



STUDY OF ANALYSIS OF FAILURE TO GROW INCIDENT IN TODDLERS BASED ON COMPOSITE ANTHROPOMETRIC INDEX (CIAF) IN WEST SUMATERA PROVINCE

Author:

Neila Sulung¹⁾, Evi Hasnita²⁾, Rina Mariyana³⁾, Mega Syafriyanti⁴⁾

^{1,2}Public Health Program, Master Fort De Kock University Bukittinggi

³Nursing Study Program, Fort De Kock University Bukittinggi

⁴Masters student of Public Health study program, Fort De Kock University Bukittinggi

Corresponding Email: [*neilasulung@fdk.ac.id](mailto:neilasulung@fdk.ac.id)

About the Author

- | | |
|--------------------|---|
| 1. 1st Author | : dr. Neila Sulung, Spd. M. Kes |
| Affiliation | : Public Health Program, Master Fort De Kock University Bukittinggi |
| Mailing address | : Singgalang housing complex a 9 no 07 pandang |
| Author email | : neilasulung@fdk.ac.id |
| ID Orchid | : |
| Google Scholar URL | : https://search.app/MLB88Qjj1P8giiL89 |
| Phone number | : 085365658494 |
| 2. 2nd Author | : Prof. Dr. Evi Hasnita Spd.M.Kes |
| Affiliation | : Public Health Program, Master Fort De Kock University, Bukittinggi |
| Mailing address | : Hercules Street No. 13, Black Stump, Padang |
| Author email | : evihasnita@fdk.ac.id |
| ID Orchid | : https://orcid.org/0009-0004-7698-0153 |
| Google Scholar URL | : https://search.app/cuDEJ1GYQ417dKc18 |
| Phone number | : 081363046204 |
| 3. 3rd Author | : Ms. Rina Mariyana, S. Kep., M. Kep |
| Affiliation | : Nursing Study Program, Fort De Kock University Bukittinggi |
| Mailing address | : Jorong surau gadang batu taba ampek angkek |
| Author email | : rinamariyana@fdk.ac.id |
| ID Orchid | : https://orcid.org/0000-0002-3033-6707 |
| Google Scholar URL | : https://search.app/Rr5xZqoqKumY17Nq9 |
| Phone number | : 082382455556 |
| 4. 4th Author | : Mega Syafriyanti |
| Affiliation | : Master of Public Health Study Program Student, Fort De Kock University Hilltop |
| Mailing address | : Payakumbuh, West Sumatra |

ABSTRACT

CIAF is an anthropometric index that combines three indices of weight, age, and height to determine the nutritional status of toddlers. Assessment of a child's nutritional status is carried out by comparing the results of measurements of weight and length/height with the child's anthropometric standards. Good nutritional status is an important factor in achieving optimal health. However, various nutritional disorders and malnutrition due to poor food quality or food quantity that does not match each person's body needs are still often found. Therefore, the purpose of this study is to know the determining factors of children's nutritional status based on Anthropometric Composite Index (IKA). This study aims to determine the determinants of children's nutritional status based on Composite Index of Anthropometrics (CIAF) in West Sumatra Province. Method: This type of research is quantitative with a cross-sectional research design conducted in May-August 2018. The study population was 9,164 children aged 24-59 months with a sample of 801 children aged 24-59 months in 10 districts and cities in West Sumatra Province. Data analysis used chi square statistical tests and logistic regression. Results of the study: Determinants related to children's nutritional status based on IMR in 10 districts and cities in West Sumatra Province were maternal education with (p 0.024; OR: 0.588 (0.37-0.93)), economic status (p 0.003; OR: 0.492 (0.31-0.78)), infectious diseases (p 0.000 5; (OR: 0.298 (0.21-0.43)) and dietary diversity (p : 0.000 5; OR: 0.2 17 (0.14-0.33)). Conclusion: Toddlers with short-thin and normal short categories, low maternal education level, lack of diversity in food, low economic status and infectious diseases are risk factors for growth failure in children based on CIAF.

