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The Influence of Maternal Nutrition Consumption Level During Breastfeeding on Breast Milk Macronutrient Component and Infant's Weight

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ABSTRACT

Fine intake of maternal nutrient consumption was important for the health of mother and the baby. There were previous researches explained that the maternal nutrition consumption level during breastfeeding could influence breast milk macronutrient component. Breast milk macronutrient components can support infants growth process. Analyzing the influence of maternal nutrient consumption level during breastfeeding on breast milk macronutrient component and infant weight. The information regarding maternal nutrition consumption level during breastfeeding was obtained by using food recall for 24 hours in two days. Furthermore, infant birth weight was measured by using Z-score value, while macronutrient component of breast milk by using MIRIS tool with 60 breastfeeding mother as the sample. Statistic test used categorical regression (CATREG). Based on 60 samples, it was showed that average carbohydrate consumption level 384.3 ± 53.3 gram, protein consumption level 81.5 ± 11.9 gram, and fat consumption level 85.1 ± 15.5 gram. There carbohydrate components of milk of 4.7 ± 0.6 gr / dl, protein components of breast milk 2.4 ± 2.2 gr / dl, and fat component of breast milk 3.6 ± 1.4 gr / dl. Fat consumption levels negative influenced towards the carbohydrate components of breast milk ($B = -0.356$, $p = 0.001$) and the level of protein and fat consumption level took a positive effect on fat components of breast milk ($B = 0.218$ and $B = 0.576$, $p = 0.029$ and $p = 0.000$). Meanwhile, protein and fat components of breast milk were positive effect on infant weight ($B = 0.323$ and $B = 0.253$; $p = 0.037$ and $p = 0.045$). Fine fat consumption could produce a good fat component of breast milk. In addition, protein and fat component of breast milk give impact on infant weight.

Keywords: Maternal nutrition, Consumption level, Breastmilk, Macronutrient, Infant's weight

INTRODUCTION

Human milk feeding is a perfect nutrition resource for infant birth at 0-6 month. Regarding this phenomenon, there are some inventions explains that human milk feeding has bio-active components such as immunoglobulin, growth hormone, probiotics, and anti-inflammatory which can prevent diarrhea, gastrointestinal, respiratory tract infection and it can support baby growth and development process⁽¹⁾. Recent research explains that breastfeeding for the infant prevent the incident of metabolic disorder, especially obesity and type 2 diabetes⁽²⁾. In addition, World Health Organization (WHO) and United Nation Children Found (UNICEF) has given recommendation that infants should be exclusively breastfed for the first six months of life to achieve optimal growth, development and health⁽³⁾. Thereafter, to meet their evolving nutritional needs, infants should receive safe and nutritionally adequate complementary foods while breastfeeding continues for up to two years of age or beyond⁽³⁾. In Indonesia, exclusively breastfed has fluctuated in which the numbers of breastfeeding mother in 2015 were 55.7%. This percentage had decreased where in 2014 the numbers of breastfeeding mother were 72.89%⁽⁴⁾.

Breast milk components are 87% of water, 3.8% of water, 1.0% of protein, 7% of lactose. Meanwhile, each components of fat and lactose respectively provides 50% and 40% breast milk energy in total⁽⁵⁾. Additionally, the nutritional components of human milk derive from three sources: Some of the nutrients of milk originate by synthesis in the lactocyte, some are dietary in origin, and some originate from maternal stores⁽⁶⁾.

The macronutrient composition of mature breast milk is 6.7-7.8 g / dl, while the carbohydrate component of breast milk is 0.9-1.2 g / dl and for the protein components of breast milk and 3.2-3.6 g / dl for the fat component is 1.2-3.6 g/dl. However, its composition is dynamic and changes which is influenced by some factors such as stages of breastfeeding, the feed of breastfeeding mother, the health of breastfeeding mother, the exposure of environment.

