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THE SOCIO-ECONOMIC EFFECT OF BREAST MILK MACRONUTRIENT CONTENT ON UNDER WEIGHT INFANTS AGED 0-6 MONTHS

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ABSTRACT

Prevalence of exclusive breastfeeding program has inclined for the last three years, although prevalence of underweight infants has been rising at the same time. Social economical factor has become a substantial factor of family's food reserve. Breast milk is a baby's primary source of macronutrient which contains of carbohydrate, fat, and protein. The research objective was to analyze socio-economic factor on breast milk macronutrient content on the under weight infant aged 0-6 months. The research applied quantitative case-control which was administered in Kotakulon, Wringin and Ijen Public Health Center, Bondowoso Regency, Indonesia on June until August 2021. The research samples were 30 respondents (10 people as treatment group and 20 people as control group). Sample analysis of breast milk used luff school (carbohydrates of breast milk), babcock (fat of breast milk), and Kjedahl (protein of breast milk). Statistical analysis used multiple linier regressions with intervening variable. Most of underweight infants were from mothers with low educational background (elementary, secondary) and earned under the minimum regional wage, meanwhile those infants who had normal body mass had mothers with fair educational background (senior high school) and earned above minimum regional wage. There was significant macronutrient content of breast milk on the underweight infants aged 0-6 months (carbohydrate $p = 0,045$; fat $p = 0,033$; protein $p = 0,005$). Mother's educational background and family's income were the substantial factor of how breast milk macronutrient content affected on the below body mass of infants age 0-6 months.

KEYWORDS: Breast milk macronutrient, Mother's Education, Family's Income, Infant's Body Mass.

INTRODUCTION

The breastfeeding program in Indonesia has been implemented since 1990, yet there has been increasing numbers of annual prevalence of infant malnutrition. It consequently contributes to the infant mortality. Malnutrition, by the time goes on, will become a factor of underrated human quality resources. During the first 1000 days of human's life, a vast growth and development happens. At this time, human's infants are susceptible to health and nutrition issues, so they are much dependent on the best quality and quantity of nutrition. Any kind of malnutrition is possible defecting their intelligence and productivity. Exclusive breastfeeding for the first six months of life is crucial for infants (Andyarini, 2017).

The Indonesian Demographic and Health Survey in 2020 showed that those infants who were provided with exclusive breastfeeding reached the percentage only (69.62%), even though the target was 80%. District or city data showed that the coverage of infants who were exclusively breastfed in East Java in 2020 was 66.90% (BPS, 2020). The exclusive breastfeeding program in Bondowoso Regency in 2018, 2019 and 2020 was 56%, 68%, and 73.2%, meaning that there was accelerating numbers of breastfeeding coverage each year, yet it was still less than the expected target of 80%. The exclusive breastfeeding program aims to reduce nutritional problems, especially malnutrition in infants.

The prevalence of malnourished infants aged 0-23 months in Indonesia in 2016 was (13.58%), that in 2017 was (12.40%), and that in 2018 was (15.20%). East Java

prevalence rates for malnourished infants aged 0-23 months in 2016 was (14.88%), that in 2017 was (14.80%), and that in 2018 was (15.20%) (BPS, 2020b). The prevalence of malnutrition in infants by weight per age in Bondowoso Regency in 2018, 2019 and 2020 was 3.9%, 7.6% and 8.2% respectively. It can be seen that a number of prevalence of malnutrition in infants increased. The national revolutionary endeavor to increase breastfeeding was announced on December 22, 1990 by President Soeharto, on the 62nd Mother's Day Anniversary. Indonesian communities have been carrying on the program to improve the state quality, yet the malnutrition cases of infants have still been scaling up. The compliance of macronutrient nutrition during breastfeeding is adequately able to suppress malnutrition of infants.

