

ORIGINAL ARTICLE

The correlation between basic measles immunization historical and nutritional status on toddler: factorial stunting prevalence

Bella Mardya^{a*} | Muhsinin Muhsinin^b | Diah Retno Wulan^c

^aNursing Profession Department, Faculty of Nursing and Health Science, Universitas Muhammadiyah Banjarmasin

^bPediatric Nursing Department, Faculty of Nursing and Health Science, Universitas Muhammadiyah Banjarmasin

^cCritical Nursing Department, Faculty of Nursing and Health Science, Universitas Muhammadiyah Banjarmasin

* Corresponding Author: bella.mardya16@gmail.com

ARTICLE INFORMATION

Article history

Received March 20, 2023

Revised June 10, 2023

Accepted July 05, 2023

Keywords

Growth Disorders, Measles Immunization, Nutritional Status, Stunting, Toddler

ABSTRACT

Introduction: The problem of nutritional status in toddlers is still one of the world's problems that must continue to be resolved, such as stunting. Stunting, or being too short for one's age, is below -2 standard deviations from the median height-for-age z-score. Stunting can directly be affected by infectious disease and incomplete immunization, such as essential measles immunization.

Objectives: This research aims to determine and analyze the correlation between essential measles immunization and nutritional status, especially the incidence of stunting in toddlers. **Methods:** This observational analytic study used a cross-sectional approach with non-probability sampling. The samples included 134 toddlers who were 12-36 months, were not sick, and had the KIA/KMS book. Primary measles immunization and nutritional status were dependent variables, whereas stunting prevalence was independent. Data analysis used the Spearman's Rho correlation test with $\alpha = 0.05$. **Results:** The results showed that most toddlers experienced nutritional status problems, especially stunting (51.5%), and that most had received primary measles immunization (67.9%) and based on the Spearman's Rho statistical test, obtained $p\text{-value} = 0.003$ ($p\text{-value} < 0.05$) with correlation coefficient (r) = -0.251. **Conclusions:** A significant correlation exists between essential measles immunization and nutritional status, especially in stunting. This finding suggests that the local government should initiate an innovative program of health education focusing on knowledge and preventing the increasing stunting, such as by collaborating with the nursing profession, which can act as an exemplary educator and caregiver.

Journal of Nursing is a peer-reviewed journal published by the School of Nursing at the Faculty of Health Science, University of Muhammadiyah Malang (UMM), and affiliated with the Indonesia National Nurse Association (INNA) of Malang.

This journal is licensed under the [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/)

Website: <http://ejournal.umm.ac.id/index.php/keperawatan>

E-mail: journal.keperawatan@umm.ac.id

1. Introduction

The growth and development of children is a serious matter, not only for Indonesia (Beal et al., 2018) but also for the whole world. Optimal growth for a child is a normal progression of changes in height, weight, and head circumference according to age standards in the pediatric population. Optimal growth is reflected as a condition of good health and nutritional status in childhood (Schnepf & Hurlock, 2016). However, not all children experience optimal growth according to age because some experience growth faltering. Growth faltering is defined as a poor pattern of nutritional status and weight gain caused by three general mechanisms, namely inadequate intake of nutrients to support growth, malabsorption of nutrients, and disorders of nutrient metabolism caused by chronic disease or congenital metabolic disorders (Titaley et al., 2019). There are many types of nutritional status problems that can cause growth and development faltering in children, including stunting.

Stunting is a problem that the whole world must solve. Globally, in 2016, 22.9% or 154.8 million children under five years of age suffered from child stunting, defined by low height-for-

age ([WHO Library Cataloguing-in-Publication Data, 2018](#)). In 2017, of the 83.6 million stunting children under five in Asia, the most significant proportion came from South Asia (58.7%), and the lowest was Central Asia (0.9%). Indonesia is one of the third countries with the highest prevalence (36.4%) in the Southeast Asia Region after Timor Leste (50.5%) and India (38.4%) ([Juliansyah, 2018](#)). For 2019, the national stunting prevalence rate is 27.67%. Although there has been a decrease in prevalence, stunting is still considered a severe problem in Indonesia because the prevalence rate is still above 20% ([Teja, 2019](#)).

