Determinants of Failure to Thrive among Children Aged 6-24 Months

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ABSTRACT

Background: *Failure to thrive is still a common problem among children, especially in developing countries, and it is one of the risk factors for stunting. Factors that contribute to failure to thrive are medical conditions, nutrition, eating skills, and psychosocial characteristics. This study was conducted to determine the prevalence of growth failure in children and the factors that influence failure to thrive in children aged 6-24 months who live in the working area of Cisaat Health Center.*

Method: *This research uses a cross-sectional design to examine 125 respondents. The data were acquired from semi-quantitative food frequency questionnaires and were analyzed using logistic regression.*

Results: *The prevalence of failure to thrive was 38.4% (48 children). The results of the multivariate analysis showed that children's age influences failure to thrive. In this case, the age of 6-15 months is the most vulnerable period (OR=3.4; 1.46-8.04), low education of mothers (OR=6.52; 2.77-15.30), sub-standard family income (OR=3.6; 1.67-7.78), low energy intake (OR=5.08; 2.33-11.10), low iron intake (OR=4.14; 1.88-9.129), and low zinc intake (OR=4.07; 1.89-8.75). The most dominant factor for failure to thrive in children is the mother's education level. Health personnel should routinely detect the incidence of failure to thrive health personnel so that the problem of failure to thrive in children can be identified early.*

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INTRODUCTION

The rapid processes of human brain development and linear growth occur between the newborn period and two years of age.[1] The impact of malnutrition, either under or overnutrition, on children in this period is generally irreversible, affecting their quality of life, both short term and long term.[2] At the primary stage, the children's need is food. It is necessary to ensure growth and development according to their genetic abilities.[2]

One of the most efficient approaches to improving the quality of Indonesian children's growth is preventing malnutrition. Nutritional intake by infants is crucial in supporting their optimal growth and preventing Failure to Thrive (FTT), which is responsible for stunting and IQ reduction of up to 4.2 points.[1] Child experiencing FTT in their earlier life stage will suffer from poor physical development, in addition to higher behavioral and cognitive risks as well as emotional disturbances.[3]

FTT is still a common problem among children, especially in developing countries. A report mentioned that 27% of infants had experienced FTT in their first year. In the United States, 5-10% of infants, 3-5% of children hospitalized, and 15% of children living in poverty have FTT. The disorder can usually be recognized from birth to three years of age.[4] During the weaning period, at the age of 4-6 months, weight loss occurs; if this is neglected, FTT can occur. In another study, FTT was found most frequently at 6-8 months.[4] In another study, FTT was more common in children aged 1-2 years. One of the causes is ineffective feeding.[5]

Various factors influence FTT, but primarily by non-organic factors or non-medical conditions; only a small proportion is caused by organic factors or medical conditions. The most dominant non-organic factor causing FTT is undernutrition.[6] Numerous research found that one of the factors associated with FTT is biopsychosocial. Further, age influences FTT occurrences in toddlers; when they lose weight at 4-6 months of age during the weaning period. Other studies have found that FTT is most common at 6-8 months and more common in children aged

1-2 years.[6] Apart from age, poor feeding patterns in infants and toddlers, influenced by the mother's experiences, family needs, socioeconomic conditions, family income, and cultural traditions[7], also cause FTT. Children from low-income families are more likely to experience FTT than those from families with moderate and high incomes.[8] FTT is often associated with other factors that can significantly impact development, such as co-morbidities, malnutrition, iron deficiency, poor mother-infant interaction due to depression, and other pressures of poverty.[3,9]

Examining children who experience failure to thrive is rarely done, especially in primary health facilities. Early FTT detection still needs to be done, especially in primary health facilities. Its early detection is crucial to reducing the number of stunting occurrences, one of Indonesia's current child health problems. This study was conducted to determine the prevalence of FTT in children and to determine risk factors, i.e., characteristics and nutritional intake, which influence FTT occurrences in children aged 6 to 24 months. Research on FTT, especially in Indonesia, is still rare. Its early detection by health workers can reduce stunting occurrences in children.

METHOD

This research was conducted from April to October 2021, using an analytic observational design with a cross-sectional approach and the total population sampling technique. Of 125 mothers in 22 Integrated Healthcare Centers who have babies aged 6 to 24 months in Sukaresmi village under the working area of the Cisaat Health Center in Sukabumi regency participated in this research.