Breast milk is liquid containing complex substances that are highly recommended for infant for its benefits. In the early stages of life, an infant requires special nutritional needs to maintain its health and to promote its growth and development. Infant absorbs abundant of energy mostly from glucose due to the transformation of lactose contained in breast milk. Breast milk also contains long-chain double proteins, decosahexanoic acid (DHA) and arachidonic acid (ARA). Breast milk contains protein, especially essential amino acids. It also contains enzymes, hormones, growth factors and body defenses. During its initial life, breast milk is the finest source of nutrition for infants that must be fulfilled in the right amount of energy and nutrients. The content of these macronutrients is influenced by many factors including pregnancy, lactation stage, body mass index, maternal parity, maternal diet and techniques in pumping breast milk (Leke et al., 2019).

Rochow, et al (2020) investigated the impact of fortification on growth and metabolism of preterm infants by adjusting breast milk macronutrients. The control group received standard fortification and the intervention group received standard fortification targets by adding modular protein, fat and carbohydrates. As a result, infants in the intervention group had higher macronutrient intake and increased infant weight. Infants in the intervention group from mothers with below-average breast milk protein content showed a large influence on body weight, length, head circumference, fat and food intolerance was less frequent.

Regulation of the Minister of Health of the Republic of Indonesia number 28 of 2019 concerning the recommended nutritional adequacy rate for the Indonesian people, to create healthy life of Indonesia, nutritional intake is essentially required based on the recommended nutritional adequacy rate. In the Article 3, concerning the nutritional adequacy rate, it is used at the level of consumption including the adequacy of energy, protein, fat, carbohydrates, fiber, water, vitamins and minerals (Permenkes RI, 2019). The fulfillment of this nutritional adequacy rate greatly impacts the nutritional status of mothers and babies.

Malnutrition is a risk factor for infant mortality. The infant mortality factors due to macronutrient and micronutrient deficiencies are associated with an increased risk of infant mortality. It is due to decreased disease which are caused by underweight infants due to suboptimal breastfeeding, diseases due to chronic factors, such as low body mass index and low diet of fruits and vegetables, nutritional deficiencies in mothers, underweight newborn babies, low family's income, mother's education affecting the food intake and health behavior in raising the babies. The major factors causing under nutrition in infants are nutritional intake and disease. These factors are also generated by economic factors relating to family's food system. Low income households are disposed for having less ability to acquire healthy food, especially when the food prices are rising; it puts infants at greater risk of malnutrition. In rural and urban households in recent years, food stocks have consumed the three-fourths of the total income causing households irresistible with economic shocks such as rising food prices (Ramokolo et al., 2018).

Riskesdas (2018), Bondowoso is a district that has the 4th highest number of malnutrition and low nutrition cases in East Java Province, especially in Bondowoso that the low nutrition cases have accelerated in the last three years. Bondowoso Regency also has the 1st highest stunting case in East Java Province (Kemenkes RI, 2018). The malnutrition program has not been optimal since infancy can lead to other nutritional problems, especially stunting; because stunting occurs due to inadequate nutrition in a relatively long period of time. There must be an equality between nutrients intake and needs for optimal health, especially for mothers during breastfeeding. Breastfeeding is a precious period for both the mother and the baby. Therefore, it is important to analyze the macronutrient content of breast milk in breastfeeding mothers against underweight in infants so that they can determine future promotive and preventive actions.

METHOD

This research was a quantitative case-control research aimed to discover the effect between (health condition or disease) with risk factors. The research design was used to assess the role of risk factors in the incidence of disease (cause-effect relationship). This research was conducted in Kotakulon, Wringin, and Ijen Public Health Center. These three public health services have different geographical locations; Kotakulon Public Health Center located in central town with an altitude of 253 meters above sea level (lowlands), the Wringin Public Health Center located in a coastal border area with an altitude of 502 meters above sea level (moderate plains), Ijen Public Health Center located in higher land with an altitude of 1,130 meters above sea level (highlands). This research was conducted from Juni to August 2021. The sampling

technique was determined by using the minimum sample size formula in each experimental group of 10 respondents (underweight group) and 20 control group respondents (normal weight) with a ratio of 1:2. The sampling technique was non-probability sampling using purposive sampling.

