



Serum calcium as a candidate marker in detecting stunting in toddler

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ABSTRAK

Latar Belakang: Anak di bawah usia lima tahun membutuhkan asupan gizi yang cukup. Asupan gizi yang tidak mencukupi menyebabkan anak mengalami stunting. Kalsium merupakan salah satu parameter darah yang dapat dinilai, karena defisiensi kalsium akan mempengaruhi pertumbuhan linier anak. Selama ini pemantauan status gizi hanya berdasarkan antropometri dan tidak diikuti dengan penilaian parameter darah.

Tujuan: Penelitian ini bertujuan untuk mengukur kadar kalsium serum sebagai kandidat marker dalam mendeteksi stunting pada balita. mendeteksi dini kejadian stunting dengan menggunakan antropometri dan pengukuran kadar kalsium serum serta menganalisis hubungan antara status gizi dengan kadar kalsium serum pada balita.

Metode: Desain penelitian ini adalah cross sectional dengan sampel anak balita usia 2-5 tahun berjumlah 62 orang. Data karakteristik sampel diperoleh melalui kuesioner, sedangkan untuk pengukuran kadar kalsium serum dilakukan pengambilan sampel darah vena dan diukur dengan metode colorimetric. Kejadian stunting diketahui berdasarkan pengukuran TB/U, Z-score dihitung menggunakan software Anthro 1.02. Data dianalisis secara univariat (distribusi frekuensi) dan bivariat (independent t-test dan chi square) menggunakan SPSS versi 22.

Hasil: Berdasarkan pengukuran antropometri didapatkan bahwa 21 (33.9%) balita mengalami stunting, sedangkan hasil pengukuran kadar kalsium serum didapatkan 28 (45.1%) balita mempunyai kadar kalsium serum yang rendah dan sebagian besar balita (54,9%) mempunyai kadar kalsium serum yang normal. Tidak terdapat perbedaan yang bermakna ($p=0.989$) antara kadar kalsium serum antara balita stunting dan tidak stunting ($1.961 \pm 0.223 \mu\text{g/dL}$ vs $1.960 \pm 0.175 \mu\text{g/dL}$). Hasil bivariat juga menunjukkan tidak terdapat hubungan yang bermakna ($p=0.414$) antara kadar kalsium serum dengan kejadian stunting.

Kesimpulan: Pengukuran kadar kalsium serum belum dapat dijadikan kandidat marker untuk mendeteksi kejadian stunting pada balita. Pengukuran kadar kalsium serum belum dapat mewakili pengukuran antropometri untuk mendeteksi dini kejadian stunting pada anak.

KATA KUNCI: antropometri; balita; kadar kalsium serum; stunting

ABSTRACT

Background: Monitoring the nutritional status of toddlers is a very important thing to do. Calcium is one of the blood parameters that can be assessed, because calcium deficiency will affect the child's linear growth. So far, monitoring of nutritional status is only based on anthropometry and is not followed by assessment of blood parameters.

Objectives: This study aims to measure serum calcium levels as a candidate marker in detecting stunting in toddlers.

Methods: The design of this research is cross sectional with 62 samples of toddlers aged 2-5 years. Data on sample characteristics was obtained through a questionnaire, as for serum calcium levels measurement, venous blood samples were taken and measured with the colorimetric method. The incidence of stunting is obtained based on TB/U measurements and Z-score was calculated using Anthro 1.02 software. Data were then analyzed univariately (frequency distribution) and bivariate (independent t-test and chi-square) using SPSS version 22.

Results: Based on anthropometric measurements, it was found that 21 (33.9%) toddlers had stunting, 28 (45.1%) toddlers had low Serum calcium levels and the majority of toddlers (54.9%) had normal serum calcium levels. There was no significant difference ($p=0.989$) in mean serum calcium levels between stunting and non-stunting toddlers ($1.961 \pm 0.223 \mu\text{g/dL}$ vs $1.960 \pm 0.175 \mu\text{g/dL}$). Bivariate results also showed that there was no significant relationship ($p=0.414$) between serum calcium levels and the incidence of stunting.

Conclusions: Measuring serum calcium levels cannot be used as a candidate marker for detecting stunting in toddlers. Further research is needed with a larger number of samples and measurements of various parameters related to calcium balance.