In general speaking maternal nutrition need during breastfeeding is greater than pregnancy. The nutrition intake during breastfeeding has always to be noticed, due to breast milk content required for the infant depend on the food nutrition consumed by the mother⁽⁷⁾. For feeding preterm infants, the lower level of total protein and specific amino acids from donor (typically, term, late lactation) milk alone is limiting, and requires additional supplementation. Human milk protein concentration is not affected by maternal diet, but increases with maternal body weight for height, and decreases in mothers producing higher amounts of milk⁽⁶⁾. In addition, Nasser (2010) explained that The amount of dietary α -linolenic acid was not enough to impact docosahexaenoic acid level in breast milk in a short time frame, while arachidonic acid increased in the breast milk when a low fat diet was consumed. Changes in breast milk fatty acid composition can be achieved within a short period in time by changing dietary fat content⁽⁸⁾.

The composition of breast milk nutrient content is optimally able to ensure the process of growth and development of the baby normally. Infant's growth is largely determined by the amount of milk obtained including energy and other breast milk nutrition content, breast milk without the supplementary foods can meet the growing needs of infant up to the age of 6 months⁽⁷⁾. There are no consistent differences in adiposity during the first 4-5 months of life, but during the later part of the first year of life the preponderance of the evidence suggests that breast-fed infants are leaner than formula-fed infants^{(9),(10)}. Faster weight gain early in infancy may contribute to a greater risk of later obesity in formula-fed compared to breast-fed infants⁽¹¹⁾. The study in Germany in 2004 showed that levels of the hormone insulin is higher at infants who consume formula compared to infants who received breast milk, lead to fat deposits, hence the risk of obesity has begun to occur at an early age⁽¹²⁾. Carbohydrates, proteins, fats, enzymes and electrolytes are nutritional component that contribute to baby growth process. The research conducted by Prentice (2015) showed that the fat and carbohydrate macronutrient components of breast milk carbohydrates can increase the baby's weight and increase in infant fat tissue until the age of 12 months⁽¹³⁾.

The purpose of this study was to investigate the influence of maternal nutrition consumption level during breastfeeding on breast milk macronutrient component (carbohydrate, fat, protein) which affect on the growth of the infant in the area of Community Health Clinic.

METHODS

The breast milk samples were obtained from 60 breastfeeding mothers in the working authority area of Wonokusumo Surabaya community health clinic (puskesmas) who exclusively breastfed in infants at age 1-2 months. Furthermore, the sampling of breastfeeding mothers in this study was taken by random sampling in the working authority area of Wonokusumo Surabaya community health clinic (puskesmas). Additionally, inclusion criteria for breastfeeding mothers were willingness to be respondents, nursing mothers at age 20-35 years, postpartum period of 4-8 weeks, good maternal health and normal delivery. Besides, the criteria of infants were term infants born, infants at age 1-2 months, and healthy infants. This research had been approved by The Ethics Committee of Faculty of Public Health, Airlangga University, Surabaya. All respondents in this study were willingness to be a research sample and gave signature the informed consent that already available.

Information on nutritional data was obtained by using food recall questionnaire 24 hours for 2 days. Besides, the analysis data on the level of nutrient consumption was obtained by using nutrisurvey software program. Additionally, the characteristics of respondents such as age, occupation, education, family income was obtained from interview results, while nutritional status of breastfeeding mothers was obtained by using parameters Body Index (BMI) and maternal weight and height data was obtained by interviewing the respondents.

Data on infant weight was obtained from secondary data of KIA book with the result of the last weighing of the baby. The Z-score of infant weight by age was calculated by using the international mean reference that recommended by the National Center for Health Statistics (NCHS).

Exclusive maternal breastfeeding to infants age at 1-2 months were required to express breastmilk manually by hand in the morning and before giving breast milk to the baby for 8-10 ml. Breast milk sample was taken twice in different days with the same breastfeeding schedule which are in the morning and before breastfeeding the baby. Breast milk samples were inserted into breast milk bags and put the samples in the cupboard. All breastmilk samples would be taken simultaneously at 10:00 am on the day the mother removes the milk manually, and the breastmilk sample is transferred to the cooler box for the transport process, as well as the breast milk sample the next day. The measurement of breast milk components was performed in Dr. Soetomo hospital Surabaya at the nursery room by using breastfeeding measurement tools (MIRIS®, Uppsala, Sweden). Before breast milk measurement was conducted, MIRIS tool always is standardized and always repeated every after the measurement of 10 samples of breast milk.