Data collection techniques in the form of:
a) Breast milk sampling
The sample collecting time was accommodated by nutritionists and village midwife officers, was at 19.00 WIB after dinner, due to the low body's basal metabolic rate. Then the breast milk was stored in the freezer until the following morning, then was sent to the laboratory of the Jember State Polytechnic. The delivery was carried out using the cooler bag provided and taken to the laboratory no more than 1 hour away. Previous researchers had coordinated with laboratory experts. Laboratory test analysis used luff school method to test carbohydrate analysis, babcock to test fat analysis, kjeldahl to test protein analysis.

b) Filling out the Questionnaire
Filling out a questionnaire was to find out mother's education, family's income and infant's date of birth.

c) Baby Weight Measurement
It used an infant digital scale with the GEA brand that had been calibrated at the Jember University Calibration Laboratory with a certificate number 077/Te/04/2020. Then the weight and age of infants were calculated to get the z-score value to determine their nutritional status.

Data analysis used multiple linear regressions with the mediator variable (intervening variable). The education variable used an ordinal data scale which was transformed using the Method of Successive Interval (MSI). Ethical Clearance of the research had received permission from the ethical committee approval with no. 1220/UN25.8/KEPK/DL/2021 on 10th May 2021 from The Ethical Committee Of Medical Research Faculty of Dentistry, University of Jember, under perquisites that were complied with the applicable health protocols mandated by the Decree of Health Minister of the Republic of Indonesia Number HK.01.07/MENKES/382/ 2020 concerning health protocols in public places and facilities as an attempt of preventing and controlling the 2019 corona virus disease (covid-19).

RESULTS

1. Univariat Analysis
Table 1. Breast Milk Macronutrient Content-based Respondents in Kotakulon, Wringin, and Ijen Public Health Center, Bondowoso Regency.

Respondent	Under Weight Infant		Normal Weight Infant		Total	
	n	%	n	%	n	%
Breast Milk Carbohydrate Content						
Less < 7,0 g/100 ml	10	100	20	100	30	100
Fair ³ 7,0 g/100 ml	0	0	0	0	0	0
Minimum	6,70 g/100 ml		6,40 g/100 ml		6,40 g/100 ml	
Maximum	6,80 g/100 ml		6,75 g/100 ml		6,80 g/100 ml	
Average	6.74 g/100 ml		6,53 g/100 ml		6.60 g/100 ml	
Breast Milk Fat Content						
Less < 3,2 g/100 ml	9	90	3	15	12	40
Fair ³ 3,2 g/100 ml	1	10	17	85	18	60
Minimum	2,75 g/100 ml		2,85 g/100 ml		2,75 g/100 ml	
Maximum	3,20 g/100 ml		3,60 g/100 ml		3,60 g/100 ml	
Average	2,90g/100 ml		3,20 g/100 ml		3,15 g/100 ml	
Breast Milk Protein Content						
Less < 1,5 g/100 ml	10	100	18	90	28	93,3
Fair ³ 1,5 g/100 ml	0	0	2	10	2	6,7
Minimum	1,12 g/100 ml		1,27 g/100 ml		1,12 g/100 ml	
Maximum	1,28 g/100 ml		1,51 g/100 ml		1,51 g/100 ml	
Average	1,22 g/100 ml		1,41 g/100 ml		1,35 g/100 ml	

Based on Table 1, It shows the respondents according to breast milk macronutrient content in Kotakulon, Wringin and Ijen Public Health Center. Some of underweight Infants had mothers with less breast milk macronutrient content, while the normal weight infants had mothers with fair breast milk macronutrient content.

Table 2: Distribution of Respondent Frequency According to Socio-economic in Kotakulon, Wringin, and Ijen Public Health Center, Bondowoso Regency.

Respondent	Under Weight Infant		Normal Weight Infant		Total	
	n	%	n	%	n	%
Mother's Education						
Low = Elementary, Secondary	10	100	1	5	11	36,7
Fair = Senior high/Vocational	0	0	10	50	10	33,3
High = Diploma 3, Diploma 4, Bachelor	0	0	9	45	9	30
Minimum	Elementary		Elementary		Elementary	
Maximum	Elementary		Bachelor		Bachelor	
Average	Elementary		Senior high/ Vocational		Elementary	
Family's Income						
Under UMK= < Rp. 1.954.705	10	100	6	30	16	53,3
Above UMK = ≥ Rp. 1.954.705	0	0	14	70	14	46,7
Minimum	Rp. 500.000		Rp. 1.000.000		Rp. 500.000	
Maximum	Rp. 1.300.000		Rp. 3.000.000		Rp. 3.000.000	
Average	Rp. 745.000		Rp. 2.080.000		Rp. 1.675.000	

*UMK *(Upah Minimum Kabupaten)* = Regional Minimum Wages

Based on Table 2, It shows socio-economic respondents in Kotakulon, Wringin, and Ijen Public Health Center. Most of underweight infants have mothers with low education level and under UMK income, while those normal weight infants have mothers with fair education level and above UMK income.

