

Correlations between Nutritional Status, Iron Intake, and Fine Motor Development in Infants Aged 6-11 Months

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ABSTRACT

Background: Undernutrition can inhibit growth and development. Specifically, in development, it can change the structure and function of the brain. Fine motor development in infants is affected by many factors such as undernutrition and iron intake. Undernutrition status can occur due to unfulfilled nutritional intake. Iron deficiency can negatively affect fine motor development in children. This study aimed to determine the correlation of nutritional status, iron intake, and fine motor development in infants aged 6-11 months.

Subjects and Method: This was a cross-sectional study conducted at eight Community Health Centers in Kulon Progo Regency, Yogyakarta, Indonesia. A total of 201 infants aged 6-11 months were randomly selected as the sample of the study. The dependent variable was fine motor development. The independent variable was status (Weight/Age). The data on fine motor development were measured by a Prescreening

Developmental Questionnaire (PDQ). The data were analyzed by Chi-square.

Results: Good nutritional status increased fine motor development in infants aged 6-11 months (OR= 7.12; 95% CI= 3.03 to 16.73; $p < 0.001$). There was no difference between iron intake and fine motor development (OR= 0.61; 95% CI= 0.20 to 1.83; $p = 0.469$).

Conclusion: Good nutritional status increases fine motor development in infants age 6-11 months.

Keywords: fine motor development, nutritional status, iron intake

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BACKGROUND

The nutritional status of children in Indonesia is still a problem. Based on the result of the Indonesian Basic Health Research in 2016, the prevalence of malnutrition and undernutrition, according to the Weight/Age indicator in infants in 2016 was 11.1%. It consisted of 8.0% undernutrition and 3.1% malnutrition. However, the prevalence rate in 2015 was 11.9%, consisting of 8.2% under-

nutrition and 3.7% malnutrition (Susanto, 2019).

Undernutrition can inhibit growth and development. Specifically, in development, it can change the structure and function of the brain. The human brain has extraordinary structural and functional changes from the 24th week until the 42nd week after conception (Santrock, 2011). This development continues from birth to the age of 2 or 3

years, the fastest period of the first 6 months of life. Therefore, brain cell growth lasts until the age of 3 years (Georgieff, 2008). Under-nutrition in children under 2 years of age will cause brain cells to decrease by 15%-20%, so that the children will have a brain quality of around 80%-85% (Gunawan et al., 2016). Based on the previous studies, the level of fine motor development in children with undernutrition status that was not in line with the age occurred in 66.7% of children. In addition, the level of motor development in children with the normal nutritional status that was not in line only occurred in 32.8% of respondents. Based on the result, nutritional status greatly affects motor development in children under five (Kasenda, 2015).

The growth and development in infants are also affected by micronutrient intake such as iron. Therefore, iron deficiency can negatively affect fine motor development in children. Iron deficiency will interfere with the process of myelination. The process of imperfect myelination causes information from the central brain to be slowly received by body cells. Therefore, the body is slow to respond to the information from the brain. Slow body movements in responding to information will disrupt fine motor development in children. Children who are late experiencing important motor events had a significantly decreased myelination rate (Almatsier, 2009). Iron deficiency also negatively affects the functioning of the neurotransmitter system, thus reducing the sensitivity of the dopamine nerve receptors. Decreased density and affinity of dopamine receptors would affect motor performance, cognitive, and behavior (McCann and Ames, 2007). Some of the studies above explain that there was a correlation between nutritional status, iron intake, and gross and fine motor development. However, there were no studies on fine motor development in infants aged 6-11 months. Therefore, the study on the

correlation between nutritional status, iron intake, and fine motor development in infants aged 6-11 months needed to be conducted. This study aimed to determine the correlation between nutritional status, iron intake, and fine motor development in infants aged 6-11 months.

SUBJECTS AND METHOD

1. Study Design

This was a cross-sectional study conducted from November 2019-January 2020 at the Community Health Centers in Kulon Progo Regency, Yogyakarta, Indonesia.

2. Study Subjects

The population of this study was 5,086 infants. A total of 284 infants as the study subjects aged 6-11 months were selected by purposive sampling

3. Study Variables

The dependent variable was fine motor development. The independent variable was nutritional status (Weight/Age) and iron intake.

4. Operational Definition of Variables

Nutritional status was the provision of nutrients to cells and body tissues, thus forming normal growth based on Weight/Age.

Iron intake was the average amount of iron nutrients consumed from food in a day.

Fine motor development in infants aged 6-11 months was a movement carried out by certain body movements and only involved some of the body's muscles in infants aged 6-11 months.

5. Study Instrument

The data of nutritional status obtained using the question and answer method and observing the data of the Health Card (KMS). The data of the nutritional status in infants and the data obtained from growth charts were calculated based on the Z-Score. The data of iron intake were obtained through interviews using the 24-hour recall form that

was carried out twice with non-consecutive days. The result of the 24-hour recall was converted with the Nutrisurvey application. The data of fine motor development were measured using the Prescreening Developmental Questionnaire (PDQ).