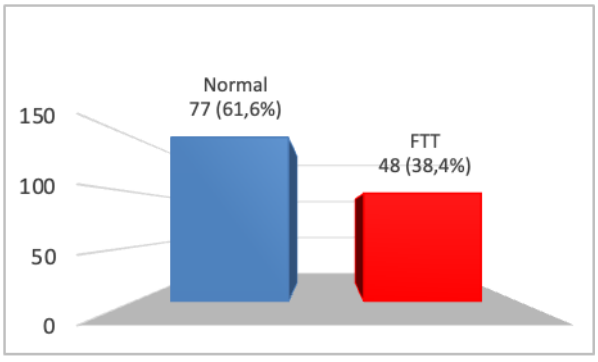
The data were obtained from monthly weighing, interviews, and questionnaires. The criterion of the respondents is the mothers of children aged 6 to 24 months who regularly came to the Integrated Health Centers for three months from February to April 2021. Then, the children were grouped into FTT and normal categories. The data regarding the mother's identity, history of infectious diseases, socioeconomic status, and nutritional intake adequacy (i.e., calories, protein, zinc, and iron) were obtained from interviews with mothers from semi-quantitative food frequency questionnaires and were processed in Nutri Survey. The macronutrients consist of calories and protein, while the micronutrients consist of zinc and iron.

Before the study, the researcher explained to the enumerator (research assistant) about questionnaire completion, consent sheets, and medical terms that the respondent might not understand. At this time, the appropriate time to start the study was also determined.

RESULTS AND DISCUSSION

Diagram 1 explains that the FTT occurrences in children aged 6-24 months are 38.4% (48 children). The WHO Growth Velocity Standards table guides this FTT data by taking data on the results of weighing children under 5 for the last 3 months. A child is declared to have FTT if his weight gain is below 5%. Therefore, monitoring of body weight should be done regularly every month for early detection of growth retardation. FTT can be easily handled through simple interventions. Doing early can positively affect a child's growth and development. This is in line with research conducted in South Korea, which found that supplementation interventions had a positive effect on increasing body weight in children with FTT symptoms and that supplementation interventions in children suffering from stunting had no significant impact.[10] Cole et al. reported that the most crucial factor for interventional management of FTT in children is the attainment of appropriate information about children's eating habits and energy intake. Thus, primary health care providers such as Public Health Centers can manage children with FTT unless other diseases accompany the disorder. In the United States, children with FTT are 5-10% of pediatric patients in primary care and 3-5% of pediatric patients in hospitals.[11, 12]

Diagram 1. Description of FTT occurrences in children



FTT is a state of malnutrition due to inadequate intake or absorption of calories caused by behavioral or psychosocial problems. FTT is a general term that refers to children with significantly lower rates of weight and height gain compared to other children of the same age.[5] FTT has been classified into organic (with medical pathology) and non-organic (due to behavioral and psychological factors).[13] Some researchers have advocated abandoning the dichotomous division between organic and non-organic for FTT occurrences. This dichotomous division was considered too simple for clinical and research purposes. It did not capture the complexities of children-with-FTT handling. Some researchers have argued that FTT is explained by several biopsychosocial factors and arises from interactions between these other factors. Factors contributing to FTT are dispersed: medical condition, nutrition adequacy, eating skills, and psychosocial. These factors may contribute simultaneously to FTT among children.[14]

Parents need to pay attention to aspects of child growth and development if they want to know their nutritional status. The role of the mother is very influential on the child's nutritional state. Parenting style plays an essential role in the occurrence of growth disorders in children.[15] Mazze et al. emphasized that three components (food, health-psychosocial stimulation) play an important role in creating optimal child growth and development.[8] Research conducted by Pratiwi in Padang regarding the nutritional status of toddlers stated that families with good parenting styles for toddlers would be able to optimize the quality of the nutritional status of toddlers. Mothers have an essential role in the process of raising children.[15] Here, mothers greatly determine the nutritional state of their children, while parenting plays an essential role in their growth. Food, health, and psychosocial stimulation are factors with crucial roles in optimal child growth. Previous research in West Java reported a positive deviation in the nutritional status of toddlers. Families with good toddler care are able to optimize the quality of their children's nutritional status. At the same time, mothers have an important role in childcare.[16]

