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Malnutrition in children is associated with low insulin like growth factor-1 (igf-1) levels

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ABSTRACT

This study aimed to compare serum levels of Insulin-like Growth Factor-1 in children with malnutrition and good nutritional status. This cross-sectional study included 41 participants consisting of 31 malnourished, 10 well-nourished children, aged between 36-60 months. Demographic data of participants were obtained by means of a questionnaire. Nutritional status was determined by calculating the Z-score of body weight for age, height for age and body weight for height indices using the WHO classification. IGF-1 levels were determined by Enzyme Linked Immunosorbent Assay (ELISA) method. Median serum IGF-1 levels in malnourished children were found to be lower i.e. 1.75 ng/mL (minimum-maximum: 0.97-85.97) compared to well-nourished children 101.81 ng/mL (minimum-maximum: 1.23-158.12).

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INTRODUCTION

According to the World Health Organization (WHO), malnutrition is a deficiency, excess or imbalance of nutrient intake. WHO estimates that 41 million children under five are overweight and 159 million have stunted growth. WHO also predicts that 175 million children in developing countries are malnourished, based on weight-for-age data, and around 230 million are stunted, based on height-for-age data (WHO, 2016).

According to*United Nations Children's Fund* (UNICEF) through the State of the World's Children 2019: Children, Food and Nutrition report stated that 50% of toddlers in Indonesia suffer from malnutrition (UNICEF.2019). Toddlers suffering from severe acute malnutrition and severely malnourished children are at 5-20 times greater risk than children with good nutrition (Mamoun et al., 2005). Malnutrition plays a role and is responsible for 60% of infant deaths (A.-G. et al., 2006).

The infant mortality rate in Indonesia has decreased sharply, but has not yet reached the MDGs target in 2015. This condition has an impact on the achievement of human development in 2030 (Rahmad, 2016). RPJMN (National Medium Term Development Plan) 2015-2019, has several main targets in efforts to improve the nutritional status of the community, namely decreasing the prevalence of malnutrition in toddlers by 17% and the prevalence to 28% and thin toddlers

decreasing by 9.5% (Al Rahmad, 2018)(Azizah & Achyar, 2020)(Al Rahmad et al., 2021)(Nurak et al., 2023).

Children aged 3-5 years are at risk of experiencing malnutrition, because eating problems often occur, because children are already active and tend to be picky about the food they will consume (Sari et al., 2016). Toddlers are most vulnerable to malnutrition because breast milk substitutes or weaning foods often have high carbohydrate content but very low quality and protein content (K. et al., 2008).

The toddler period in the first 1000 days of life determines the quality of life in the future (Kuntari et al., 2013). The cause of malnutrition is a lack of protein, calories or total energy deficiency. In toddlers, it is characterized by resistance to growth hormones. Malnutrition or malnutrition needs to be detected early because it is an ongoing problem and threatens the future of the nation through identification of toddler growth and development (Kuntari et al., 2013) The growth hormone that is also predicted to be a benchmark for determining nutritional status is the IGF-1 hormone (Fazeli & Klibanski, 2014).

Insulin Like Growth Factor-1 (IGF-1) is a growth hormone that plays an important role as an intermediary for the anabolic effects of protein and linear growth of GH (Growth Hormone) found in the pituitary gland which functions to stimulate toddler growth (Laron, 2001).

Identification of toddler nutritional status by examining growth hormone levels is still rarely done (Aritonang et al., 2020)(Tampubolon et al., 2021)(Country, 2023)(Paramita et al., 2024). This is due to the lack of knowledge and socialization related to growth hormone examination in toddlers as an accurate way to determine the level of nutritional status of toddlers.

RESEARCH METHOD

This study used a cross-sectional study method, namely a research design where the measurement or observation of research variables is carried out at the same time or once. The purpose of the study was to determine the levels of IGF-1 in malnourished toddlers aged 36-60 months. The research location was at the Bara-Baraya Health Center, Makassar City with a sample size of 41 people.

The research instrument used a questionnaire and measurement of IGF-1 levels. The questionnaire contained a list of questions that were distributed to respondents. Measurement of IGF-1 (Insulin-Like Growth Factor-1) levels was carried out using the ELISA (Enzyme Linked Immunosorbent Assay) method at the UnitHasanuddin University RSP Research Laboratory.

RESULTS AND DISCUSSIONS

Univariate Analysis

The characteristics of the research respondents include family characteristics, socio-economic, environmental characteristics, birth history and morbidity history as stated in the following table.

Table 1. Distribution of respondent characteristics at the Bara-Baraya Community Health Center, Makassar City (n=41)

Characteristics	Frequency (%)
Family characteristics	
Number of Family Members	
3—4	19 (46.3)
>4	22 (53.7)
Socio-Economic	
Last education	
Low education	22 (53.7)
Higher education	19 (46.3)
Family income	

Characteristics	Frequency (%)
<UMR	36 (87.8)
≥UMR	5 (12.2)
Ownership of toilets	
No toilet/public toilet	26 (63.4)
Private toilet	15 (36.6)
Birth history	
Birth Weight	
< 2,500 gr	18 (43.9)
2,500-4,000 gr	23 (56.1)
Birth Length	
< 48 cm	19 (46.3)
48 -52 cm	22 (53.7)
Exclusive Breastfeeding	
Yes	22 (53.7)
No	19 (46.3)

The table above shows the majority of family members >4, the mother's education is mostly low, the family income is mostly <UMR, ownership of toilets in this case is more of those who do not have private toilets. Birth history is more with birth weight 2,500-4,000gr, birth length >48cm and receiving exclusive breastfeeding.

