CHARACTERISTICS ENERGY, AND PROTEIN INTAKE OF PREGNANT WOMEN DURING THE COVID-19 PANDEMIC AND ITS RELATION WITH INFANT BIRTH WEIGHT

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ABSTRACT

The COVID-19 pandemic is an outbreak that has a risk of a food crisis and changes in diet that have an impact on the nutritional status of pregnant women and babies. This study was aimed to analyze the relationship between the characteristics of pregnant women in the third trimester and food intake during the COVID-19 pandemic with birth weight. This research used cross-sectional method with a sample of 91 third trimester pregnant women at the Pundong and Bantul 1 Community Health Centers, Bantul Regency, Yogyakarta, which were randomly selected. The data was collected using a questionnaire. The nutritional status was measured based on MUAC (Mid Upper Arm Circumference), food consumption was measured using SQFF (Semi-Quantitative Food Frequency) questionnaire, and birth weight was measured using a digital weight scale with an accuracy of 0.1 kg. Bivariate analysis was done using Fisher-Exact with 95% CI. The results showed that the characteristics of pregnant women in the third trimester such as education, income, occupation, and disease history had no relationship with birth weight; gestational age ($p = 0.007$) and nutritional status ($p = 0.002$) had a relationship with birth weight; energy intake had no relationship while protein had a relationship with birth weight ($p = 0.001$). The conclusion is that gestational age, nutritional status, and protein intake have a relationship with birth weight during the COVID-19 pandemic. Therefore, pregnant women should always pay attention to food intake and carry out regular pregnancy checks to health services to detect early abnormalities to prevent low birth weight**.**

Keywords: gestational age, nutritional status, protein, birth weight, COVID-19

INTRODUCTION

The COVID-19 pandemic has significantly increased food insecurity in the community which causes serious nutritional problems (Pedroso et al., 2020). As a result, there is a change in individual eating patterns and poor nutritional status (Naja & Hamadeh, 2020). This pandemic is projected to severely impact food security, nutrition, and health, especially for vulnerable groups including children, pregnant, and lactating mothers (Roberton et al., 2020). During the COVID-19 pandemic, the health of pregnant women, newborns, and children is a major concern as they are at a high risk of health problems (Roberton et al., 2020).

Changes in nutritional status during the pandemic in pregnant women can occur such as mid-upper arm circumference (MUAC) indicator (Huizar et al., 2021; Mehta, 2020). MUAC presents the state of muscle tissue and fat layer under the skin and reflects the growth of fat tissue and muscle. It is used for screening chronic energy shortage in pregnant women with the risk of low birth weight (LBW) (Harjatmo et al., 2017).

Nutritional status can be influenced by nutritional intake; if it is not balanced, there will be a nutritional deficiency, which will result in poor nutritional status (Khasanah 2020). LBW in infants can occur because of a lack of energy and protein intake during pregnancy (Irbianto & Wahyuningsih, 2012).

Protein functions in the formation of enzymes in metabolic processes and maintains cells and body tissues (Amrang et al., 2020). If there is a lack of protein and energy intake during pregnancy, it will affect fetal growth and development (Kartikasari et al., 2011) and the mother is at risk of disease complications such as anemia, bleeding, infectious diseases, and LBW (Rukmana & Kartasurya, 2014).

According to The Indonesian Basic Health Survey (RISKESDAS) data, the prevalence of LBW in 2013 was 5.7% and increased in 2018

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to 6.2% (Kemenkes, 2013; Kemenkes, 2018). In 184 countries, preterm births range from 5% to 18% of babies born. In Indonesia, premature birth is ranked 5th worldwide (WHO, 2012). It is estimated that around 15 million babies are born prematurely with one million deaths per year due to complications of preterm birth. This incidence accounts for 80% in between 32 and 37 weeks of gestation (Lawn et al., 2013). In 2015, about 5 - 9 million deaths of children under 5 years, and about 2--7 million occurred in the neonatal period. Babies born prematurely are at a high risk of infection and death (Liu et al., 2016).

Based on the data from the Bantul Health Office in 2019, there were infant deaths due to LBW. The highest death cases in Bantul Regency were 110 while maternal death in 2019 accounted for 13 cases (Dinas kesehatan Kabupaten Bantul, 2020; Profil Kesehatan DIY, 2020). A study revealed that babies with low weight are 6.16 times more at risk of stunting (Supriyanto et al., 2017).

The importance of this research is to determine the relationship between the characteristics of third-trimester pregnant women and food intake during the COVID-19 pandemic with LBW, and it is expected to provide the latest information on health and nutrition developments in several regions in Indonesia during the COVID-19 pandemic.