2.   Multivariate
Table 3: Analysis of Breast milk Macronutrient Content on Underweight Infants Aged 0-6 Months with Multiple Linier Regression.

Variable	Under weight		Normal Weight		*P-Value*
	n	%	n	%	
Carbohydrate Content Less = <7,0 g/100 ml	10	100	20	100	*0,041**
Fair = ≥7,0 g/100 ml	0	0	0	0	
Fat Content Less = <3,2 g/100 ml	9	90	3	15	*0,029**
Fair = ≥3,2 g/100 ml	1	10	17	85	
Protein Content Less = <1,5 g/100 ml	10	100	18	90	*0,007**
Fair = ≥1,5 g/100 ml	0	0	2	10	

*Significant if the $p < \alpha$ (0,05)

Based on Table 3, it shows that some of under weight infants have mothers with low breast milk macronutrient content and normal weight infants have mothers with fair breast milk macronutrient content. According to multiple linier regression test result, it was found that significance value was less than $\alpha=0,05$, so it can be concluded that there was significant effect between the breast milk macronutrient content with the infant's weight.

b) Mother's Education
Table 4: Analysis of Education as Mediator of Breast milk Macronutrient Content on The Under Weight Infants Aged 0-6 Months with Multiple Linier Regression.

Variable	Mother's Education						*P-Value*
	Low		Medium		High		
	n	%	n	%	n	%	
Carbohydrate Content Less:<7,0 g/100 ml	16	53,3	10	33,3	9	30	*0,002**
Fair:≥7,0 g/100 ml	0	0	0	0	0	0	
Fat Content Less:<3,2 g/100 ml	9	30	3	10	0	0	*0,006**

Fair:≥3,2 g/100 ml	2	6,7	7	23,3	9	30	
Protein Content Less:<1,5g/100 ml Fair: ≥1,5 g/100 ml	11 0	36,7 0	10 0	33,3 0	7 2	23,3 6,7	*0,025*
Infant's weight Less : <-2 SD to -3 SD Normal : -2 SD to 2 SD	10 1	33,3 3,3	0 10	0 33,3	0 9	0 30	*0,028*

*Significant if the p < α (0,05)

Based on Table 4, it shows some of mothers with low education and less breast milk macronutrient content and under weight infants. According to multiple linier regression test result, it was found that significance value was less than α = 0,05, so it can be concluded that education played as a mediator of breast milk macronutrient content on infant's weight.

c) Family's Income
Table 5: Income as a Mediator of Breast milk Macronutrient Content on Infant's Weight Aged 0-6 Months.

Variable	Family's Income				P-Value
	Under UMK		Above UMK		
	n	%	n	%	
Carbohydrate Content Less:<7,0 g/100ml Fair: ≥ 7,0 g/100ml	16 0	53,3 0	14 0	46,7 0	*0,013*
Fat Content Less: < 3,2 g/100ml Fair: ≥ 3,2 g/100ml	10 6	33,3 20	2 12	6,7 40	*0,019*
Proteint Content Less: <1,5 g/100ml Fair: ≥1,5 g/100ml	16 0	53,3 0	12 2	40 6,7	*0,013*
Infant's Body Mass Less : <-2 SD to -3 SD Normal : -2 SD to 2 SD	10 6	33,3 20	0 14	0 46,7	*0,046*

Description
UMK: *(Upah Minimum Kabupaten/Kota)* = Regional Minimum Wages
SD: Standar Deviasi
*Significant if the p < α (0,05)

Based on Table 5, it shows that most of the mothers with under UMK income relate to less carbohydrate content and less protein content, meanwhile, some mothers with above UMK income relate to fair fat content and normal weight infants. According to multiple linier regression test result, it was found that significant value was less than α = 0,05, so it can be concluded that family's income played as a mediator of breast milk macronutrient content on infant's weight.

