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URL of this article: <http://heanoti.com/index.php/hn/article/view/hn20308>

Risk Factors of Growth Faltering on Infants Aged 6-12 Months in Tongkuno, Southeast Sulawesi

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ABSTRACT

Background: The prevalence of underweight and severe malnutrition on under-five children in Southeast Sulawesi based on the latest *Riskesmas* was 23.9%, which higher than the national prevalence (19.6%). This study aimed to analyze risk factors of growth faltering on infants aged 6-12 months in Tongkuno. **Methods:** This was a cohort prospective study. The numbers of subjects were 79 infants: 32 infants who were given early complementary feeding and 47 infants who were not. Consecutive sampling technique was used in this study. The adequacy levels of energy and protein intake were collected using 2x24 hours food recall. The incidence of upper respiratory tract infection was recorded through interviews using structured questionnaires. Data were analyzed by logistic regression method. **Results:** There were 46.9% of the infants who had growth faltering among the early complementary feeding group. Multivariate analysis showed that the early complementary feeding, low levels of energy adequacy, and frequent URTI were the risk factors for growth faltering. The frequent URTI was the most influential factor for growth faltering (OR= 5.52; 95%CI: 1.63-18.72). **Conclusion:** The frequent URTI was the most important factor for growth faltering on infants aged 6-12 months in Tongkuno. Increased exclusive breastfeeding promotion and URTI prevention are recommended.

Keywords: Risk factors, Growth faltering, Infants

INTRODUCTION

Background

Growth faltering is a condition characterized by a lower increase on children body size than it should be⁽¹⁾. The prevalence of severe malnutrition and underweight in Southeast Sulawesi based on the latest *Riskesmas* was 23.9%, which higher than the national prevalence (19.6%)⁽²⁾. Muna District had the highest percentage of under five children weighted below the red line in 2016 (13.83%)⁽³⁾. This percentage was increased compared to the percentage in 2015 (4.83%)⁽⁴⁾. The percentage of under five children weighted below the red line in Tongkuno health center in 2015 was 13.2%⁽⁵⁾, while in 2016 was 11.8%⁽⁶⁾. This percentage was almost similar with the percentage in 2015. Below the red line in growth chart indicates that the child clearly suffer from underweight⁽⁷⁾.

Underweight occurs when food intake less than expenditure⁽⁸⁾. Inadequate nutrition, infection and maternal-child interactions can impair child growth⁽⁹⁾. Appropriate complementary feeding can prevent malnutrition and make the infants achieve optimal growth⁽¹⁰⁾. According to World Health Organization, growth faltering in children can be identified through weight increment; which is less than the 5th percentile⁽¹⁾. Children who experience weight faltering at 9 months of age will have an impact on the low IQ when they reached 8 years old, which the average in decreasing of 1 standard deviation will decrease the IQ by 0.84 points⁽¹¹⁾.

Silva et al's study in Sri Lanka showed that the presence of acute illnesses, non-exclusive breastfeeding and inadequate diet were risk factors for growth faltering on infants aged 6-12 months⁽¹²⁾. Kholdi et al's study in Tehran, Iran showed that the inappropriate complementary feeding and respiratory infection were risk factors for the incidence of growth failure in children aged 0-2 years, with respective OR values of 9.58 (OR= 9.58; 95%CI: 6.48-14.18) and 4.95 (OR= 4.95; 95%CI: (4.40-5.57))⁽¹³⁾. However, Rehman et al's study in Vellore, South India

showed that the age of giving complementary feeding was not related to chronic growth faltering in children ($p=0.115$)⁽¹⁴⁾. A study by Nugroho in Langkapura subdistrict, Bandar Lampung City, Indonesia also showed that the early complementary feeding was not a determinant factor of growth faltering on infants aged 2-12 months ($p=0.21$; OR= 2.14; 95%CI: 0.78-5.82)⁽¹⁵⁾. Exclusive breastfeeding on infants under 6 months was related to a longer and weightier body length and weight⁽¹⁶⁾. Exclusive breastfeeding coverage in Southeast Sulawesi was 46.63% and had not reached the national target (85%)⁽³⁾.