Keywords: Education, Nutritional Status, Stunting Composite Index of Anthropometric Failure (CIAF)

ABSTRAK

CIAF adalah indeks antropometri yang menggabungkan tiga indeks berat badan, umur, tinggi badan untuk menentukan status gizi balita. Penilaian status gizi anak dilakukan dengan membandingkan hasil pengukuran berat badan dan panjang/tinggi badan dengan standar antropometri anak. Status gizi yang baik merupakan faktor penting dalam mencapai kesehatan yang optimal. Namun demikian, berbagai gangguan gizi dan kekurangan gizi akibat kualitas makanan yang kurang baik atau kuantitas makanan yang tidak sesuai dengan kebutuhan tubuh setiap orang masih sering dijumpai. Untuk itu tujuan dari penelitian ini adalah untuk mengetahui faktor-faktor penentu status gizi anak berdasarkan Indeks Komposit Antropometri (IKA). Penelitian ini bertujuan untuk mengetahui determinan status gizi anak berdasarkan Composite Index of Anthropometric (CIAF) di Provinsi Sumatera Barat. Metode: Jenis ini penelitian adalah kuantitatif dengan desain penelitian sectional cross yang dilakukan pada bulan Mei-Agustus 2018. Populasi penelitian sebanyak 9.164 anak usia 24-59 bulan dengan sampel sebanyak 801 anak usia 24-59 bulan di 10 kabupaten dan kota di Provinsi Sumatera Barat. Analisis data menggunakan uji statistik chi square dan regresi logistik. Hasil penelitian: Determinan yang berhubungan dengan status gizi anak berdasarkan AKBA di 10 kabupaten dan kota di Provinsi Sumatera Barat adalah pendidikan ibu dengan (p 0,024; ATAU : 0,588 (0,37-0,93)) , status ekonomi (p 0,003; OR : 0,492 (0,31-0,78)), penyakit infeksi (p 0,000 5; (OR: 0,298 (0,21-0,43)) dan keragaman makanan (p : 0,000 5; ATAU: 0,2 17 (0,14-0,33)). Kesimpulan: Balita dengan kategori pendek-kurus dan pendek normal, tingkat pendidikan ibu yang rendah, kurangnya keragaman dalam makanan , status ekonomi rendah serta infeksi penyakit merupakan faktor resiko terjadinya gagal tumbuh pada anak berdasarkan CIAF.

Kata kunci: Pendidikan, Status Gizi, Stunting, Indeks Komposit Kegagalan Antropometri (CIAF)

INTRODUCTION

Malnutrition in toddlers (children under five years old) has a negative impact on their growth and development. In the short term, malnutrition can lead to an increased risk of disease, disability, and even death. Meanwhile, in the long term, the impacts include decreased intellectual ability, economic productivity, and reproductive function, as well as an increased risk of metabolic and cardiovascular diseases. Based on the results of the 2022 Indonesian Nutritional Status Survey (SSGI), it was recorded that 7.7% of toddlers experienced wasting (acute malnutrition), 3.5% were overweight, 21.6% experienced stunting (stunted growth), and 17.1% experienced underweight (underweight). Stunting remains a major concern because it has the highest prevalence compared to other nutritional problems.

Stunting is a condition in which a toddler (under five years old) has a height that is not in accordance with his age and experiences permanent cognitive impairment caused by failure to thrive. Failure to thrive experienced by toddlers can have a negative impact in the future. The short-term impact is a decrease in academic achievement at school age due to decreased cognitive development. Meanwhile, the long-term impact is a decrease in the quality of life of toddlers in adulthood, both in terms of education, employment opportunities, and income. According to the United Nations International Children's Emergency Fund (UNICEF) in 2020, failure to thrive in children is caused by several main factors, namely direct, indirect, and supporting factors. Direct factors such as inadequate food consumption in terms of quality and quantity, and a history of infectious diseases. Indirect factors include children's diet⁷, parenting patterns⁵, health services, and environmental sanitation. In addition, supporting factors that can influence the incidence of growth failure in toddlers include governance, resources, and norms that apply in society.

In 2017, globally, 150.8 million children under the age of 5 were estimated to be stunted. Wasting was also estimated to threaten 7.5% or 50.5 million children under the age of five. An estimated 5.6% of children worldwide were overweight, or 38.3 million children. (WHO 2018). In developing countries, children aged 0-5 years are the most vulnerable group to nutrition. Children usually suffer from various infections and are in low nutritional status. The biggest nutritional problem in Indonesia is malnutrition. The number of malnourished toddlers in Indonesia is still quite high, namely 17.9% malnourished, 35.6% stunted and 13.3% underweight.