Data on the nutritional status of children under five shows that in 2018, 28.77% of children under five were stunting at Pemurus Dalam Health Center, Banjarmasin City, South Kalimantan, Indonesia, while 2019 data from Pemurus Dalam Health Center ranked third for stunting with an increase in the percentage of toddlers with stunting, which was 29.50%, consisting of 9.14% of toddlers are very short and 20.40% are short ([Banjarmasin Health Office, 2020](#)).

Stunting is a dominant nutritional problem in Indonesia compared to other nutritional issues such as malnutrition, underweight, and overweight ([Fitriani et al., 2020](#)). Stunting has many adverse effects on the national economy; stunting is an enormous drain on economic productivity and growth. Economists estimate that stunting can reduce a country's gross domestic (CGD) product by up to 3% ([WHO, 2020](#)). Besides that, stunting has many effects on children's health and development; stunting has long-term effects on individuals and societies, including diminished cognitive and physical development, reduced productive capacity and poor health, and an increased risk of degenerative diseases such as diabetes ([WHO, 2020](#)).

WHO in Data and Information Center [Ministry of Health of the Republic of Indonesia \(2018\)](#) also explains the long-term impact that stunting children will experience, namely, posture that is not optimal as adults (shorter than in general), risk of obesity and other diseases, decreased reproductive health and capacity for learning and work and sub-optimal performance during school. Based on the prevalence of stunting and the adverse effects it causes, stunting is now identified as a significant global health priority and the focus of several high-profile initiatives like Scaling Up Nutrition, the Zero Hunger Challenge, and the Nutrition for Growth Summit ([de Onis & Branca, 2016](#)). Reducing the number of children suffering from stunting is the first target of the six other targets in the Global Nutrient Targets for 2025. The second indicator must be achieved in the Sustainable Development Goals (SDGs), namely, to reduce hunger and all forms of malnutrition ([Wicaksono & Harsanti, 2020](#)).

Several factors cause a child to experience stunting, one of which is the completeness of primary immunization for children from 0-24 months. The measles immunization is one type of immunization that has received more attention; this is in line with Indonesia's global commitment to participate in eliminating measles and controlling rubella by 2020 by achieving a minimum measles immunization coverage of 95% in all regions. The program for giving measles immunization to children under five is expected to be able to provide prevention against measles infection ([Amaliyah & Mulyati, 2020](#)).

Measles is highly contagious when a person with measles breathes, coughs, or sneezes. Measles causes a rash and fever and results in failure to thrive in infants and young children; if children get measles, they could get the most severe complications including blindness, encephalitis (an infection that causes swelling of the brain), severe diarrhea and dehydration, and severe respiratory infections such as pneumonia ([Noorhasanah et al., 2020](#); [de Onis & Branca, 2016](#)) Children who were not immunized against measles, it affected the duration of diarrhea and fever, thus affecting the nutritional status and ultimately disrupting growth and development ([Noorhasanah et al., 2020](#)). In addition, disturbances in the respiratory system and the occurrence of fever in children as a series of processes from the course of measles will also affect the disruption of the child's growth and development process associated with metabolic disorders and decreased nutritional intake, which results in inadequate nutritional intake that supports children's growth such as height ([Solis-Soto et al., 2020](#)).

Children who have received measles immunization are expected to avoid measles and its complications in the form of encephalitis, pneumonia, and severe diarrhea that often accompanies measles. Therefore, measles immunization is essential to help prevent pneumonia and severe diarrhea (Sinambela et al., 2019). Diarrhea or other inflammatory gastrointestinal diseases and fever in children will affect development (Brander et al., 2019). Children who do not get complete immunization are more susceptible to illness, especially diarrhea, and ARI, so children have difficulty or no appetite, which results in unfulfilled nutrition in toddlers and ultimately causes children to have shorter bodies than they should and have the potential to experience stunting in the future (Kaunang et al., 2016).