METHODS

This study used a cross-sectional design, conducted in two working areas of Pundong and Bantul 1 Community Health Centers, Bantul Regency, Yogyakarta. The population in this study was 12,983 pregnant women in Bantul Regency and obtained from each of two Community Health Centers, namely 130 pregnant women in the third trimester.

The minimum sample calculated using Lemeshow's formula (1997) was 83 respondents added by 10%, resulting in 91 respondents. Furthermore, the respondents were divided according to the proportions for each community health center using proportional random sampling to determine each sample representing two health centers. The minimum sample size was calculated using Lemeshow's formula.

$$n = \frac{Z^{2}\,1-\alpha/2xp(1-P)xN}{d^{2}\,(N-1)+Z^{2}\,1-\alpha/2xp\,(1-P)}$$

Remark:
n = Number of subjects
N = Number of populations
P = Proportion from previous research
Z^2 = Degree of confidence of 95% and Z = 1.96
D = Desired precision of 10%

The respondents were pregnant women in the third trimester with births during the COVID-19 pandemic. The characteristics of maternal income was categorized based on national income, which is, high economy (> Rp2,017,664) and low economy (< Rp2,017,664). The occupation was divided into working and not working. The birth age was divided into two categories, ≥ 37 weeks and < 37 weeks, and maternal disease history was divided into with disease history and without disease history. The data was obtained by using questionnaires or structured interviews. Furthermore, the nutritional status of pregnant women was determined based on MUAC (Mid-Upper Arm Circumference) using the MUAC tape with the categories of normal (≥ 23.5 cm) and low (< 23.5 cm); food consumption data were collected using the SQFF (Semi-Quantitative Food Frequency) by asking 10 questions about their food intake for the past 3 consisting of staple foods, animal side dishes, vegetable side dishes, vegetables, fruits, oils, processed foods, beverages, supplements and more. The data were then categorized into the good intake (80--100% RDA), less intake (< 80% RDA), and excess intake (> 110% RDA) using interviews. Birth weight data was obtained by measuring the baby's weight using a digital scale with an accuracy of 0.1 kg with a normal category of ≥ 2,500 and low < 2,500. All datas were tested using univariate and bivariate tests before being analyzed descriptively and statistically. Univariate analysis was conducted to determine the frequency distribution of the variables while bivariate analysis was used to determine the relationships between research variables using Fisher-Exact analysis with 95% CI and 0.05 alpha. This study has received approval from the Ethics Commission of Universitas Alma Ata Yogyakarta, which was issued on May 5, 2021, number KE/AA/V/0442/EC/2021.

RESULTS AND DISCUSSION

The characteristics of pregnant women in the third trimester include general conditions including education, income, occupation, disease history, and gestational age.

Table 1 shows that, from the education category, the research subjects are mostly high-educated, 64% of whom have low income, and 60.4% of the respondents are not working. 30.8% of the respondents had a disease history, and most of them (91.2%) were at term. Of 91 newborns, 11 babies (12.1%) had LBW.

Table 2 shows that, of the 91 research respondents, 10 (13.2%) had less energy intake, 69 (75.8%) had sufficient energy intake, and 10 (11%) had more energy intake, while 11 (12.1%) had a lack of protein intake. 69 respondents (75.8%) had adequate protein intake, and 11 respondents (12.2%) had more protein intake.

Table 3 shows that maternal education does not have a relationship with birth weight (p = 0.297). This depends on the form of awareness to carry out pregnancy checks, facilities, and health workers. Although mothers with low education also receive services and are more likely to have curiosity, they still need education to overcome the problems that arise. Therefore, there is no fundamental difference between mothers who have high education and those with low education (Afrida 2019). The level of education is correlated with a person's knowledge. People with higher education can have better knowledge about health (Notoatmodjo, 2012). However, based on the literature, maternal educational level is not

Table 2. Energy and Protein Intake of Third-Trimester Pregnant Women

Nutritional Intake	Nutrients			
	Energy		Protein	
	n	%	n	%
Insufficient Intake	12	13.2	11	12.1
Sufficient Intake	69	75.8	69	75.8
Excessive Intake	10	11	11	12.1
Total	91	100	91	100

Table 1. Characteristics of Research Variables

Characteristics of	Subjects (n=91)	
	n	%
Education		
Low (not studying, elementary school, junior high school)	9	9.9
High (Senior High School, College)	82	90.1
Income		
Low Rp2,017,664	32	35.2
High Rp2,017,664	59	64.8
Occupation		
Not Working	55	60.4
Working	36	39.6
Disease History		
No	63	69.2
Yes	28	30.8
Gestational age		
Insufficient Month (< 37 weeks)	8	8.8
Sufficient Month (≥ 37 weeks)	83	91.2
Nutritional status		
Low (UAC < 23.5 cm)	20	22
Normal (UAC ≥ 23.5 cm)	71	78
Birth weight		
Low <2500	11	12.1
Normal ≥ 2500	80	87.9