DISCUSSION

1. Effect of breast milk macronutrient content on under weight infants aged 0-6 months in the Kotakulon, Wringin and Ijen Public Health Centers, Bondowoso Regency

The findings of this research indicated that most infants with low body weight had less breast milk carbohydrate content < 7.0 g/100 ml; breast milk the fat content was less than <3.2 g/100 ml and breast milk protein content was less than 1.5 g/100 ml; while infants with normal weight had less breast milk carbohydrate content < 7.0 g/100 ml; The breast milk fat content was sufficient 3.2 g/100 ml and the protein content was less than 1.5 g/100 ml. The findings of the multiple linear regression statistical test showed p-value = 0.041 on the carbohydrate content; 0.029 in the fat content and 0.007 in the protein content, indicating that there was an effect of breast milk macronutrient content on under weight infants aged 0-6 months in the Kotakulon, Wringin and Ijen Public Health Center, Bondowoso Regency.

The standard carbohydrate content was 7.0 grams per 100 ml, fat content was 3.2 grams per 100 ml and protein content was 1.5 grams per 100 ml (Kemenkes RI, 2018). According to the research results, the average carbohydrate content was 6.6 g/100 ml, fat content was 3.15 g/100 ml and protein content was 1.35 g/100 ml. Compared to several previous studies, Martini et al., (2020), the sample of breast milk in the present research had lower fat and protein content; which were 3.25 g/100 ml fat and 1.81 g/100 ml protein. This was because the samples used under weight and normal weight infants while in Martini et al.'s (2020) research the sample used infants aged 1-3 months and assessed the macronutrient levels of and the growth of their babies. The results showed that there was a correlation between macronutrient levels in breast milk on infant's growth,

total calories and protein correlated with infant head circumference, but lactose and fat did not correlate with infant body weight and length.

The research of Burianova et al., (2019) explained that a research conducted for 6 weeks on mothers having preterm babies with an average macronutrient content of breast; carbohydrates 6.7 g/100 ml, breast milk fat 3.8 g/100 ml and breast milk protein 1.1 g/100 ml. The findings of the significance of the breast milk macronutrient content on maternal body mass index, parity and smoking habits from the results of this research were important to have a strategy in macronutrient intake in preterm infants. Nutrient deficiency leaded to poor growth. Impact of target on infant growth and metabolism by adjusting breast milk macronutrients. Infants in the intervention group had higher breast milk macronutrient intake, weight gain and length of the baby. Target fortification of low macronutrient breast milk was to improve nutritional quality and growth in infants (Rochow et al., 2020).

This research concluded that it was in line with the research of Syarifah & Indriyanti (2019), stating that the quality, quantity and age of breastfeeding affected the nutritional status of infants. Research by Martini et al., (2020), stating that there was a correlation between macronutrient levels in breast milk and infant growth. Another research, Martini (2019), also stated that there was a relationship between macronutrient levels in breast milk and anthropometry of infants at first 3 months. In line with the research of Abdelhamid et al., (2020) that breast milk was the main source of nutrition for newborns before they were able to eat and consume other foods. Breast milk had carbohydrates, lipids, complex proteins, and other biologically active components gave a direct effect on the growth of the baby.

2. The Effect of Mother's Education as a Macronutrient Content Mediator of Breast Milk on Underweight Infants aged 0-6 Months in the Kotakulon, Wringin and Ijen Public Health Center, Bondowoso Regency

The findings of the research showed that most of the underweight baby's mothers were in the low level of education with less breast milk macronutrient content; while the mothers of infants with normal weight are having higher education levels with less carbohydrate content, sufficient fat content, and less protein content in breast milk. The findings of the multiple linear regression statistical test with the educational mediator variable showed p-value = 0.002 on carbohydrate content; 0.006 in fat content; 0.025 in protein content; and 0.028 in infant's weight, meaning that education has an effect as a mediator of breast milk macronutrient content on the weight of infants aged 0-6 months in the Kotakulon, Wringin and Ijen Public Health Centers, Bondowoso Regency.