Children who do not have a history of basic immunizations, one of which is measles immunization, have a chance of becoming stunted 1,983 times. There is a significant correlation between giving measles immunization and prevention of the occurrence of stunting. Based on the research, it is concluded that giving measles immunization can reduce the incidence of stunting by 11.50% -18.30% (Bogler et al., 2019). Thus, the completeness of basic immunizations, one of which is measles immunization, significantly affects stunting (Noorhasanah et al., 2020).

Whereas stunting is influenced by the health of toddlers who have been immunized, nutritional intake, and parenting patterns (Kang et al., 2018; Purwaningtyas et al., 2019). In addition, measles affects appetite in children, resulting in disruption of metabolism and a decrease in nutritional intake, which results in inadequate intake of nutrients that support child growth and development, such as height and weight.

Effective measles immunization in infants can prevent around 11% of under-five deaths due to pneumonia as part of the clinical course of measles (Sinambela et al., 2019). Infectious diseases such as measles can interfere with linear growth by first affecting the nutritional status of children under five. It occurs because infectious diseases such as measles can reduce food intake, interfere with the absorption of nutrients, cause direct loss of nutrients, and increase metabolic needs (Setiawan et al., 2018).

Therefore, the research results have been put forward into a research gap that needs to be studied, especially in areas with a relatively high incidence of stunting in Pemurus Dalam District, Banjarmasin City, South Kalimantan Province, Indonesia. This research aimed to determine the relationship between essential measles immunization and nutritional status, a factorial of stunting prevalence in toddlers. Therefore, based on the background and description of the problems above, the researchers are interested in researching the correlation between essential measles immunization history and the nutritional status of toddlers in the prevalence of stunting.

2. Methods

This observational analytic study used a cross-sectional approach with non-probability sampling (accidental sampling) and was conducted from February to May 2021.

The population in this study were all toddlers in the Pemurus Dalam Public Health Center of Banjarmasin City working area who have a KIA/KMS book. In contrast, the samples are 134 toddlers who were 12-36 months, were not sick (such as common cold, cough, fever, diarrhea), and have the KIA/KMS book.

Primary measles immunization and nutritional status were dependent variables, whereas stunting prevalence was independent. Primary data were obtained from filling out the documentation study form based on the KIA book and measuring toddlers' weight, height, and abdominal circumference. Secondary data was obtained from books with KIA (children's medical records) at Pemurus Dalam Public Health Center.

The number of samples taken from this study was adjusted to the number of children under five found from nine integrated health cares (*Posyandu*) which were taken using non-probability sampling, namely the accidental sampling technique that the researchers present in every *Posyandu* activity. Therefore, the samples from the study amounted to 134 respondents without bias because these samples were by accidental sampling.

Data were obtained from documentation study from the KIA book (observations of the KIA/KMS) and measured the toddler's height with a microtome or infantometer board and compared with the table of measurement table recommended by WHO. In this research, the researchers used a documentation study form instrument made by us in the form whose filling is adjusted to the history of immunization data for children written in the child's KIA/KMS book. Besides that, the form is also filled in based on the child's anthropometric index data adjusted with the standard anthropometric measurement table recommended by WHO 2005 and also contained in the regulation of the Minister of Health of the Republic of Indonesia number two of 2020 concerning anthropometric standards for children (Ministry of Health of the Republic of Indonesia, 2020). Therefore, using these instruments did not go through the validity and reliability test. Then, Spearman's Rho with $\alpha = 0.05$ for the data analysis. Data were analyzed using statistical analyzing software, SPSS version 25.0.