Purpose

The low coverage of exclusive breastfeeding illustrates that many infants got early complementary feeding. The risk factors of growth faltering on infants aged 6-12 months in the area of Tongkuno health center has not been known yet. This study aimed to analyze risk factors of growth faltering on infants aged 6-12 months.

METHODS

Research design and subjects

This was a cohort prospective study. This study was conducted in the working area of Tongkuno Health Center, Muna District, Southeast Sulawesi, Indonesia from August to October 2017. Subjects in this study were 79 infants aged 6-12 months. A total of 32 infants were given early complementary feeding (exposed group) and 47 infants who were given timely complementary feeding (unexposed group). They were chosen by consecutive sampling technique and fulfilled the inclusion criteria, which then followed for 2 months to observe the growth faltering. The inclusion criteria of the exposed group and the unexposed group were infants in the range of aged between 6 to 12 months, had normal weight (weight-for-age z-score was -2 SD to 2 SD) at the beginning of the study, no congenital abnormalities, resided in the area of Tongkuno health center, and the mothers were agreed to participate and able to communicate. The exclusion criteria was prematurity. Early complementary feeding defined as feeding given to infants before 6 months old. Respondents in this study were mothers of infants who were agreed to participate in the study.

Measurements

Weight measurements used digital scales for infants with 30 kg capacity and a precision of 5 g. WHO weight increment standard table was used to calculate WAZ percentiles. Growth faltering was defined as the weight increments within two months of body weight < 5 th percentile of WHO standard⁽¹⁾.

Measurement of nutrient intake was done by one enumerator. A 24-hour recall form was used to list the food intake. Nutrient adequacy level was calculated using the Nutrisurvey 2007 program and were based on 2013 Indonesian Recommended Daily Allowances (IRDA). The 2 x 24 hours food recall was done every two weeks, so that within 2 months it was done 4 times of 2 x 24 hours recalling of food consumption. The averaged values of the measurements were used to calculate the adequacy levels of energy and protein intake. The adequacy level was categorized as low if $< 80\%$ of IRDA and adequate if $\geq 80\%$ IRDA⁽¹⁷⁾.

The incidence of upper respiratory tract infections was measured by conducting interviews using structured questionnaires. Upper respiratory tract infection was defined as the respondent's statement about the infant who had at least two symptoms of fever, cough, or cold in a day or experiencing one of the symptoms of fever, cough, or cold at least two days without shortness of breath or rapid breathing⁽¹⁸⁻²⁰⁾. If the infants had upper respiratory tract infection for ≥ 2 times during 2 months of observation, they were categorized as frequent and if < 2 times were categorized as rare.

Statistical analysis

Normality test was used to know the distribution of variable data. Normality was evaluated using the Shapiro-Wilk test on IBM SPSS Statistics 16 program. Mann-Whitney test was used to know the differences between the variables in the exposed group and the unexposed group. This test was used because the distribution of variable data not normal.

Bivariate analysis was done by Chi square test, which to know the relationship between the independent variable and the dependent variable. Multiple logistic regression was used to identify variables that as the risk factors of growth faltering and to control the confounding factors. The p value of < 0.05 was defined as a statistically significant.

Ethical clearance

This study was conducted after obtaining approval from the ethical commission on Public Health Faculty, Diponegoro University in July 14, 2017 with Number 164/EC/FKM/2017.

RESULTS

There were 46.9% of the infants who had growth faltering among the early complementary feeding group, while 19.1% of the infants in the timely complementary feeding group. Table 1 shows that in gender and maternal age between the groups there were no differences. The averages of maternal age in both groups were 28 years old.

Table 1. Respondent characteristics based on exposed status

Respondent Characteristics	Infants who were given early complementary feeding		Infants who were given timely complementary feeding		p*
	n	%	n	%	
Gender					
Male	13	36.1	23	63.9	0.618 ^a
Female	19	44.2	24	55.8	
Total	32	40.5	47	59.5	
Maternal age (years)	28.91±6.596		28.57±5.778		0.896 ^b

^a: Chi Square, ^b: Mann-Whitney test

Table 2 shows that the adequacy levels of energy and protein intake, as well as the incidence of URTI between the groups there were no differences.