Statistical analysis used SPSS software program. Statistical analysis used to investigate influence the level of nutritional consumption on the macronutrient component of breast milk while categorical regression (CATREG) was used to check infant weight. The levels consumption of carbohydrate, protein and fat had been selected to be independent variables of the dependent variable on average of macronutrient components of breast

milk (carbohydrates, proteins, and fats), whereas the average of the carbohydrate, protein and fat component of breast milk had been selected to be independent variables from the dependent variable of infant weight.

RESULTS

The Level of Nutrition Consumption

The level of Maternal nutrition consumption consisted of the level of carbohydrate consumption, protein and fat are displayed in table 1. The average level of carbohydrate consumption is 384.7 ± 53.3 gr which is appropriate with protein nutrient adequacy ratio of breastfeeding mother of infant at age 0-6 month (77 g). While the average level of fat consumption is 85 ± 15.5 is appropriate with protein nutrient adequacy ratio of breastfeeding mother of infant at age 0-6 month.

Tabel 1. The level of maternal nutrition consumption during breastfeeding in the working authority area of Wonokusumo Surabaya community health clinic (Puskesmas) 2017

No	The level of nutrition consumption	Mean \pm SD
1	The level of carbohydrate consumption	384.7 \pm 53.3
2	The level of protein consumption	81.5 \pm 11.9
3	The level of fat consumption	85 \pm 15.5

Breast Milk Macronutrient Component

Breast milk macronutrient component includes Breast milk carbohydrate component, breast milk protein component, breast milk fat component will be presented in table 2. The average score of breast milk carbohydrate component is 4.7 ± 0.6 which is lower than preterm breast milk carbohydrate level (6.7-7.8 gr/dl). Meanwhile the average score of breast milk protein component is 2.4 ± 2.2 gr/dl which is the same with normal score of amature breast milk fat level (3.2-3.6 gr/dl).

Tabel 2 Breast milk macronutrient component of breastfeeding mother in the working authority area of Wonokusumo Surabaya community health clinic (Puskesmas) 2017

No	Breast milk macronutrient component	Mean \pm SD
1	Breast milk carbohydrate component	4.7 \pm 0.6
2	Breast milk protein component	2.4 \pm 2.2
3	Breast milk fat component	3.6 \pm 1.4

Infant's Weight

The infant's weight was measured by using Z-score value based on the aged that calculated by using the international mean reference that recommended by the *National Center for Health Statistics (NCHS)*. The mean score of Z-score of the infant's weight is -0.4 ± 1.3 . This Z-score -0.4 shows that infant's nutrient category is good (81.7%).

The Influence of Nutrition Consumption Level on Breast Milk Macronutrient Component

The test result on the influence by using categorical regression analysis shows fat consumption average influence on breast milk carbohydrate component, but it has negative impacts ($B = -0.356$, $p < 0.001$). Meanwhile the average of fat and protein consumption has positive influence on breast milk fat component. ($B = 0.218$, $p < 0.029$; $B = 0.576$, $p < 0.000$). The influence of nutrition consumption level on breast milk macronutrient component can be seen in table 3.

Tabel 3. The influence of maternal nutrition consumption level on the breastmilk macronutrient component of breastfeeding mother

No	Variable	Breast milk carbohydrate component		Breast milk protein component		Breast milk fat component	
		B	p-value	B	p-value	B	p-value
1	The level of carbohydrate consumption	-0.248	0.072	0.179	0.172	-0.118	0.341
2	The level of protein consumption	-0.127	0.257	-0.016	0.913	0.218	0.029
3	The level of fat consumption	-0.356	0.001	0.095	0.470	0.576	0.000

The Influence of Breast Milk Macronutrient Component on Infant's Weight

The test result on the influence by using categorical regression analysis shows that the average of protein and fat breastmilk component have positive impact on infant's weight ($B = 0,323$, $p < 0,037$; $B = 0,253$, $p < 0,045$). In addition, the influence of breast milk macronutrient component on infant's weight can be seen in table 4

Tabel 4. The influence of breast milk macronutrient component on Infant's Weight

No	Breast milk macronutrient component	Infant's weight	
		B	p-value
1	Breast milk carbohydrate component	0.221	0.099
2	Breast milk protein component	0.323	0.037
3	Breast milk fat component	0.253	0.045