3. Results and Discussion

3.1 Results

Based on Table 1, it is shown that the majority age of respondents are 12-24 months old (45.5%). Based on gender, the majority of respondents were 52.2% male. In addition, based on the primary measles immunization, most respondents got immunization (67.9%). Based on nutritional status, most respondents were stunted (51.5%).

Table 1. Distribution of Respondents Frequency based on Age, Gender, Basic Measles Immunization, and Nutritional Status (n=134)

Characteristics	Quantity (Frequency)	Percentage (%)
Gender		
Male	74	52.2
Female	60	44.8
Age		
12-24 months	61	45.5
25-36 months	73	54.5
Basic Measles Immunization		
Got Immunization	91	67.9
Did not get immunization	43	32.1
Nutritional Status		
Prevalence Stunting	69	51.5
Normal	65	48.5

Table 2. Cross-tabulation of Correlation between Giving Basic Measles Immunization on Nutritional Status of Toddlers

Basic Measles Immunization	Nutritional Status			Quantity (Frequency)	Percentage (%)	
	Stunting	%	Normal	%		
Got Immunization	39	29.1	52	38.8	91	67.9
Did not get immunization	30	22.4	13	9.7	43	32.1
Sum	69	51.5	65	48.5	134	100.0
Spearman's Rho Test	ρ value = 0.003			r = - 0.251		

Based on the results of statistical tests using Spearman's Rho test, the ρ value = 0.003 is obtained by setting the degree of significance at 0.05, which means the hypothesis of this research is accepted. From the acquisition of the value, it can be concluded that there is a significant correlation between the history of giving essential measles immunization and nutritional status, in this case, the incidence of stunting in toddlers in the working area of Pemurus Dalam Public Health Center in Banjarmasin City.

The results of this statistical test analysis also show that the value of the correlation coefficient (r) is -0.251, which means the correlation between the two variables is weak correlation, and the direction of the correlation between the variables is opposite (the correlation coefficient is worth opposing). The negative value is the opposite value from each variable, which means if the basic measles immunization coverage is increased, then a nutritional status problem, especially the incidence of stunting in toddlers, can be lowered.

3.2 Discussion

Measles vaccination/immunization can substantially reduce the incidence of stunting by reducing diarrhea and fever, resulting in decreased nutritional status in children adversely affecting weight loss and impaired metabolism in low and middle-income countries (Bogler et al., 2019). This study also aligns with research that states a relationship between immunization and the incidence of stunting in children (Bogler et al., 2019). Children who do not have a history of basic immunizations, one of which is measles immunization, have a chance of becoming stunted 1,983 times. There is a significant correlation between giving measles immunization and preventing stunting of children (Bogler et al., 2019).

Based on the research, it is concluded that giving measles immunization can reduce the incidence of stunting by 11.50% -18.30% (Bogler et al., 2019). Immunization can reduce mortality and morbidity in children (Berendsen et al., 2016; Bogler et al., 2019). In addition, immunization in children from an early age and at the right age can reduce the risk of children experiencing stunting (Andriani, 2017).

Measles vaccination aims to prevent a child from suffering from measles or other infections that can accompany measles, such as acute respiratory infections (ARI), pneumonia, or acute diarrhea to severe diarrhea (Noorhasanah et al., 2020). If toddlers often experience infections in their growing age, it is feared that they will be at risk for developing growth disorders in the future. Infection in children causes disturbances in the body's metabolism and immune system due to inflammation. In addition to inadequate nutritional intake due to decreased appetite, the association of a history of infection with growth disorders is related to the mechanism of infection/inflammation. At the time of infection/inflammation, the protein hsRC (High-sensitivity C-reactive Protein) is secreted by the body and has an impact on growth hormone resistance GH (Growth Hormone) (DeBoer et al., 2017; Alaraj et al., 2021).