The prevalence of stunting in West Sumatra has fluctuated in recent years. In 2021, the stunting rate was recorded at 23.3%. However, in 2022, this prevalence increased to 25.2%, which is higher than the national average of 21.6%. This increase shows that there are still challenges in efforts to improve child nutrition and health in the region. This fluctuation in stunting rates shows that despite efforts to improve, more intensive and sustainable steps are still needed to achieve the national target of reducing stunting rates below 20%.

The method that can identify children who experience complex malnutrition failure is the composite anthropometric index method, namely the Composite Index of Anthropometric Failure or CIAF. (Smith, 2005). CIAF is an anthropometric index that combines three indices, namely weight, age and height to determine the nutritional status of toddlers. Children's anthropometric standards are used to evaluate or determine children's nutritional status. Assessment of children's nutritional status is carried out by comparing the results of measurements of weight and length/height with children's anthropometric standards. Classification of nutritional status assessment based on anthropometric indices is in accordance with the nutritional status category in the WHO Child Growth Standards for children aged 0-5 years. Anthropometric Standards and Child Growth Charts (SPA) consist of Weight by Age (BB/A), Weight by Height (BB/B), Height by Age (TB/A), and Body Mass Index by Age (BMI/A). Malnutrition in toddlers (under five years) has a negative impact on their growth and development. The short-term impacts of malnutrition include illness, disability, and death. (Ministry of Health of the Republic of Indonesia 2020)

Research conducted using data from the 2013 Riskesdas results showed that 2.5% of children in Indonesia experienced underweight, stunting, and wasting. The results of the study in Depok in 2024 found that 31% of children experienced growth failure based on CIAF. The number of normal children with the CIAF index is less than that of normal children with conventional indices such as Weight for Age (BB/A), Height for Age (TB/A), or Weight for Height (BB/TB)²². This shows that the CIAF index shows the prevalence of nutritional problems in children as a whole.

Handling of nutritional problems is closely related to the nation's strategy in creating healthy, intelligent and productive human resources. Efforts to improve quality human resources begin with

methods of handling child growth as part of a family with good and correct nutritional intake. Good nutritional status is an important factor in achieving optimal health. However, various nutritional disorders and malnutrition due to poor food quality or food quantity that does not meet the needs of each person's body are still often found. Low nutritional status clearly has an impact on the quality of human resources. Based on this background, it is necessary to conduct research that aims to determine the determining factors of children's nutritional status based on the Anthropometric Composite Index (IKA) in West Sumatra Province.

RESEARCH METHODOLOGY

This research is a descriptive research using design *cross-sectional*, observational research design conducted at a specific point in time to measure the relationship between independent variables (risk factors) and dependent variables (events or conditions being studied). The population in this study consisted of 9,164 children, while the sample used was 801 children aged between 2-5 years. The sample selection was conducted using the Simple Random Sampling technique. The inclusion criteria in this study were determined as follows: all mothers who have children aged 2–5 years and are willing to be respondents, mothers who can communicate well, mothers who have the ability to read and write, mothers who are in the health center's working area when the study was conducted, and children who are no longer receiving breast milk and are able to stand firmly. Exclusion criteria were mothers who checked their toddlers but were unwilling to be respondents for various reasons, mothers who checked their toddlers but did not routinely go to the integrated health post, respondents who were not present during visits to the integrated health post, and children who suffered from chronic infections. Primary data was obtained through the distribution of questionnaires that had been prepared to collect the necessary information. The questionnaire was given to respondents, namely mothers who had children aged 2-5 Years.

RESULTS

Assessment results The nutritional status of 801 toddlers in West Sumatra Province based on the results of measurements using CIAF (Height/Age and Weight/Height) can be seen in table 1 below:

Table . 1

Frequency Distribution of Nutritional Status of Children Aged 24-59 Months Based on KMS in West Sumatra Province

Nutritional Problems	Children aged 24-59 years		Z-Score
	f	%	
Short -Skinny	97	12.11	Z-Score Height/Age <-2 and Z-score Weight/Height <-2
Short -Normal	295	36.82	Z-Score TB/U <-2 and BB/TB Z-score between -2 to 2
Short-Fat	93	11.61	Z-Score ≥ -2 to ≤ 2
Normal-Thin	69	8.61	Z-Score TB/U ≥ -2 and BB/TB Z-score <-2
Normal-Normal	234	29.21	Z-Score TB/U ≥ -2 and BB/TB Z-score between -2 to 2
Normal- Fat	13	1.62	Z-score TB/U ≥ -2 and Z-score BB/TB >2
Total	801	100	