Table 2. Description of food intake, and the incidence of URTI based on exposed variable

Variables	Infants who were given early complementary feeding			Infants who were given timely complementary feeding			p*
	Median	SD	Min-Max	Median	SD	Min-Max	
Energy adequacy level	92.32	41.02	43.74-256.69	89.17	26.63	44.42-222.34	0.562 ^a
Protein adequacy level	97.99	76.11	31.18-383.99	95.85	48.81	33.00-331.22	0.600 ^a
The incidence of upper respiratory tract infection	2	1.06	0-4	1	0.95	0-3	0.397 ^a

^a: Mann-Whitney test

Table 3 shows that the early complementary feeding, low level of energy adequacy, low level of protein adequacy, and the frequent upper respiratory tract infection were risk factors for growth faltering on infants aged 6-12 months, with respective RR values of 2.45 (RR= 2.45; 95%CI: 1.22-4.90), 3.06 (95%CI: 1.62-5.78), 2.41 (95%CI: 1.26-4.62), and 4.31 (RR= 4.31; 95%CI: 1.79-10.40).

Table 3. Bivariate Analysis for Early Complementary Feeding, Food Intake, and The Incidence of URTI on Growth Faltering

Variables	Growth Faltering				RR	95%CI	p
	Yes		No				
	n	%	n	%			
Early complementary feeding							
Yes	15	46.9	17	53.1	2.45	1.22-4.90	0.009
No	9	19.1	38	80.9			
Energy adequacy level							
Low	13	59.1	9	40.9	3.06	1.62-5.78	0.001
Adequate	11	19.3	46	80.7			
Protein adequacy level							
Low	13	50.0	13	50.0	2.41	1.26-4.62	0.008
Adequate	11	20.8	42	79.2			
The incidence of upper respiratory tract infection							
Frequent	19	51.4	18	48.6	4.31	1.79-10.40	<0.001
Rare	5	11.9	37	88.1			

Multiple logistic regression aimed to identify variables that the most influential factors for growth faltering and to control the confounding factors. Table 4 shows that the early complementary feeding was a risk factor for growth faltering (OR= 3.45 (95%CI: 1.08-10.92)). Other variables that were also affect the growth faltering on infants aged 6-12 months i.e, low level of energy adequacy (OR= 4.06 (95%CI: 1.20-13.66)) and the frequent upper respiratory tract infection (OR= 5.52 (95%CI: 1.63-18.72)).

Table 4. Multiple logistic regression of significant variabels of growth faltering

No.	Variables	OR	95% CI	p
1.	Given early complementary feeding	3.43	1.08-10.92	0.037
3.	Low level of energy adequacy	4.06	1.20-13.66	0.024
2.	The frequent upper respiratory tract infection	5.52	1.63-18.72	0.006
	Constanta	-2.838		

DISCUSSION

A total of 79 infants were followed for two months, among them 30.4% of infants had growth faltering. Among 24 of infants who had growth faltering, 4 of them suffered from growth faltering at 7 months, 5 infants at 8 months, 6 infants at 9 months, 6 infants at 10 months, and 3 infants at 11 months. There were 46.9% of the infants who had growth faltering among the early complementary feeding group, while 19.1% of the infants in the timely complementary feeding group. Early complementary feeding was a risk factor for growth faltering. A longitudinal study by Kholdi et al in Tehran, Iran also showed that inappropriate complementary feeding was a risk factor for growth failure on children aged 0-2 years⁽¹³⁾. However, this present study was conducted on infants aged 6-12 months, while Kholdi et al's study was conducted on children aged 0-2 years with a bigger sample size.

Among the 79 subjects, 40.5% received early complementary feeding. Among the infants who received early complementary feeding, 46.88% were given solid food such as commercial complementary foods, banana, and porridge. There were 7 infants who were given commercial complementary foods; all of them were given at ≤ 4 months. There were 7 infants who were given banana, 5 of them were given at ≤ 3 months and 2 infants at 5 months. In addition, there was one infant who was given porridge at 5 months. Vahabzadeh et al's study in Ahwaz, Iran also showed that the weaning age was associated with growth faltering on children aged 3-36 months⁽²¹⁾. A case control study which conducted by Purnamasari et al in Kungkung subdistrict, Central Java, Indonesia showed that the infants aged 2-6 months who were given early complementary feeding at ≤ 3 months would increase the risk of growth faltering by 16 times⁽²²⁾.