It happened since the respondents with low levels of education potentially had knowledge shortage about healthy dietary lifestyle during breastfeeding so that respondents did not aware of suitable food for nutritional adequacy rates that fulfilled the quantity and quality amount for a body. Breastfeeding mothers with low levels of education tended to consume makeshift food available at home. The level of knowledge affected in receiving information. Mothers played an important role in raising children, including providing a balanced nutritional intake for children's growth and development. However, moderate and high education also did not guarantee that mothers could provide good parenting. Neither did mothers with higher education could guarantee them providing the best for their children if they were not intelligent enough to find out about nutrition. Accordingly, plenty of low educated mothers preferred to foods high in carbohydrates, but low in fat and protein. This preference was influenced by the level of income and knowledge that it was in line with the research of Mulyani et al., (2018) explaining that the effect of education for families on dietary habits had a positive and significant effect. The role of the family, especially mothers, in providing a balanced nutritional intake for children greatly affected the nutritional status of children. Mothers also contributed in providing balanced nutritional content for the sake of their children's health. Mothers with higher education would consider purchasing qualified foodstuffs. It was supported by the research of Karcz et al., (2021) explained that the level of education affected the acceptance of information. Information had an influence on the behavior of mothers during breastfeeding. Another research, Mutisya et al., (2016) explained that the level of education affected food expenditure in the household, it could be seen that the level of mother's education per year would increase household food expenditure. Mother's education was the foundation of the economy as she was the main role of providing food for the whole family.

3. The Effect of Family's Income as a Mediator of Breast Milk Macronutrient Content on Under Weight Infants aged 0-6 Months in the Kotakulon Public Health Center, Wringin and Ijen District, Bondowoso Regency

The findings showed that under weight infants had mothers whose income was below the minimum wage having less breast milk macronutrient content, while those normal weight ones had mothers whose income was above the minimum wage having less carbohydrate content, sufficient fat content, and less protein content. The findings of the multiple linear regression statistical test with the income mediator variable showed p-value = 0.013 on the carbohydrate content; 0.019 in the fat content; 0.013 in the protein content; and 0.046 in infant weight, meaning that income had an effect as a mediator of macronutrient content on the weight of infants aged 0-6 months in the Kotakulon, Wringin and Ijen Public Health Centers, Bondowoso Regency.

Researcher assumed that family's income was the main generator in the availability of food for the family. The availability of food was influenced by the ability of purchasing taken from family's income. Thus, below the minimum wage income indicated poor food security. Nutritional intake in breastfeeding mothers would have an impact on the quality and quantity of breast milk. Mother's milk contained macronutrients and micronutrients that were essential for the growth and development of infants. This was in line with the research of Xin & Ren, (2021) which explained that the level of family income had a significant effect on body mass index moderated by the education level. This was also supported with the research of Yadegari et al., (2017) which explained that income affected food consuming habits of family. Socio-economic status was a key factor of the availability of food at the family level. The available food and food security in the family affected the purchasing ability or family income. This family income also was associated with the aspects of education and work. Balanced nutritional intake was related to fresh and pricy food, compared to fast foods with high fat content. Low socio-economic status could affect the intake of low nutritional food. This was far much different to someone with high economic status where nutritional intake was obtained from healthy and nutritious food.

This research produces conclusions accordance with Hidayatunnikmah's research (2019) which states that there is an influence of economic income on the protein and fat content of breast milk. According to research by Del Gobbo et al., (2015) explaining that if someone got higher salary, there would be higher demand for food quality and quantity that also affecting food intake and purchase habits. The higher the income was, the higher the shopping list would be. As a result, family's income factor affected the quantity and quality of good food for the family.

CONCLUSIONS

Based on the results of this research, researchers concluded that the macronutrient content of breast milk had an effect on under weight infants aged 0-6 months. Moreover, the mother's education and family's income had become a mediator on under weight infants aged 0-6 month in Kotakulon, Wringin and Ijen Public Health Center, Bondowoso Regency, Indonesia.

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