Historical infections or inflammation, such as disorders of the respiratory system and the occurrence of fever in children as a series of processes from the course of measles, will also reduce the function of nutritional intake so that it delays the child's growth and development process (Brander et al., 2019). In addition, the mechanism that occurs is related to metabolic disorders and low performance of the body's absorption of the minerals eaten, so that it is inadequate to support children's growth and development such as height, which can make children stunted (Noorhasanah et al., 2020). Infections such as measles and its complications in the body will inhibit the work of Insulin Growth Factor-1 (IGF-1), which acts as a mediator between GH and the growth of muscle and bone cells in humans.

Therefore, if the work of IGF-1 in toddlers is inhibited, it can disrupt the growth process of muscle and bone cells during the growth and development of toddlers. Research in Tanzania shows that levels of IGF-1 play a protective role against stunting in children (Syed et al., 2018). Therefore, to minimize the incidence of infections such as measles and its complications during childhood growth, one of the interventions that can be done is to provide measles immunization.

This study has several strengths and limitations. As a strength, this research is the first in Indonesia and South Kalimantan to study the correlation between stunting and giving essential measles immunization to toddlers. This research is one of the continued researches done in several countries by Bogler et al. in 2019, and we have never found similar research in Indonesia and South Kalimantan.

Besides the strengths, this study has several limitations. The first research location was one location, Pemurus Dalam District, Banjarmasin City, South Kalimantan, Indonesia. The study may be conducted in other areas to explore the same context with various variables. Secondly, this research was carried out during the COVID-19 pandemic. Therefore, the *Integrated Healthcare Center (Posyandu)* activities are to be carried out door-to-door or through home visits; this is different from the *posyandu* implementation process before the COVID-19 pandemic, so the sample and data collection process can only be obtained through accidental sampling technique with a certain number of samples within a predetermined research time limit. Therefore, a larger sample size will be needed for the following research.

4. Conclusion

This research shows that if the basic measles immunization coverage is increased, nutritional status problems, especially the incidence of stunting in toddlers, can be lowered. There is a significant correlation between the history of giving essential measles immunization and the nutritional status of toddlers, especially for the category of stunting. Innovative health education is still needed to increase public knowledge to increase knowledge and prevention behavior to reduce the risk of stunting. This research can contribute as a reference in increasing the role of nurses as educators who will educate the public, especially in the *Posyandu* activity, for increasing interest in immunization to prevent infections in toddlers that can cause growth disorders. Another benefit is that the nursing profession is expected to contribute to the success of achieving the SDGs target of reducing the incidence of stunting by 2025.

This research can also contribute and provide evidence-based information and additional knowledge and mobilize the public to make evidence-based decisions (evidence-based decision making), especially for parents and prospective parents to participate in improving the health status of their children. In addition, parents can also be involved in efforts to achieve the SDGs targets and encourage parents to be more concerned with the health of their children, one of which is through assessing and monitoring of children's health and growth and development as well as providing complete basic immunizations, one of which is primary measles immunization on a toddler. This study can provide input on the level of knowledge and behavior of the government in making the right policies and strategies regarding the prevention of stunting.

Ethics approval and consent to participate

The Human Research Ethics Committee of the University of Muhammadiyah Banjarmasin reviewed and approved this research with validation number 034/UMB/KE/IV/2021. The ethical principles used during the research involve the informed consent principles, anonymity, confidentiality, and justice.

Acknowledgments

The author expresses praise and gratitude to Allah *Subhanahu Wa Ta'ala*, thanks to all those who have contributed to this research, Pemurus Dalam Public Health Center Staff, all *Integrated Healthcare Center (Posyandu)* and also cadres where we conducted the research, and all participants who were willing to provide data, participate, and support in this study until it was finished.