Information :

Information : Height/Age ≥ -2 SD $\rightarrow$ Normal (Not Stunting)
 TB/U < -2 SD to -3 SD $\rightarrow$ Stunting
 Height/Age < -3 SD $\rightarrow$ Severe Stunting

Assessment results nutritional status of 801 toddlers, only 234 toddlers (29.21%) have Normal-Normal nutritional status (Z-score Height/Age ≥ -2 and Z-score Weight/Height between -2 to 2). As many as 70.79% have abnormal nutritional status which has value Z-Score TB/U <-2, Z-Score TB/U ≥ -2 And Z-score BB/TB <-2, Z-score BB/TB between -2 to 2 And score-Z BB/TB >2.

The variables that are significantly related to the nutritional status of children in West Sumatra Province can be seen in Table 2.

Table 2
Determining Factors Related to Children's Nutritional Status Based on KIA in West Sumatra Province

Variables	Nutritional status				Total		p-value	OR (95% CI)
	Abnormal		Normal		f	%		
	F	%	f	%				
Food Diversity								
There is No Variety	261	62.6	156	37.4	417	100	0.0005	0.17
Various	348	90.6	36	9.4	384	100		(0.12 - 0.26)
Gender								
Woman	289	77.5	84	22.5	373	100	0.415	1.16
Man	320	74.8	108	25.2	428	100		(0.84 - 1.61)
Mother's Education								
Low	271	65.9	140	34.1	411	100	0.0005	0.29
Tall	338	86.7	52	13.3	390	100		(0.21 - 0.43)
Economic Status								
Low	257	64.4	142	35.6	399	100	0.0005	0.26
Tall	352	87.6	50	12.4	402	100		(0.18 - 0.37)
Disease Infection								
Yes.	193	60.9	124	39.1	317	100	0.0005	0.25
No.	416	86	68	14	484	100		(0.18 - 0.36)

Table 2 explains that Variables that are significantly related to the nutritional status of children in West Sumatra Province are food diversity, maternal education, economic status and infectious diseases ($p < 0.05$).

The analysis was continued with multivariate analysis with logistic regression test to see the influence of variables simultaneously on nutritional status and to see which variables had the greatest influence on children's nutritional status.

Table 3
Multivariate Analysis of Determinants Related to Children's Nutritional Status Based on the Composite Index of Anthropometric Failure (CIAF)

Variables	B	p-value	Exp (B)	95% CI
Mother's Education	-0.531	0.024	0.588	0.37 - 0.93
Economic Status	-0.709	0.003	0.492	0.31 - 0.78
Disease Infection	-1,210	0.0005	0.298	0.21 - 0.43
Food Diversity	-1,527	0.0005	0.217	0.14 - 0.33

Table 3 explains below Factors related to the nutritional status of children aged 2-5 years. based on IMR in 10 districts and cities in West Sumatra Province include maternal education (p 0.024; OR: 0.588 (0.37-0.93)), economic status (p 0.003; OR: 0.492 (0.31-0.93)), infectious diseases (p 0.0005; OR: 0.298 (0.21-0.43)), and food diversity (p 0.0005; OR: 0.217 (0.14-0.33)). Of the four variables, the most dominant factor influencing the nutritional status of children aged 2-5 years is maternal education with CI = 0.37-0.93.

DISCUSSION

Composite Index of Anthropometric Failure(CIAF) is a combined anthropometric index to determine the overall nutritional problems of children. The socio-economic conditions of the family

greatly affect the adequacy of primary, secondary needs, and the need for attention and affection that children receive. The family's ability to meet food needs is influenced by the family's income level. Low income means a low amount of money to be spent on food so that the food purchased for the family is not sufficient to obtain and maintain the health of all family members.