The age of 6 months is the best time to start giving complementary foods because the baby's gut is able to digest other foods. Early introduction of foods cause the infants cannot easily digest the food (such as starch), so that the nutrients can not be well absorbed. If the infants start weaning foods too early, it also may result in suckle less, and decreased breast milk supply. Thus, the infants cannot get enough energy and nutrients to account for growth⁽²³⁾. The appropriate complementary feeding enables the infant to achieve optimal growth and prevent malnutrition⁽¹⁰⁾.

In our study, the energy intake was measured after the infants were given early complementary feeding, so this energy adequacy level represented the current infant's energy intake. This study showed that there were no differences between the adequacy level of energy in the early complementary feeding group and timely complementary feeding group. Food intake influenced by functional gastric capacity, which determines the volume of food an infant can ingest during one meal. Energy intake is increased through a high energy density, increased intake of breast milk, and more frequent meals. Energy density is increased by raising the content of fat and sugar, and it will be decreased if the foods have higher water content. Too low an energy density may cause an energy deficit and result in poor growth⁽²⁴⁾.

Energy is very important for tissue maintenance and growth on children⁽²⁴⁾. The sources of energy were include the major macronutrients i.e, carbohydrate, protein, and fat. The negative energy balance occurs when energy intake is lower than energy expenditure. Consequently, the child body weight less than ideal body weight⁽²⁵⁾. Our study showed that there were 59.1% of the infants who had growth faltering among the infants who have low level of energy adequacy, while 19.3% of the infants who have adequate energy intake. Low level of energy adequacy was a risk factor for growth faltering. A similar study by Silva et al in Sri Lanka found that an inadequate diet on infants aged 6-12 months increases the risk of growth faltering by 2.7 times compared with those with an adequate diet⁽¹²⁾. However, this present study was a cohort prospective study, while Silva et al's study was a case control study.

Our study showed that there were no differences between the incidence of URTI in the early complementary feeding group and timely complementary feeding group. Early introduction of complementary foods affects growth indirectly through increased incidence of diseases⁽⁹⁾. The another indirect causes of

respiratory infection were inadequate breastfeeding, poor immunization, attendance to day care centers, large family size, poor parental educational status, parental smoking, living in the urban area, and use of biofuel⁽²⁶⁾. Receipt vitamin A and contact with someone who had cough also were associated with respiratory infection^(27,28).

The acute illnesses was associated with growth faltering on infants⁽¹²⁾. This present study showed that the frequent upper respiratory tract infection was the most influential factor for growth faltering incidence on infants aged 6-12 months. There were 51.4% of the infants had growth faltering among the infants who have frequent URTI, while 11.9% of the infants who have rare URTI. Another study in Tehran, Iran showed that the respiratory infections was a risk factor of growth failure on children aged 0-2 years⁽¹³⁾.

The upper respiratory tract infection was the main determinant of growth faltering on infants in Indonesia^(22,15). In rural Papua, upper respiratory tract infection has a negative effect on weight gain on children under five years old⁽²⁹⁾. Respiratory infection and fever lead to increased of metabolism and decreased of food intake so that can cause growth faltering⁽³⁰⁾. Therefore, increased exclusive breastfeeding promotion and upper respiratory tract infection prevention are needed, so that the growth faltering incidence can be prevented.

CONCLUSION

This study proves that the early complementary feeding, low adequacy level of energy, and frequent upper respiratory tract infection were affecting growth faltering. The frequent URTI was the most influential factor for growth faltering on infants aged 6-12 months in Tongkuno health center. Increased exclusive breastfeeding promotion and upper respiratory tract infection prevention are suggested. Growth faltering prevention might be a necessary concern to avoid the occurrence of severe malnutrition on infants.

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