References

- Alaaraj, N., Soliman, A., & Rogol, A. D. (2021). Growth of malnourished infants and children: How is inflammation involved? *Expert Review of Endocrinology and Metabolism*, 16(5), 213–216. <https://doi.org/10.1080/17446651.2021.1956903>
- Amaliyah, E., & Mulyati, M. (2020). Effectiveness of health education and nutrition rehabilitation toward community empowerment for children under five years with stunting: A quasi-experimental design. *Jurnal Ners*, 15(2), 173–177.
- Andriani, L. (2017). Hubungan Karakteristik Balita, Umur Saat Imunisasi Campak, Riwayat Asi Eksklusif Terhadap Campak Klinis. *Jurnal Berkala Epidemiologi*, 5(2), 265–272. <https://doi.org/10.20473/jbe.v5i2.2017.265-275>
- Banjarmasin Health Office. (2020). Profil Kesehatan Kota Banjarmasin Tahun 2019. Laporan Tahunan Pemerintah Kota Banjarmasin.
- Beal, T., Tumilowicz, A., Sutrisna, A., Izwardy, D., & Neufeld, L. M. (2018). A review of child stunting determinants in Indonesia. *Maternal and Child Nutrition*, 14(4), 1–10. <https://doi.org/10.1111/mcn.12617>
- Berendsen, M. L. T., Smits, J., Netea, M. G., & van der Ven, A. (2016). Non-specific effects of vaccines and stunting: Timing may be Essential. *EBioMedicine*, 8, 341–348. <https://doi.org/10.1016/j.ebiom.2016.05.010>
- Bogler, L., Jantos, N., Bärnighausen, T., & Vollmer, S. (2019). Estimating the effect of measles vaccination on child growth using 191 DHS from 65 low- and middle-income countries. *Vaccine*, 37, 5073–5088. <https://doi.org/10.1016/j.vaccine.2019.06.05>
- Brander, R. L., Pavlinac, P. B., Walson, J. L., John-Stewart, G. C., Weaver, M. R., Faruque, A. S. G., ... Kotloff, K. L. (2019). Determinants of linear growth faltering among children with moderate-to-severe diarrhea in the Global Enteric Multicenter Study. *BMC Medicine*, 17(1), 1–16. <https://doi.org/10.1186/s12916-019-1441-3>
- de Onis, M., & Branca, F. (2016). Childhood stunting: A global perspective. *Maternal and Child Nutrition*, 12, 12–26. <https://doi.org/10.1111/mcn.12231>
- DeBoer, M. D., Scharf, R. J., Leite, A. M., Ferrer, A., Havt, A., Pinkerton, R., Lima, A. A., & Guerrant, R. L. (2017). Systemic inflammation, growth factors, and linear growth in the setting of infection and malnutrition. *Nutrition*, 33, 248–253. <https://doi.org/10.1016/j.nut.2016.06.013>
- Fitriani, H., R, A. S., & Nurdiana, P. (2020). Risk factors of maternal nutrition status during pregnancy to stunting in toddlers aged 12-59 months. *Jurnal Keperawatan Padjadjaran*, 8(2), 175–183. <https://doi.org/10.24198/jkp.v8i2.1305>
- Juliansyah, N. (2018). *Situasi Balita Pendek (Stunting) di Indonesia: Pusat Data dan Informasi, Kementerian Kesehatan RI. Kementerian Kesehatan Republik Indonesia* (Vol. 53).
- Kang, Y., Aguayo, V. M., Campbell, R. K., Dzied, L., Joshi, V., Waid, J. L., Gupta, S. D., Haselow, N. J., & West, K. P. (2018). Nutritional status and risk factors for stunting in preschool children