Table 1 explains that out of 801 toddlers, only 234 toddlers (29.21%) have normal nutritional status, with the criteria of height according to age (TB/A) Z-score ≥ -2 and weight according to height (BB/TB) Z-score between -2 to 2. Meanwhile, 70.79% of toddlers have abnormal nutritional status, which includes various conditions such as short-thin, short-normal, short-fat, thin-normal, and fat-normal. Where Anthropometric index with height for age (H/A) is used to assess stunting, while height also plays a role in other indicators such as BB/H and BMI/A to assess the overall nutritional status of children. $H/A \geq -2$ SD $\rightarrow$ Normal (Not Stunting), $H/A < -2$ SD to -3 SD $\rightarrow$ Stunting, $H/A < -3$ SD $\rightarrow$ Severe Stunting

It is known that children in the short-thin and short-normal categories are said to be stunted as many as 48.93% and children who have poor nutritional conditions are short-thin, normal-thin, short-fat as many as 32.33%.

This condition reflects a nutritional problem that needs more attention, because toddlers with abnormal nutritional status are at risk of experiencing growth and development disorders that can have long-term impacts. Variations in abnormal nutritional status indicate the complexity of nutritional problems in toddlers, which are not only limited to the problem of undernutrition (thin) but also include the problem of overnutrition (fat), as well as an imbalance between height and weight. Proper handling of this problem requires more focused nutritional interventions and efforts to raise awareness of the importance of a healthy and balanced diet. Research conducted by Ismail (2021) examined the phenomenon of the double burden of malnutrition, where stunting (undernutrition) and obesity (overnutrition) can occur simultaneously in children in Indonesia. The study found that both nutritional problems can hinder children's physical and cognitive development and impact their quality of life. This study encourages the need for a more holistic policy in addressing malnutrition, which involves aspects of nutrition, parental education, and access to healthy food.

Table 2 shows that the variables that are significantly related to the nutritional status of children in West Sumatra Province are food diversity, maternal education, economic status and infectious diseases, which provide an important picture of the factors that influence the quality of children's nutrition in the area. Food diversity, which includes the variety of foods consumed by children, has been shown to be an important factor in determining children's nutritional status. Good food diversity helps ensure that children get a variety of nutrients needed for optimal growth and development. Conversely, limited food diversity often leads to deficiencies in certain nutrients, such as vitamin and mineral deficiencies, which can inhibit children's growth process.

The higher the mother's education level, the lower the prevalence of stunting in toddlers. Mothers who have completed college education are known to have a protective effect on the risk of toddlers experiencing stunting compared to mothers who have only completed elementary or high school education. One of the indirect causes of malnutrition in toddlers is identified as the lack of adequate parenting. Several important aspects of parenting that can affect children's health and nutritional status include feeding, child health protection, and cognitive support and stimulation of children. The creation of good parenting cannot be separated from the role of the mother. Mothers are considered the most important party in the survival of toddlers. As someone who conceives, gives birth, breastfeeds, and cares for, mothers have a major influence on the growth and development of toddlers. One of the foundations for forming good parenting is through education. This is in line with research conducted by Alvarado, GR, & Taylor, M. (2019), which shows that the level of maternal education affects the nutritional status of children in developing countries. Mothers with

higher levels of education are known to be better able to provide good nutrition to their children, so that the risk of malnutrition can be reduced and overall health can be improved.

The researcher's assumption is that maternal education plays a very important role in determining the nutritional status of toddlers, because the knowledge gained through education gives mothers the ability to make better decisions related to meeting their children's nutritional needs. We assume that mothers with higher education are more likely to understand the importance of a balanced and nutritious diet, which in turn increases their ability to provide food that meets their children's nutritional needs. In addition, highly educated mothers are more likely to be involved in health programs that can support children's health, such as immunization and regular health checks, which directly support children's growth and development.

Low economic status is a risk factor for growth failure based on CIAF with CI-(0.18 - 0.37). Economic status plays a significant role in the growth and development of toddlers. Children raised in families with low economic levels are at greater risk of experiencing growth failure, including stunting and malnutrition. Research in Tanzania showed similar results, where children from poor families had a higher risk of experiencing growth failure based on the Composite Index of Anthropometric Failure (CIAF) compared to children from families with better economic conditions. Another study in India also revealed that children from poor households were twice as likely to experience growth failure based on CIAF compared to children from more prosperous families. Families with lower economic status often have difficulty providing nutritious food on a regular basis. As a result, children from these families are more vulnerable to malnutrition which impacts their health and development. Therefore, interventions to increase family income, such as social assistance programs or skills training, can help improve children's nutritional status. Infectious diseases, such as diarrhea, acute respiratory infections, and others, also have a significant impact on children's nutritional status. Infections can interfere with nutrient absorption and cause children to lose their appetite, which ultimately affects the body's nutritional balance. The presence of infectious diseases that are not treated properly can worsen malnutrition in children, especially in areas with limited health facilities.