Table 3. Relationship Between Maternal Characteristics and Birth Weight

Characteristics	Birth Weight		p-value	OR
	Low	Normal		
Education				
Low (not studying, elementary school, junior high school)	2 (22.2%)	7 (77.8%)	0.297	2,317
High (Senior High School, College)	9 (11%)	73 (89%)		
Income				
Low Rp2,017,664	4 (12.5%)	28 (87.5%)	1.000	1.061
high Rp2,017,664	7 (11.9%)	52 (88.1%)		
Occupation				
Not Working	5 (9.1%)	50 (90.9%)	0.223	0.500
working	6 (16.7%)	30 (83.3%)		
Disease History				
No	7 (11.1%)	56 (88.9%)	0.454	0.750
Yes	4 (14.3%)	24 (85.7%)		
Gestational age				
Insufficient Month (< 37 weeks)	4 (50%)	4 (50%)	0.007	10,857
Sufficient Month (≥ 37 weeks)	7 (8.4%)	76 (91.6%)		
Nutritional status				
Low (UAC < 23.5 cm)	7 (35%)	13 (65%)	0.002	9.019
Normal (UAC ≥ 23.5 cm)	4 (5.6%)	67 (94.4%)		

necessarily correlated with birth weight because it does not always imply good knowledge about health (Mahayana et al., 2015). This study is not in line with the research conducted by Gage et al. (2013) which suggested that the educational level of Mexican pregnant women influenced their births**.** Lack of nutritional behavior in pregnant women tended to result in poor eating patterns during pregnancy (Sumiyarsi et al., 2018).

Family income can affect the nutritional status of children at birth (Mahmoodi et al., 2013). Family income showed no relationship with birth weight (p = 1.000). This study was in line with the research of Aghadiati et al. (2019) which concluded that there was no relationship between income and birth weight, but this result contradicts the results of Illahi (2017), research which stated that there was a relationship between family income and infant nutritional status. Low income is one of the risk factors for stunting due to LBW (Chandra, 2013). The quality and quantity of the food we eat, including access to good quality food, is supported by income as a determining factor. Food insecurity in the family occurs due to low income, making them unable to access safe food in terms of quality and quantity (Fikawati, 2013). The COVID-19 pandemic has changed the world's socioeconomic order, starting from the education, health, food, and income sectors (Nicola et al., 2020). Low income in a household affects the ability to obtain food (Pechey & Monsivais, 2016). A study conducted by Chiwona-Karltun *et al.* (2021) from qualitative data collected from 12 countries in South Sahara revealed that the lockdown policy during the COVID-19 pandemic resulted in decreased income, disturbed household food security, and other health problems.

In this study, the occupation did not have a relationship with birth weight (p = 0.223). This result was in line with Salawati, (2012) research that there was no significant relationship between the work of pregnant women and LBW because there are several factors that are not considered, such as the type of mother's work without considering the mother's daily physical activity. Like mothers who have working hours, the intensity of the mother's work during pregnancy can cause stress and cannot rest which ultimately affects her fetus (Kouis et al., 2018), leading to LBW (Mahmoodi et al., 2015).

In this study, there was no relationship between maternal history and birth weight (p = 0.454). Disease history such as high blood pressure, diabetes mellitus, and anemia can occur

in pregnant women, but it may be influenced by health care factors after delivery, income, and nutritional intake. This is as explained in a study conducted by Maulinda et al., (2021) that women who are of sufficient age, good nutritional status, optimal nutritional intake, and routine antenatal care (ANC) visits are very likely to give birth to normal babies even though they have childbirth complications. Pregnant women who always carry out prenatal care are very good at preventing complications and detecting complications early so that they can be prevented to avoid the impact on the fetus and pregnant women (Manurung dan Helda 2020). This study is contrary to what was done by Indrasari, (2012). Her analysis showed a relationship between disease history and the incidence of low birth weight (LBW). Maternal disease history and other disease factors can influence the occurrence of LBW babies (Hashash and Kane, 2015; Wahyuningrum et al., 2016). Several diseases such as anemia, hypertension, preeclampsia, eclampsia, bladder infections, and colitis during pregnancy can cause LBW in infants (Hashash and Kane, 2015; Wahyuningrum et al., 2016).

