally (Devakumar et al., 2018). In the other hand, mother from poor households were found to have a poor nutritional status before conception and insufficient weight gain during pregnancy. This situation lead to fetal growth deprivation (Has et al., 2020).

The study's limitation was the retrospective design, which used the mother's ability to remind their behaviour and health condition during the latest pregnancy. The cross-sectional approach also limits the ability to explore causation.

CONCLUSION

This study pointed out the importance of maternal health behaviour and health condition during pregnancy associated with neonate anthropometry. Maternal factors play a crucial point in the intergenerational cycle of malnutrition. A maternal nutritional condition during pregnancy, especially for those who belong to low socioeconomic status, requires serious attention, as correlated with neonate anthropometry. Health promotion strategies such as promoting antenatal care visits at all pregnancy stages were needed, to ensure mother's nutrition which support optimal fetal development.

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CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the research, authorship, and publication of this paper.

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