Good feeding is very important for nutritional intake. In addition to what children eat, the attitude of mothers, for example, their presence in watching their children eat, is also essential. The provision of good food supports the nutritional status of children. Sulistijani revealed that, as children get older, the variety of food provided must be nutritionally complete and balanced to support their growth and development. Mother's care affects children's development through the adequacy of food and health conditions.[17]

Table 1. Distribution frequency of respondents' characteristics

Variables	FTT		Normal		p-value	OR	CI 95%	
	n	%	n	%			Lower	Upper
Age								
6-15	39	47.6	43	52.4	0.04	3.4	1.460	8.041
16-24	9	20.9	34	79.1				
Sex								
Male	22	43.1	29	56.9	0.366	0.714	0.344	1.48
Female	26	35.1	48	64.9				
Disease history								
Have history	8	61.5	5	38.5	0.70	2.880	0.883	9.394
Have no history	40	35.7	72	64.3				
Mother's education								
Low (Elementary School, Junior High School)	25	69.4	11	30.6	0.000	6.522	2.778	15.309
High (High School-College)	23	25.8	66	74.2				
Family income								
< Minimum Wage	26	57.8	19	42.2	0.01	3.608	1.673	7.781
≥ Minimum Wage	22	27.5	58	72.5				
Mother's age								
20-35 years	34	37.4	57	62.6	0.696	0.852	0.381	1.905
35 /<20 years	14	41.2	20	58.8				

According to Table 1, children aged 6-15 months are more likely to experience FTT than those aged 16-24 months. Most of the FTT suspects are females, and most of the children with FTT are those who have no medical history. Most children with FTT are mothers with low education and those without work. Furthermore, most children with FTT come from families with lower incomes than the regional minimum wage. The table also shows that children aged 6 to 15 months have a risk of experiencing FTT 3.4 times higher. Children of mothers with low education have a risk of experiencing FTT 6.5 times higher. Children from families with income below the minimum wage have the risk of experiencing FTT 3.6 times higher as well.

This study finds that most of the children with FTT were 6-15 months of age; they have a risk of up to 3.4 times. According to Homan, FTT occurrences are more common in children younger than 18 months.[18] This is in line with Mazze's finding that children with FTT are more often found at the age of 16 months. FTT is a common problem in the first year or two of life and can happen to all children. Approximately 94% of children who experience FTT are between the ages of 6 and 30 months.[8]

Failure to thrive can begin to occur from the age of 6-24 months. If not treated immediately, it can cause stunting. Long-term effects can occur if stunting occurs at 36 months or more.[19] At 24 months, toddlers enter the weaning phase and actively explore their surroundings. In addition, toddlers' gross motor skills also grow and develop rapidly. At this stage, some toddlers will face several possibilities that cause malnutrition: decreased appetite, low nutritional intake, reduced sleep hours, and susceptibility to infection when the mother/caregiver pays little attention to hygiene and sanitation.[20]

Toddlers aged 0-6 months still get exclusive breastfeeding which can increase the baby's immunity. During this period, the baby's nutritional needs should be well maintained. The baby rarely gets sick and does not experience dietary disorders. This differs from babies aged 7-23 months, who still get breast milk and complementary foods for breast milk. During this period, proper nutrition must be taken to prevent the child from being malnourished. Parents' knowledge of nutrition in toddlers starting from the selection of food ingredients, types of food, food portions, and frequency of feeding, serving, and processing of food, must be increased to provide nutrition according to toddlers' needs. Improper hygiene in providing complementary food for breastfeeding can cause infection, resulting in a lack of nutritional deficiencies in toddlers.[20]

Table 2 shows that FTT is more common in children with low energy intake. While protein intake by normal children and children with FTT is not significantly different, iron and zinc intakes in children with FTT were lower than those of normal children. Children with low energy intake have a risk of experiencing FTT five times higher. In contrast, children with low iron and zinc intake have a risk of experiencing FTT four times higher.