Research conducted by Htet et al. (2023) showed a significant relationship between economic status and nutritional status. This finding is in line with previous studies that also identified economic status as a determinant of nutritional status, as found by Ramendra Nath Kundu et al. (2022). Low economic factors are often associated with limited access to nutritious food, education, and health services, which can ultimately affect children's nutritional status. Research conducted by Shiferaw and Regassa (2023) emphasized the importance of developing poverty alleviation methods to address food insecurity and malnutrition in children. They revealed that poverty alleviation can increase family access to the resources needed to meet children's nutritional needs, thereby reducing the risk of malnutrition and stunting. This shows that efforts to improve family economic conditions, especially in the context of poverty alleviation, have a significant role in increasing food security and improving children's nutritional status.

The researcher's assumption is that family economic status plays an important role in determining children's access to nutritious food and health care. We assume that families with low economic status often have difficulty in purchasing nutritious food regularly, which can lead to their children being undernourished or malnourished. This can worsen children's health and hinder their physical and cognitive development. Therefore, we assume that interventions that increase family income, such as social assistance programs or skills training, can contribute to improving children's nutritional status by helping families meet their nutritional needs.

The limitations of this study are related to the selection of research variables. Only postnatal factors were analyzed, such as child factors, maternal factors, household factors, health services, and history of infectious diseases, without considering prenatal factors (before the baby is born).

CONCLUSION AND SUGGESTIONS

The prevalence of stunting in children based on CIAF in areas with high stunting reaches a quarter of the total number of toddlers (48.93%). Toddlers with short-thin and normal stunting categories, low maternal education levels, lack of diversity in food, low economic status and infectious diseases are risk factors for stunting in children based on CIAF. It is recommended that prevention of stunting in children begin as early as possible, even in the womb through the provision of adequate prenatal care services, to reduce the incidence of low birth weight (LBW) babies. After birth, the quality and quantity of food and fluid intake should be improved to support optimal physical and cognitive development during childhood. In addition, it is very important to ensure that all children receive complete immunization, with children from poor households being a special focus for nutritional interventions.

REFERENCES

- Al-Sobaihi, S, K Nakamura, and M Kizuki. 2016. "Malnutrition in Children Under 5 Years of Age in Yemen: The Role of Adequate Childcare Provided by Adults in a Food Insecure Situation." *J Rural Med* 11(2): 47-57. doi:10.2185/jrm.2915.
- Azrimaidaliza, Azrimaidaliza, Welly Femelia, Sukarsi Rusti, Resmiati Resmiati, and Nadia Nur. 2020. "A Comparison: Composite Index of Anthropometric Failure (CIAF) Incidents in Bukittinggi City and Dharmasraya Regency, Indonesia." In *AIPHC* 2019, , 1-6. doi:10.4108/eai.9-10-2019.2297252.
- Balogun, Oluwafemi Samson, Atta Muhammad Asif, Muhammad Akbar, Christophe Chesneau, and Farrukh Jamal. 2021. "Prevalence and Potential Determinants of Aggregate Anthropometric Failure Among Pakistani Children: Findings from a Community Health Survey." *Children* 8(11). doi: 10.3390/children8111010.
- Byrne, Rebecca, Mei En Joy Yeo, Kimberley Mallan, Anthea Magarey, and Lynne Daniels. 2018. "Are Australian Children's Higher Formula Intake and Limited Dietary Diversity at 14 Months Associated with Diet Quality at 24 Months?" *Appetite* 120: 240-45. doi: 10.1016/j.appet.2017.09.002.
- Chowdhury, Mohammad Rocky Khan, Hafiz TA Khan, Mamunur Rashid, Md Nazrul Islam Mondal, Farzana Akhter Bornee, and Baki Billah. 2022. "Prevalence and Correlation of Severe Anthropometric Failure in Toddlers Measured by Composite Index of Severe Anthropometric Failure in Bangladesh." *Frontiers in Pediatrics* 10. doi: 10.3389/fped.2022.978568.
- Dasgupta, Aparajita, R Parthasarathi, Ram Prabhakar V, Rahul Biswas, and A Geethanjali. 2015. "Assessment of Malnutrition by Composite Index of Anthropometric Failure (CIAF) Among Under-five Children in Rural West Bengal Keywords : " *Indian Journal of Public Health* 26(02): 132–38.
- Department of Health of the Republic of Indonesia. Basic health research report of West Java Province. Jakarta: Department of Health of the Republic of Indonesia; 2010
- Dhakal, Ram Prasad. 2023. "Factors Associated with Anthropometric Measurements of Children in Nepal: A Provincial Level Analysis Based on NDHS Data 2016." *Journal of Knowledge and Innovation* (May): 75–84. doi:10.3126/jki.v9i1.53074.
- Fenta, Haile Mekonnen, Temesgen Zewotir, and Essey Kebede Muluneh. 2021. "Spatial Data Analysis of Malnutrition in Children Under Five Years in Ethiopia." *BMC Medical Research Methodology* 21(1): 1–13. doi:10.1186/s12874-021-01391-x.
- Fenta, Haile Mekonnen, Temesgen Zewotir, and Essey Kebede Muluneh. 2022. "A Space-Time