6. Data analysis

The data were analyzed by Chi-square.

7. Research ethics

This study was approved by the Health Research Ethics Commission of Sebelas

Maret University No.356/UN27.06/ KEPK/ EC/2019.

RESULTS

1. Sample Characteristics

Table 1 shows that the subjects obtained with a minimum age of 6 months and a maximum age of 11 months had an average of 8.39 months. Table 2 shows that there were 144 boys (50.7%) and 140 girls (49.3%).

Table 1. The Characteristics of the Subjects Based on the Continuous Data

Variable	N	Mean	SD	Min.	Max.
Age	284	8.39	1.716	6	11

Table 2. The Characteristics of the Subjects Based on the Categorical Data

Sex	n	%
Male	144	50.7
Female	140	49.3

2. The Result of the Bivariate Analysis

Table 3 shows that 17 (6.8%) out of 284 infants had good nutritional status but experienced fine motor development in infants

aged 6-11 months. 25 (11.0%) out of 284 infants had iron deficiency and experienced obstacles in fine motor development in infants aged 6-11 months.

Table 3. The correlation between nutritional status, iron intake, and fine motor development in infants aged 6-11 months

Independent variables	Fine Motor Development		Total	OR	95% CI	p
	Normal	Abnormal				
Nutritional Status (WAZ)	232 (93.2%)	17 (6.8%)	100%	7.12	3.03 to 16.73	<0.001
- Good	23 (65.7%)	12 (34.3%)	100%			
- Poor						
Iron Intake	53 (93.0%)	4 (7.0%)	100%	0.61	0.20 to 1.83	0.469
- Good	202 (89.0%)	25 (11.0%)	100%			
- Poor						

DISCUSSION

In this study, there was a significant correlation between nutritional status and fine motor development in infants. However, there was a non-significant correlation between iron intake and fine motor development in infants.

Nutritional status was one of the indicators in determining the degree of child health (Widianingtyas, 2011). Infants who

had undernutrition both quality and quantity in a long time could cause growth failure and developmental delays (Sukandar et al., 2013). The growth period in children would always be related to motor skills. Children who had motor skills would be more active to do various tasks of movement skills than children who had low motor skills due to the nutritional status (Iswahyudi et al., 2019; Sutini and Rahmawati, 2018). Fine motor development

was the activity of the nerve center, nerves, and muscles coordinated to carry out an activity (Sukmaningrum, 2015). These three elements were the key to fine motor movements in children. Children, who had good nutritional status, had good growth such as the growth of the brain, nerves, and muscles (Hadi, 2019). However, undernutrition status would inhibit development because it would affect the decrease in the number and size of brain cells (Yadika et al., 2019). The ability of the nervous system in the brain to make and release neurotransmitters depended on the concentration of certain nutrients in the blood obtained from the composition of food consumed by children (Febriana and Kusumaningtyas, 2018; Sukmaningrum, 2015). The three elements such as muscles, nerves, and brain coordinated to conduct fine motor movements (Yanti, 2012). Changes in motor skills in children reflected the maturity of the brain as well as muscles in children (Winda-sari and Hasan, 2019). The movement from the simple things to the more complex things showed a fundamental thing in the child's goal to achieve something (Solihin et al., 2013).

Iron is an essential nutrient that plays a role in motor functions (Damayanti et al., 2017). Iron plays a role in monoamine synthesis, energy metabolism in neurons and glia cells, myelination, neurotransmitter systems, and dopamine metabolism (Susanty and Margawati, 2012; Umar and Maallah, 2013). The result of this study indicated that there was no correlation between iron intake and fine motor development. It might occur due to bias while measuring iron intake in the subject using the Semi-Quantitative Food Frequency Questionnaire questionnaire (Arima et al., 2016). Bias could occur because there were some foods, especially snacks that did not include nutritional value on the label. Therefore, the way to calculate the iron content was by estimating the ingredients that

might be the content of these food products (Emalia, 2015). In addition, bias could also occur because it was related to respondents' memory about the amount and frequency of food consumed by infants (Hasanah et al., 2019; Sulastri, 2012). This also occurred due to the iron intake measured was only the intake of the child especially during the first 6 months, while the nutritional intake of the mother during pregnancy in the third trimester of pregnancy was not measured (Diani and Susilawati, 2013; Susiloningtyas, 2012). In the third trimester of pregnancy, the growth and brain development began to occur so that adequate nutrition is needed especially iron and zinc (Georgieff, 2007; Prado and Dewey, 2014). Even though the result of the study showed that there was no correlation between iron intake and fine motor skills, iron deficiency in children could cause anemia. It caused fatigue, slow response, and decreased learning capability (Indartanti and Kartini, 2014; Trisnawati et al., 2017).

AUTHOR CONTRIBUTION

Catur Retno Lestari, Harsono Salimo, Adi Magna Patriadi Nuhriawangsa, made the concepts of the study, collected the data, analyzed the data, and compiled the manuscripts.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interests.

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