Table 2. Distribution frequency of nutritional intake

RDA (age of 6-24 months)	FTT		Normal		p-value	OR	CI 95%	
	n	%	n	%			Lower	Upper
Energy / Calories								
Inadequate (<1080Kkal)	30	61.2	19	38.8	0.00	5.088	2.330	11.109
Adequate (≥1080Kkal)	18	23.7	58	76.3				
Proteins								
Inadequate (<16 gr)	15	31.2	15	19.5	0.134	1.879	0.818	4.313
Adequate (≥16 gr)	33	68.8	62	80.5				
Iron								
Inadequate (<5,6 mg)	25	61.0	16	39.0	0.00	4.144	1.881	9.129
Adequate (≥5,6 mg)	23	27.4	61	72.6				
Zinc								
Inadequate (<2,4 mg)	29	58.0	21	42.0	0.00	4.070	1.893	8.752
Adequate (≥ 2,4 mg)	19	25.3	56	74.7				

Note: RDA = Recommended Dietary Allowances

Table 3. Results of bivariate analysis

Variable	p-value
Children's age	0.040
Mother's education	0.010
Family's income	0.000
Energy	0.000
Proteins	0.134
Iron	0.000
Zinc	0.000

Table 4. Results of multivariate analysis

Variable	p-value	OR	CI 95%	
			Lower	Upper
Children's age	0.003	5.054	1.750	14.595
Mother's education	0.001	5.541	1.935	15.867
Energy	0.002	4.625	1.732	12.347
Iron	0.026	3.220	1.150	9.015
Zinc	0.009	3.606	1.383	9.402

According to Table 3, all variables suspected of influencing FTT occurrences were included simultaneously in the model. If a variable has a p-value of <0.25 on bivariate analysis, i.e., showing the risk of FTT, the variable will be included in the model. Variables that have p-values of > 0.05 on multivariate analysis are not expected to affect FTT occurrences, so they are excluded one by one from the model following the highest p-value (see Table 4).

Based on the final model, the factor that influences FTT occurrences most is the mother's education, with an OR of 5,541 (CI95%; 1,935-15,867), which means that the children of mothers with low education have a risk of FTT 5.5 times higher. Children aged 6-15 months have a risk of FTT five times higher, and children who are deficient in energy intake have a risk of FTT 4.6 times higher. In addition, children deficient in iron and zinc intake have a risk of FTT four times higher.

This study finds that children with less energy intake had a five times higher risk of experiencing FTT. This is in accordance with the findings of Hong that non-organic FTT is mainly caused by insufficient caloric intake and that 20-30% of toddlers with poor nutritional intake have a higher risk of experiencing FTT. Hong also found that FTT was caused by the inability to get enough calories to maintain growth. This can be attributed to the low intake of nutrients needed for growth. Ninety percent of FTT cases have no underlying medical diagnosis.[22] This is in line with other studies, which found that 50% of children sent to better healthcare units due to FTT indications did not get enough nutrition, especially calories. Most cases of FTT were caused by non-organic factors, such as insufficient caloric intake, and environmental problems, such as negligence, indifference, and disorders in eating.[22]

Macronutrient deficiency in children is related to inadequate intake of nutrients. Fewtrell et al. have summarized evidence that low protein intake in the first year of life is associated with age-inappropriate weight gain. These findings are supported by the results of Pearce and Langley-Evans that low protein intake is associated with FTT occurrences.[23]

Protein is a substance that builds body cells, so it is very important for the process of growth and development of toddlers. It also plays an important role in replacing damaged body cells.[24] Long-term protein deficiency will cause disturbances in body and growth hormone regulation, which can cause nutritional disorders such as FTT.[24]

Carbohydrates are the primary provider of energy. If carbohydrate needs are not met, fat and protein will be used.[24] If the body has insufficient carbohydrates, it will convert protein into energy. It cannot function as a cell-building substance, and children's growth will be hampered.[25]

The results of this study indicate that children deficient in iron or zinc risk experiencing FTT 4 times higher. Insufficient intake of micronutrients (zinc and iron) is conventionally considered the cause of FTT in children. It was found that iron deficiency is one of the main causes of FTT. [10, 26]