KEYWORD: anthropometry; serum calcium levels; stunting; toddler

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INTRODUCTION

In toddlers, growth and development occurs very quickly. A sufficient nutritional intake is necessary in order to grow and develop well. Lack of nutrient intake can causes stunted growth and development according to their stage of age (1). Growth is the increase in physical measurement in children, especially the height of the body, while development is the increase in the ability of individual functions, including rough and smooth movement, hearing, sight, communication, speech, social-emotion, independence, intelligence and moral development (2-4).

Stunting impact during childhood is a condition where toddlers have insufficient height based on their age. According to WHO (2010) there are 171 million children who are stunted and 167 million of them are children living in developing countries, including Indonesia (5). The incidence of stunting toddlers is the main nutritional problem in Indonesia. Based on

nutritional status monitoring data, stunting has the highest prevalence compared to other nutritional problems such as malnutrition, underweight, and overweight. In 2013 the prevalence of stunting toddlers in Indonesia reached 37.2% and in 2018 decreased to 30.8% (6). This prevalence is still considered as high and according to WHO public health problems can be considered chronic if the prevalence of stunting is more than 20% (5).

The incidence of stunting is the impact of insufficient nutritional intake, both in terms of quality and quantity. Low nutrients intake results in low micronutrients level needed for growth and development. Rural areas have a larger proportion of stunted children (40%) compared to urban areas (33%). Poverty and the parents low level of knowledge about nutritious food intake are one of the main causes of the high incidence of stunting in rural areas (7). Stunting that is not treated will have a long-term impact, such as less learning

achievement and endurance, while in the short term it can cause disruption of brain development and physical growth during childhood (8).

Given the tremendous impact of stunting on children's growth and development, monitoring nutritional status from an early age is a very important thing to do. So far, the monitoring of nutritional status is only based on anthropometry and is not followed by an assessment of blood parameters. Calcium is one of the blood parameters that can be assessed, because calcium deficiency will affect the linear growth of children. Calcium deficiency will affect linear growth if the calcium content in the bones is less than 50% than normal (9). During the growth period, bone mineralization is highly needed. Very low calcium intake can lead to hypocalcemia, even if secretion from the parathyroid glands is maximum, which can result in low mineralization of the new bone deposit matrix and osteoblast dysfunction (10). This study aims to measure serum calcium levels as a candidate marker in detecting stunting in toddlers.

MATERIALS AND METHODS

This cross-sectional study was conducted in Muaro Jambi Regency with 62 samples of children aged 2-5 years old. The characteristics of samples and parents were obtained through questionnaires, and early detection of stunting was carried out by anthropometric measurements and measurements of serum calcium levels. Anthropometric measurements based on height / age measurements were obtained using a microtoice tool with an accuracy of 0.1 cm. The data obtained then compared to WHO standard with the height /age index using the WHO child growth standards 2005 software. Z- score is calculated using Anthro 1.02 software

(11). Measurement of serum calcium levels was carried out by taking venous blood samples and measured by the Colorimetric method using the Calcium (Ca) Colorimetric Assay Kit Cat. No. E-BC-K103-M. The data obtained were analyzed using SPSS version 22. Data analysis used to measure the difference in serum calcium levels in stunted and non-stunted children was independent t-test, while Chi-Square test was used to determine the relationship between serum calcium levels and nutritional status (95% confidence interval and $p < 0.05$). This research has received ethical approval from the Health Research Ethics Commission of the Faculty of Public Health, Sriwijaya University No. 106 / UN9. FKM/TU. KKE/2022.

RESULTS AND DISCUSSIONS

Stunting events can be detected through anthropometric measurements. Anthropometric parameters are the basis of the assessment of nutritional status. To find out whether toddlers are stunted or not, the index used is the height index according to age. Height is an anthropometric parameter that describes the state of bone growth. Height according to age is used to measure linear growth and as an index of past nutritional status. insufficient height according to age is defined as short and can reflects either normal variations or pathological condition that affects linear growth potential (11).

Based on the results of anthropometric measurements in this study, 33.9% of toddlers were stunted (Table 1). The causes of stunting are complex and multifactorial. Basic causes such as the economic and political environment underlie the socioeconomic status, and the direct causes are inadequate feeding intake and infections (12).