DISCUSSION

The Influence of Nutrient Consumption Level on Breast Milk Macronutrient Component

Based on analysis of the effect of carbohydrate, protein, and fat consumption levels on carbohydrate, protein, and fatty milk components found that fat consumption levels influences breast milk carbohydrates components. Odd value of the ratio obtained is -0.328, because it has a negative direction then it means that if there is an increased of 1 gram of fat consumption level then the carbohydrate component of ASI experiencing decreased of 0.328. The largest carbohydrate component present in breast milk is lactose. Lactose is one of the stable content of breast milk nutrition and has very little variation when breastmilk is formed. Breastfeeding components are dynamic fluid at every breastfeeding, every time, every mother and breastfeeding mother's population. The components of breast milk are influenced by genetics, and environmental factors such as food intake habits. According to Andreas et al (2015) lactose components contained in breast milk are insensitive to maternal nutrition during breastfeeding. Another study conducted by Prentice et al (1983) found that the strength of the lactation process can be modified by the intervention of food intake in breastfeeding mothers. These results show that lactose concentrations decreased but fat concentrations increased after the feeding of Gambian breastfeeding mothers was supplemented with balanced nutritional supplements. According to Prentice et al (1983) this may be due to a very little lactose metabolism processed in the mammary gland⁽¹⁴⁾.

Negative direction in the analysis results show the effect of fat consumption levels on the components of carbohydrate ASI because the data obtained showed that the good level of fat consumption in breastfeeding mother matches on the nutritional adequacy recommended by the government. Meanwhile, the average component of breast milk carbohydrates obtained from laboratory results showed below the normal value of carbohydrate components of breast milk. Previous research has largely proven that the components of breast milk carbohydrates are not influenced by the level of breastfeeding mothers' consumption during breastfeeding including the level of fat consumption. Previous research can be the basis of the reason for the results of the current study, where the level of good fat consumption affects the components of breast milk carbohydrates, but the negative effect is a decrease due to the process of lactose metabolism in the mammary gland.

Based on the results of the analysis of the effect of carbohydrate, protein, and fat levels on the components of breast milk found that there is influence of protein consumption levels, and fat to milk fat components. Fat is the second largest component of breast milk. It provides half of the energy contained in breast milk⁽¹⁵⁾. The fat component in breast milk always changes every time as the baby or infant grows to mature. Maternal dietary consumption during breastfeeding may affect breastmilk composition by several metabolic mechanisms⁽¹⁶⁾. According to the results of Hyesook's research, *et al* (2012) showed that there is an influence of fat consumption levels on the components of fatty milk⁽¹⁷⁾. Previous research conducted by Karmarkar and Ramakrishnan (1960) observed the relationship between fat consumption and fat content of breast milk in 60 Indian women with normal nutritional status. Fatty milk components increased with increasing levels of fat consumption. Hence, It can be concluded that the level fat consumption of breastfeeding mother will change fat composition in breast milk⁽¹⁸⁾.

A good level of fat consumption in the high socioeconomic breastfeeding group showed the greatest frequency of fat consumption from dairy sources, and the level of adequate fat consumption in low socioeconomic moms indicated the greatest frequency of fat consumption from fried foods. The average fat-milk component obtained in high-socially profitable breastfeeding mothers is better than the average low-socio-economic fatty component, but the average fat-milk component of low-socio-economic breastfeeding mothers is consistent with the normal value of the fatty breastmilk component. According to Hayat et al (1999) trans fatty acids contained in breast milk have an effect on the level of maternal fat consumption, especially foods from hydrogienic oils, margarine, butter, and processed foods⁽¹⁹⁾. A good enough energy for breastfeeding mothers will directly affect the 30% fatty milk component, and 60% of the milk fat component is formed from the synthesis of fatty tissue and fat stores in the body. The fatty components of breast milk are the result of the process of abortion, absorption, and transportation of maternal fat consumption in the circulation of the body, which ceases in the storage of fatty tissue and is finally sent to the long chain fatty acid breast glands and biosynthesis for medium chain triglycerides. Low calorie fat consumption has a better proportion of fat storage in the body to be used for fat synthesis in breast milk⁽²⁰⁾.