The nutritional status of pregnant women based on MUAC showed that there was a relationship with birth weight (p = 0.002). This result was supported by a research conducted by Maulidiyah (2012), who found that nutritional status based on UAC has a significant relationship with birth weight. Pregnant women who experience PED (Protein Energy Deficiency) will be more at risk of giving birth to an abnormal weight baby and, vice versa, If the nutritional status is good, they will give birth to babies of normal weight (Rukmana & Kartasurya, 2014).

The nutritional status of pregnant women plays an important role in fetal growth and development as the result of the metabolism of food consumed, absorbed, both from macronutrients and micronutrients. In other words, nutritional status determines the quality of babies born (Kartikasari et al., 2011). The poor nutritional status of the mother before and during pregnancy may lead to LBW (Sinta et al., 2017). Therefore, pregnant women who experience PED will be more at risk of giving birth to obese babies (Rukmana & Kartasurya, 2014).

The COVID-19 pandemic has the potential to increase the prevalence of malnutrition in pregnant women which will have an impact on the health status of the fetus (UNICEF, 2020).

Table 4 shows that there is no relationship between energy intake during the COVID-19 pandemic and birth weight (p = 0.872). Pregnant women have low energy intake with LBW 2 (16.7%) and sufficient energy intake with LBW 8 (11.6%). This study is the same as the research conducted by Pratiwi, Rahfiludin, and Aruben, (2017) who have similar results. This is caused by many factors including the physiological changes of pregnancy, pathological conditions, nutritional needs, and physical activity of the mother during pregnancy (Tzanetakou 2011). The other factors are low socioeconomic, low education levels, and changes in increasing adherence to dietary patterns during pregnancy (Usrina et al. 2021). However, these results are not in line with the research conducted by Irbianto & Wahyuningsih, (2012) showing a relationship between energy intake and birth weight. Insufficient energy intake during pregnancy can inhibit fetal growth and pose a risk for LBW. Nutrients are energy sources that

Table 4. The Relationship Between Energy and Protein Intake With Birth Weight

Variable	Birth Weight		Total	p-value
	Low	Normal		
Energy Intake				
Insufficient Intake	2 (16.7%)	10 (83.3%)		
Sufficient Intake	8 (11.6%)	61 (60.7)	100%	0.872
Excessive Intake	1 (10%)	9 (90%)		
Protein intake				
Insufficient Intake	6 (54.5%)	5 (45.5%)		
Sufficient Intake	3 (4.3%)	66 (95.7%)	100%	0.001
Excessive Intake	2 (18.2%)	9 (81.8%)		

act as a circulator and protein synthesizers that support physical activity and body metabolism (Mahayana, Chundrayetti dan Yulistini, 2015). Based on the research of Abadi & Putri, (2020), there was a lack of macronutrient intake during the COVID-19 pandemic.

Protein intake in pregnant women during the COVID-19 pandemic had a relationship with LBW ($p = 0.001$). Pregnant women with low protein intake are at risk of LBW 6 (54.5%) while those with adequate protein intake may experience LBW 3 (4.3%). The results of this study were proven by Najpaverova et al. (2020) who explained that protein intake during pregnancy provides benefits for fetal growth and development. Protein intake is very helpful in the process of fetal growth during pregnancy. Deficit of protein intake during pregnancy results in stunted fetal growth leading to LBW as well as excess nutrition because energy and protein intake can also inhibit the placenta and increase the risk of fetal death (Fenton et al., 2020).

Protein is a major determinant in the survival, growth, and development of the embryo. Protein functions in pregnant women are important for metabolism, cell function, and fetal formation, altering gene expression in the fetal genome and being precursors for the synthesis of molecules (e.g., nitric oxide, polyamines, and creatine) with cell signaling and metabolic function. L-arginine (Arg) is important during pregnancy for the growth and development of the conceptus (Herring et al. 2018). In addition, the baby's birth weight is also influenced by the hypertrophy and maturation phase. The baby's body becomes 2 times longer, and his weight increases to 3-4 times from the previous weight (Manuaba, 2010)

CONCLUSION

This study found that several factors, including birth age, maternal nutritional status, and protein intake of third trimester pregnant women has a correlation with child birth weight. Mother who had insufficient gestational age (<37 weeks), low MUAC, and low protein intake has a higher risk to have low birth weight infant.

Pregnant women should always pay attention to food intake and carry out regular prenatal check-ups to health services for early detection of abnormalities so that they can be addressed as quickly as possible to prevent the occurrence of LBW. It is also hoped that various parties across sectors and health services will continue to pay attention to the health of pregnant women during the COVID-19 pandemic so that maternal and child health problems can be overcome.

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