The majority of research subjects have low iron intake. Iron (Fe) is a micronutrient that plays a role in the psychomotor development of children. This result is in line with other studies which report that children who experience failure to thrive have low iron intake.[30,31] Iron

is needed for growth from infancy to adolescence. In addition, iron functions to replace lost blood and increase blood cell mass.[32] Research conducted by the South-East Asian Nutrition Survey (SEANUTS) in 2013 regarding the diet of toddlers aged 6-23 months concluded that most toddlers rarely or never eat meat, fish, and poultry.[33] This intake pattern cannot meet the body's need for iron. Iron deficiency can cause developmental disorders of the auditory nerve. Iron plays a role in monoamine synthesis, energy metabolism in neurons and glial cells, myelination, neurotransmitter systems, and dopamine metabolism. One of the symptoms due to iron deficiency in body tissues is the presence of behavioral abnormalities and cognitive function disorders. Low iron levels in the blood can result in the inhibited synthesis of hemoglobin. The hemoglobin level in the blood is in line with the child's brain development speed.[32]

Each micronutrient plays a different role in the human body. Micronutrient deficiency can cause various symptoms, including decreased cognitive function, increased infection risk, decreased physical growth, and development tardiness.[27] Lack of micronutrients in children, in addition to causing FTT, can reduce their immune system.[28,29] Several studies have analyzed differences between children with severe FTT and healthy children to identify potential associations between the micronutrient intake of both groups. However, after being analyzed, there was no statistically significant difference. This shows that most children with FTT have low micronutrient intake.[22]

In contrast to the above results, a study conducted in South Korea attempted to identify a potential association between micronutrient levels found no significant difference between children with severe FTT and healthy children. South Korea is a relatively developed country without extreme food insecurity. Children with FTT in that country can maintain adequate levels of food intake; they may not be deficient in micronutrients.[22]

Most of the subjects in this study had a history of low energy and iron intake. Adani reported that toddlers who experience failure to thrive have less energy intake. Children with low energy intake have a 1.24 times higher risk of experiencing stunting compared to children who have sufficient energy intake.[30]

The children of mothers with low education are 6.5 times more likely to experience FTT than children of mothers with higher education. Previous research also highlighted that mothers with higher education have babies with more optimal growth than mothers with low education.[19] Whereas babies of mothers with low education have a greater likelihood of experiencing growth failure compared to babies from highly educated mothers. Mother's education, even without considering other factors that affect growth, has a significant impact on increasing children's growth. This is in line with Rahmanian's finding that mothers with low education are at a 4.26 times higher risk of having FTT-vulnerable babies than those with higher education.[3, 20]

In developing countries, lack of parental knowledge, not child malnutrition per se, is the determining factor for child malnutrition. The study of Hameida et al. on Libyan children shows that mothers with low education have a significant role in malnutrition and growth failure in their children. Two independent studies in children under two years found that underweight children were those of mothers with low education.[8]

The role of the mother in raising children is a very important factor in influencing the growth and development of children. One of them is parental education. The same result was also reported by Ozkan et al. that parental education, both father and mother, is strongly associated with abnormal developmental outcomes in children aged three months to 5 years. Mothers who are well educated will have different qualities of parenting and stimulation for their children compared to those with low education. A mother's education level influences the mother's ability to comprehend information and knowledge about health and nutrition.[23]

This study finds that children from families with sub-standard incomes had 3.6 times higher risk of experiencing FTT and that household income had a significant association with growth failure in children. These findings are consistent with results from other studies. For this reason, it seems that most children with growth failure or growth retardation live in families with low economic status.[3,21] Family factors such as mental health disorders, inadequate nutrition knowledge, and financial difficulties can contribute to calorie intake, which can cause FTT. This phenomenon is often seen in rural and urban areas with lower economic status.[21]

CONCLUSION

The prevalence of FTT in children aged 6-24 months is 38.4% (48 children). FTT is influenced by characteristic factors (such as children's age, mother's education, and family income) and nutritional intake factors (such as insufficient energy intake, zinc, and iron). The most dominant factor for FTT occurrences is the mother's education level. The children of mothers with low education have a 5.5 times higher risk of experiencing stunting. While children aged 6-15 months have a five times higher risk of having FTT, children with inadequate energy intake have a 4.6 times higher risk of having an

FTT. Children with insufficient iron and zinc intake have a four times higher risk of having FTT.

Screening on FTT needs to be carried out regularly by health workers so that identification can be made as early as possible and the FTT suspects can get treatment earlier. In addition, health workers and Integrated Healthcare Center personnel must carry out health campaigns to mothers at both Public Health Centers and Integrated Healthcare Centers regarding the importance of monitoring growth for optimal children's development.

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