- in Bhutan. *Maternal and Child Nutrition*, 14(6), 1–16.
<https://doi.org/10.1111/mcn.12653>
- Kaunang, M. C., Rompas, S., & Bataha, Y. (2016). Hubungan pemberian imunisasi dasar dengan Puskesmaskembes Kecamatan Tombulu Kabupaten Minahasa. *E-Journal Keperawatan (e-Kp)*, 4(1), 1–8
- Ministry of Health of the Republic of Indonesia. (2018). Buku Saku Pemantauan Status Gizi. *Buku Saku Pemantauan Status Gizi Tahun 2017*, 7–11.
- Ministry of Health of the Republic of Indonesia. (2020). *Peraturan Menteri Kesehatan Republik Indonesia Nomor 2 Tahun 2020 Tentang Standar Antropometri Anak*. Kemenkes RI (Vol. 1). Jakarta: Kementerian Kesehatan Republik Indonesia.
- Noorhasanah, E., Tauhidah, N. I., & Putri, M. C. (2020). Faktor-faktor yang berhubungan dengan kejadian stunting pada balita di wilayah kerja Puskesmas Tatah Makmur Kabupaten Banjar. *Journal of Midwifery and Reproduction*, 4(1), 13–20.
<https://doi.org/10.35747/jmr.v4i1.559>
- Purwaningtyas, R. A., Barik, A. L., & Astuti, D. (2019). Obesity and stunting in childhood. Do Grandparents play a role? A systematic review. *Jurnal Ners*, 14(3), 71–75.
<https://doi.org/10.20473/jn.v14i3.16986>
- Schnepp, G. J., & Hurlock, E. B. (2016). *Child Growth and Development. The American Catholic Sociological Review* (Vol. 11). <https://doi.org/10.2307/3707488>
- Setiawan, E., Machmud, R., & Masrul, M. (2018). Faktor-Faktor yang Berhubungan dengan Kejadian Stunting pada Anak Usia 24-59 Bulan di Wilayah Kerja Puskesmas Andalas Kecamatan Padang Timur Kota Padang Tahun 2018. *Jurnal Kesehatan Andalas*, 7(2), 275.
<https://doi.org/10.25077/jka.v7.i2.p275-284.2018>
- Sinambela, D. P., Vidiyari, P., & Hidayah, N. (2019). Pengaruh Riwayat Pemberian ASI Eksklusif dengan Kejadian Stunting pada Balita di Wilayah Kerja Puskesmas Teluk Tiram Banjarmasin, 10(1). <https://doi.org/https://doi.org/10.33859/dksm.v10i1>
- Solis-Soto, T., Paudel, D., & Nicoli, F. (2020). Relationship between vaccination and nutritional status in children: Analysis of recent demographic and health surveys. *Demographic Research*, 42(June), 1–14. <https://doi.org/10.4054/demres.2020.42.1>
- Syed, S., Manji, K. P., McDonald, C. M., Kisenge, R., Aboud, S., Sudfeld, C., Locks, L., Liu, E., Fawzi, W. W., & Duggan, C. P. (2018). Biomarkers of systemic inflammation and growth in early infancy are associated with stunting in young Tanzanian children. *Nutrients*, 10(1158), 1–14. <https://doi.org/10.3390/nu10091158>
- Teja, M. (2019). Stunting Balita Indonesia Dan Penanggulangannya. *Pusat Penelitian Badan Keahlian DPR RI*, XI(22), 13–18.
- Titaley, C. R., Ariawan, I., Hapsari, D., Muasyaroh, A., & Dibley, M. J. (2019). Determinants of the stunting of children under two years old in Indonesia: A multilevel analysis of the 2013 Indonesia basic health survey. *Nutrients*, 11(5), 1–13.
<https://doi.org/10.3390/nu11051106>
- WHO. (2020). WHA Global Nutrition Targets 2025: Stunting Policy Brief. *Economics and Human Biology*, 6.
- WHO Library Cataloguing-in-Publication Data. (2018). *Reducing Stunting In Children. Equity considerations for achieving the Global Nutrition Targets 2025*. Retrieved from <https://apps.who.int/iris/bitstream/handle/10665/260202/9789241513647eng.pdf?sequence=1>
- Wicaksono, F., & Harsanti, T. (2020). Determinants of stunted children in Indonesia: A multilevel analysis at the individual, household, and community levels. *Kesmas*, 15(1), 48–53.
<https://doi.org/10.21109/kesmas.v15i1.2771>.