Bivariate Analysis

Table 2. Differences in IGF-1 levels in malnourished and normal toddlers

Nutritional status	Median (Minimum-Maximum	*P value*
Malnutrition	1.75 (0.97-85.97) ng/mL	< 0.001*
Normal	101.81 (1.23-158.12) ng/mL	

*mann-whitney test

To determine the difference in IGF-1 levels in malnourished and normal toddlers, the Mann-Whitney statistical test was used because the IGF-1 level data were not normally distributed. The results of the statistical test showed that there was a difference in IGF-1 levels in malnourished and normal toddlers ($p<0.001$). This indicates that there is a low level of Insulin-like Growth Factor-1 (IGF-1) in malnourished toddlers.

Discussion

Based on the results of the Mann-Whitney test, there are differences in Insulin-like Growth Factor-1 (IGF-1) levels in toddlers with normal nutritional status and toddlers with malnutrition. Toddlerhood is the golden age. In this phase, the child's brain experiences the fastest development in its growth (Sukatin et al., 2020)(Bonita et al., 2022)(LEFIANI et al., 2023). Malnutrition is a condition of nutritional deficiency due to a mismatch between the body's nutritional needs and the intake of nutrients.

The nutrients the body needs consist of macronutrients (carbohydrates, protein and fat) and micronutrients (vitamins and minerals) which are needed during the growth and development of toddlers (Wijaya, 2019)(Anissa & Dewi, 2021)(Nasriyah & Ediyono, 2023)(Haramain, 2023)(Syarifah et al., 2024). Toddler nutritional factors and growth hormone stimulate the synthesis of Insulin-like Growth Factor 1 (IGF-1) in the liver.(Lewit & Kerrebrock, 1997). Nutrition plays an important role in the regulation of IGF-1, energy and protein deficiencies can significantly reduce IGF-1 in the blood (Rozario et al., 2000). Malnutrition inhibits the production of IGF-1 (Blum et al, 2018).

Insulin Like Growth Factor-1 (IGF-1) and Growth Hormone (GH) work together in bone remodeling (formation) and maintaining toddler bone strength (Blum et al., 2018). The function of

IGF-1 is to metabolize cartilage growth for height increase. Toddlers who lack calories and protein, stunting or short stature have low IGF-1 levels. Low levels of IGF-1 in stunted children because IGF-1 is unable to metabolize bone growth through the protein binding receptor, namely IGFBP-3 (Mamabolo et al., 2007).

Measurement of serum levels of Insulin Like Growth Factor-1 (IGF-1) and IGF-1 binding protein (IGFBP-3) can complement the assessment of growth status to predict growth response. IGFBP-3 (Insulin Like Growth Factor Binding Protein-3) is a protein carrier receptor stimulated by IGF-1 (Blum et al., 2018). Calorie and protein deficiencies have been shown to decrease IGF-1 levels.

Stunting or short stature occurs if the child lacks chronic energy such as protein, fat, minerals. Therefore, malnutrition will affect IGF-1 levels in stunted children because in stunted children, growth hormone levels are inhibited, resulting in IGF-1 secretion so that IGF-1 is unable to metabolize bone growth through its protein-binding receptor, namely IGFBP-3 (Mamabolo et al., 2007).

This study showed that Insulin-like Growth Factor-1 (IGF-1) levels were lower in malnourished toddlers with a median value of 1.75 ng/mL (minimum-maximum: 0.97-85.97). This is in line with previous studies that have also shown that malnutrition reduces IGF-1 production. Growth hormone stimulates the synthesis of Insulin-like Growth Factor 1 (IGF-1) in the liver. Nutrition plays an important role in the regulation of IGF-1, lack of energy and protein can significantly reduce IGF-1 in the blood. (Rozario et al, 2015) Malnutrition inhibits IGF-1 production (Blum et al, 2018).

CONCLUSION

Croos-sectional research has been conducted and after statistical analysis it can be concluded that IGF-1 levels are low in malnourished toddlers and can be used as a parameter to assess nutritional status. This finding indicates that IGF-1 can be used as an important parameter in the assessment of nutritional status and as a potential indicator for early detection of malnutrition risk. This study provides important data relevant to the prevalence of malnutrition in Indonesia, so it can be a reference for further research in the field of public health. This study supports the theory that the hormone IGF-1 acts as a major mediator in bone and tissue growth in children, and strengthens the hypothesis of the importance of protein and energy in growth hormone regulation.

The design of this study only provides an overview at one point in time, so it cannot identify a direct cause-and-effect relationship between malnutrition and IGF-1 levels. Future research is recommended to evaluate the cause-and-effect relationship between changes in nutrient intake and IGF-1 levels in children, as well as the impact on their growth.

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