- Dynamic Regression Model to Assess Variation of Composite Index for Anthropometric Failure Across Administrative Zones in Ethiopia.” *BMC Public Health* 22(1): 1–11. doi:10.1186/s12889-022-13939-7.
- Fentahun, Netsanet, Tefera Belachew, and Carl Lachat. 2016. “Determinants and Morbidity of Multiple Anthropometric Deficits in Rural Southwestern Ethiopia.” *Nutrition* 32(11-12): 1243–49. doi:10.1016/j.nut.2016.03.023.
- Gausman, Jewel, Rockli Kim, Zhihui Li, Lucia Tu, Sunil Rajpal, William Joe, and SV Subramanian. 2022. "Comparison of Anthropometric Indicators of Childhood Undernutrition in 56 Low- and Middle-Income Countries." *JAMA Network Open* 5(3): 1–13. doi:10.1001/jamanetworkopen.2022.1223.
- Gilano, Girma, Samuel Hailegebreal, Sewunet Sako, and Binyam Tariku Seboka. 2022. "Stunting and Associated Factors in Children Aged 6–23 Months in Ethiopia: Application of Generalized Latent Linear Modeling and Mixed Modeling." *Food Ecology and Nutrition* 61(5): 608–23. doi:10.1080/03670244.2022.2109023.
- Hastoety, SP et al (2018). Disparity of Malnourished Toddlers in Indonesia. *Health Research and Development Media* 28, 201–210.
- How, Eric Tan Chee, Suzana Shahar, Fredie Robinson, Abdul Marsudi bin Manah, Mohd Yusof Ibrahim, Mohammad Saffree Jeffree, Syed Sharizman Syed Abdul Rahim, and Aza Sherin binti Mohd Yusuff. 2020. "Risk Factors for Malnutrition in Toddlers in Tenom, Sabah, Malaysia." *Malaysian Journal of Public Health Medicine* 20(1): 71–81. doi:10.37268/mjphm/vol.20/no.1/art.557.
- Htet, Min Kyaw, Tran Thanh Do, Thet Wah, Thant Zin, Myat Pan Hmone, Shahreen Raihana, Elizabeth Kirkwood, Lwin Mar Hlaing, and Michael J. Dibley. 2023. "Socioeconomic and Agricultural Factors Associated with Stunting in Children Under Five Years: Findings from a Survey in the Mountain, Dry Zone, and Delta Regions of Rural Myanmar (2016-17)." *Public Health Nutrition*: 207-10. doi: 10.1017/S1368980023001076.
- Ismail, S., Akin, J., & Utami, T. (2021). Stunting and overweight in children under five: A double burden double burden of malnutrition in Indonesia. *International Journal of Environmental Research and Public Health*. *Environmental Research and Public Health*, 18(4), 1680. <https://doi.org/10.3390/ijerph18041680>
- Ministry of Health of the Republic of Indonesia. 2020. Regulation of the Minister of Health No. 2 of 2020 Concerning Children's Anthropometric Standards. Indonesia.
- Kundu, RN, Ramendra Nath Kundu, Juri Borah, Susmita Bharati, and Premananda Bharati. 2023. "Regional Distribution of Anthropometric Failure in Toddlers and Its Determinants in India." (1).
- Kundu, Ramendra Nath, Golam Hossain Id, Ahshanul Haque, and Subir Biswas. 2022. "Factors Associated with Anthropometric Failure among Bengali Toddlers: A Comparative Study between Bangladesh and Indonesia." *PLOS ONE*: 1–14. doi:10.1371/journal.pone.0272634.
- Mburano, Jean-Robert Rwenge, and Aoudou Njingouo Mounchingam. 2021. "Déterminants Individuels, Familiaux et Contextuels de La Malnutrition Des Enfants de Moins de Cinq Ans Au Cameroun." *Biostatistiques et sciences de la santé* 2(2): 1–27. doi:10.21494/iste.op.2021.0728.
- McDonald, Christine M., Ibrionke Olofin, Seth Flaxman, Wafaie W. Fawzi, Donna Spiegelman, Laura E. Caulfield, Robert E. Black, Majid Ezzati, and Goodarz Danaei. 2013. “The Effect of Multiple Anthropometric Deficits on Child Mortality: A Meta-Analysis of Individual Data in 10 Prospective Studies from Developing Countries.” *American Journal of Clinical Nutrition* 97(4): 896–901. doi:10.3945/ajcn.112.047639.
- Mutisya, Linet M. 2019. "Socioeconomic Determinants and Nutritional Status of Children Aged 0-59 Months; A Population-Based Survey in Wolayita Zone, Rural Ethiopia." UPPSALA UNIVERSITY. <https://www.diva-portal.org/smash/get/diva2:1424245/FULLTEXT01.pdf>.
- Nie, Peng, Anu Rammohan, Wencke Gwozdz, and Alfonso Sousa-Poza. 2019. “Changes in Child