Fat consumption levels on high socioeconomic breastfeeding mother showed the highest frequency of consuming fat from animal products, fats from vegetable products, fat from dairy products, and fat obtained from snacks / fried foods. The types of fats that are contained in breast milk are Saturated Fatty Acid (SFA), Monounsaturated Fatty Acid (MUFA), and Polyunsaturated Fatty Acid (PUFA) which may be affected by fat consumption. Previous studies have suggested that breastfeeding mothers who consume SFA, PUFA, and DHA fat have a positive relationship to fatty acid conformity in breast milk⁽¹⁷⁾. The statement was supported by a study conducted on breastfeeding mothers in Greece that PUFA consumption for 1 month postpartum showed a very positive effect on breastfeeding PUFA⁽²¹⁾, and other studies conducted on breastfeeding mothers in Sweden⁽²²⁾ and Chinese⁽²³⁾ showed that there was influence of fat consumption of docosahexaenoic acid (DHA) to the fat component of DHA in breast milk.

The results of this study showed that not only the level of fat consumption that affects the fatty components of breast milk, but also the level of protein consumption of breastfeeding mother affect the components of breast milk. In addition, the consumption of high-protein foods mostly contain fat. The consumption of dietary protein sources increased frequently accompanied by the increased of fat consumption (especially saturated fat)⁽²⁴⁾. According to Lafsdottir et al (2006) from the results of observational studies in Iceland showed that there was a positive correlation between the composition of DHA in breast milk with total maternal protein intake⁽²⁵⁾.

The Influence of Breast Milk Macronutrient Component on Infant's Weight

Based on the analysis the effect of breast milk macronutrient components on the growth of infant weight, it is found that the level of breast milk protein and fat components support the infant weight. Breast milk is an ideal food source for babies who provide all the nutrients your baby needs in the growth process and provide many health benefits for mothers and infants⁽²⁶⁾. Breast milk fat component is very important to meet the nutritional needs of infants, since nearly 50% of the calorie intake of breastfeeding mothers is aimed at babies in the form of breast milk components⁽²⁷⁾. Based on the results of the research conducted by Munch et al (2013) showed that there is a positive influence between LCPUFA fat components to baby fat mass⁽²⁸⁾. Another study conducted by Prentice et al (2016) showed that there is an influence between the components of breast milk to infant growth⁽¹³⁾. This is due to the increased supply of n-3 fatty acids during the critical period of growth of infant fat tissue through stimulation of fat-milk component accumulation in the early years of life⁽²⁹⁾.

The baby's growth process (infant weight) is strongly supported by protein synthesis. The amount of protein synthesis of relative is very high for the growth of infant weight. Infants born with sufficient rapid growth so that the need for greater protein intake in comparison with adults. Research conducted by Heinig et al (1993) which states that the total protein consumed by infants showed a positive effect on the infant's weight exclusive breastfeeding. Specifically, breast milk protein consumption by infants has a positive effect on their weight⁽³⁰⁾. Another study by Butte et al (2000) supports the above statement which says that the consumption of breast milk protein components has a positive effect on infant weight growth and increase the muscle and other non-fat tissue or called Fat-Free Mass (FFM)⁽³¹⁾. The results of this study are in line with research conducted by Prentice et al (2016) which shows that high protein intake at the time of the baby associated with weight gain and BMI in childhood⁽¹³⁾.

Research Weakness

The weakness is the samples used should not be taken in 24 hours due to constrained energy, the cost and the likelihood of breastfeeding participation will be less because it interferes the convenience of breastfeeding mothers. Meanwhile, the time of breastfeeding samples on each respondent is not the same. Even, the respondent's address given by the puskesmas were mostly untrue hence to find another replacement for the respondent was quite difficult and time consuming.

Meanwhile, the measurement of infant's growth was based on the using of the latest weight data from the KIA book owned by the mother. In the meantime, maternal weight and maternal height were also not examined directly and relied on the mother's memory of the last mother's weight. Maternal data taken used food of photo book and did not use food model and was not reviewed by using (weighing).

CONCLUSION

The level of maternal nutrition consumption during breastfeeding affect on fat component of breast milk, especially the consumption of source of protein and fat. In addition, carbohydrate and protein component of breast milk give impact on infant birth weight.

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