Table 1. Characteristics of Subjects

Characteristics	n	%
Gender		
Male	34	54.8
Female	28	45.2
Nutritional Status		
Stunted	21	33.9
Non-Stunted	41	66.1
Serum Calcium Level		
Low	28	45.1
Normal	34	54.9

Parental characteristics data in this study (Table 2) showed that, 74.2% of parents have low economic status and most are poorly educated. According to Beal et al (2018) low socioeconomic status and low educated households are important determinants of stunting in Indonesia (13). The prevalence of stunted children in poorly educated households is 17 times higher than the prevalence among children in highly educated households (7).

The results of a study conducted by Budiastutik et al (2019) stated that, children with low educated mothers are 3.27 times more likely to be stunted (14).

Inadequate intake of energy and nutrients, as well as infectious diseases are factors that play a very important role in stunting. Some micronutrients that are very important to prevent stunting are vitamin A, zinc, iron and iodine (15).

Table 2. Frequency Distribution characteristic of parents

Frequency Distribution	n	%
Mother's Education		
Low	39	62.9
High	23	37.1
Mother's Occupation		
Farmer	38	61.3
Unemployed	24	38.7
Father's Education		
Low	36	58.0
High	26	42.0
Father's Occupation		
Farmer	34	54.8
Employee	28	45.2
Economic Status		
Low	46	74.2
High	16	25.8

However, some other micronutrients such as calcium and phosphorus are also very important for children linear growth (16,17). The results of measuring serum calcium levels in this study showed that, there was no significant difference ($p>0.05$) between serum calcium levels in stunted and non-stunted toddlers (**Table 3**). The results of this study are in line with the results of a study conducted by Kurniasari et al (2016) which stated

that, there is no significant difference between serum calcium levels in stunted and non-stunted children ($p = 0.193$) aged 24-59 months in Pontianak City (18). However, a study conducted by Burckhardt et al (2010) stated that calcium intake was significantly lower in stunted children than non-stunted children, with the risk of stunting was 3.93 times greater in toddlers with low calcium intake (19).

Table 3. Average serum calcium levels in toddlers

Nutritional Status	n	Serum Calcium Levels Mean $\pm$ SD (mmol/L)	p
Stunting	21	1.961 $\pm$ 0.223	0.989
Non-Stunting	41	1.960 $\pm$ 0.175	

According to Prentice (1993), calcium deficiency will affect linear growth if the calcium content in the bones is less than 50% of the normal content (9). Based on this theory, the average serum calcium levels did not differ significantly in stunted and non-stunted children in this study. In addition, bone mineral mass in

childhood is influenced by many factors including genetics, gender, calcium and protein intake, physical activity, and endocrine status (parathyroid hormone, vitamin D, calcitonin, and insulin-like growth factor) (19). The concentration of calcium in the plasma especially free calcium ions is very carefully maintained in such a way for

the transmission of nerve impulses and muscle contractions. Calcium homeostasis is regulated mainly through an integrated hormonal system that controls the transport of calcium in the intestines, kidneys, and bones. Serum calcium homeostasis is necessary to maintain calcium ion levels in the extracellular within normal range by transporting calcium to and from reserves in the

bones (20). Calcium and phosphorus deposits in the organic matrix in the form of hydroxyapatite crystals during the mineralization process give strength to the bones. Deficiencies of these two minerals or improper ratios can affect bone growth, while a balanced ratio between calcium and phosphorus can help calcium absorption (21).

Table 4. Relationship of serum calcium levels with nutritional status in toddlers

Serum Calcium Levels (mmol/L)	Nutritional Status				Total		p	OR (CI 95%)
	Stunting		Not Stunting					
	n	%	n	%	n	%		
Low	11	52.4	17	41.5	28	100	0.414	0.644 (0.224- 1.855)
Normal	10	47.6	24	58.5	34	100		
Total	21	100	41	100	62	100		

There is no significant relationship between serum calcium levels and nutritional status in toddlers. Measurements of serum calcium levels have not been able to represent anthropometric measurements to detect stunting earlier in toddlers. There were limitations in this study, such as a small number of samples, and not measuring calcium intake and some parameters related to calcium balance. More research is still needed regarding the relationship between serum calcium level and stunting.

CONCLUSIONS AND RECOMMENDATIONS

Measuring serum calcium levels cannot be used as a candidate marker for detecting stunting in toddlers. Further research is needed with a larger number of samples and measurements of various parameters related to calcium balance.

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