- Nutrition in India: A Decomposition Approach." *International Journal of Environmental Research and Public Health* 16(10): 1–22. doi:10.3390/ijerph16101815.
- Permatasari, Tria AE, Chairunnisa, Hernani Djarir, Lily Herlina, Munaya Fauziah, Andriyani, and Yudi Chadirin. 2023. "Determinants of Stunting in Toddlers in Three Municipalities in the Special Capital Region of Jakarta." *Public Health* 18(1): 32–40. doi:10.21109/kesmas.v18i1.6405.
- Phong, Hai, Ngan TD Hoang, Liliana Orellana, Tuyen D Le, Rosalind S Gibson, Anthony Worsley, Andrew J Sinclair, Nghien TT Hoang, and Ewa A Szymlek-gay. 2019. "Anemia and its Association with Demographic, Socioeconomic and Anthropometric Factors in Rural Primary School Children in Hai Phong City, Vietnam." *Nutrition* 11: 1–15.
- Rahmadini, Nurani, Trini Sudiarti, and Diah Mulyawati Utari. 2013. "Nutritional Status of Toddlers Based on the Composite Index of Anthropometric Failure." *Public Health: National Journal of Public Health* 7(12): 538. doi:10.21109/kesmas.v7i12.327.
- Sen, Jaydip, Sima Dey, and Nitish Mondal. 2011. "Community Conventional Nutrition Index and Composite Index of Anthropometric Failure: Which is More Appropriate for Assessing Malnutrition Among Children? A Cross-Sectional Study Among School Children of Bengali Muslim Population." *ITALIAN JOURNAL OF PUBLIC HEALTH* 8(2): 173–85.
- Sen, Jaydip, and Nitish Mondal. 2012. "Socio-Economic and Demographic Factors Affecting Composite Index of Anthropometric Failure (CIAF)." *Annals of Human Biology* 39(2): 129–36. doi:10.3109/03014460.2012.655777.
- Shiferaw, Negussie, and Nigatu Regassa. 2023. "Levels and Trends of Key Socioeconomic Inequalities in Childhood Undernutrition in Ethiopia: Evidence from the Ethiopian Demographic and Health Survey 2000-2019." *Discover Social Science and Health* 3(1). doi:10.1007/s44155-023-00034-4.
- Smith, George Davey. 2005. "Poverty, Malnutrition and Child Morbidity: New Evidence from India." *Bulletin of the World Health Organization* 011650(04): 210–2016.
- WHO. 2018. *Asia-Pacific Journal of Population Extent and Trends in Childhood Malnutrition*. Geneva: WHO. doi:10.18356/6ef1e09a-en.
- World Health Organization. 2023. 27th quarterly Milbank Memorial FundWorld Health Statistics Health Monitoring for the Sustainable Development Goals (SDGs).