

6._IODINE_INTAKE_DEFICIENCY _AS_A_KEY_PREDICTOR.pdf

by master 1

Submission date: 06-Nov-2023 09:27AM (UTC+0700)

Submission ID: 2196876495

File name: 6._IODINE_INTAKE_DEFICIENCY_AS_A_KEY_PREDICTOR.pdf (210.91K)

Word count: 4744

Character count: 25471

IODINE INTAKE DEFICIENCY AS A KEY PREDICTOR OF STUNTING AMONG ADOLESCENT GIRLS IN COASTAL AREA, MAJENE DISTRICT

Patimah S^{1*}, Arundhana AI², Sundari³ and Septiyanti¹

¹Nutrition Department, School of Public Health, Universitas Muslim Indonesia, Indonesia

²Nutrition Department, School of Public Health, Hasanuddin University, Indonesia

³Midwifery Department, School of Public Health, Universitas Muslim Indonesia, Indonesia

Abstract: Adolescence is a period in a lifespan with increased nutrition requirements for supporting optimal growth and reproductive maturation. There is a dearth of studies exploring the risk of stunting among adolescents in coastal areas. Majene Regency is a coastal area that is rich in animal protein source. However, the stunting prevalence of adolescent girls in this area was relatively high. Therefore, this study aimed to identify the contributing predictors of stunting in adolescent girls. A cross-sectional involving 360 adolescent girls in secondary school was employed. Data were analyzed using the chi-square test and logistic regression with a significance of 5%. The overall prevalence of stunting in adolescent girls was 31.7%. Factors significantly associated with stunting were energy and iodine deficiency and wasting. Adolescent girls with low iodine intake (below RDA) were 1.9 times more likely to be stunted ($p=0.027$). This study concluded that the prevalence of stunting among adolescent girls living in this coastal area was a high community nutritional problem. We recommended that nutrition promotion is needed, especially regarding the importance of consuming animal food sourced from the sea and the use of iodised salt fortification to prevent stunting in adolescent girls.

Keywords: iodine intake, nutrient deficiency, stunting, adolescent girls, coastal area

Introduction

Adolescent girls (aged 10-19 years) are a transition period from children to adults, characterised by rapid growth, sexual maturity, and complex psychosocial interactions, and the formation of lifelong adaptive or maladaptive behaviours. In addition, it is also a critical period for optimal nutrition fulfilment and as a phase of the window of opportunity to correct or pursue inadequate growth since childhood and reduce the impact of malnutrition in the first 1000 days of life (Patil et al., n.d.; Sparrow et al., 2021). Theoretically, up to 20% of total height and 45% of bone mass can be achieved during adolescence, with a peak growth rate that nearly matches that of infancy (Sparrow et al., 2021). Hence, youth is considered an additional critical window of opportunity, the last chance to pursue linear growth (Azupogo et al., 2021). About 15-25% of adults' height is achieved during the adolescence (Christian & Smith, 2018). Adequate growth during adolescent girls is needed to ensure

*Corresponding Author's Email: imhasudirman@gmail.com



optimal pregnancy outcomes, and avoiding teenage pregnancy is necessary to ensure optimal growth (Chaparro & Lutter, 2016).

In recent decades, nutritional problems among adolescent girls have been neglected in national and global research and policy. But the view has been shifted to prioritise young women as a driving force for global health and international development (Sparrow et al., 2021). Since many studies found that malnourished among young women was prevalent, intervention could benefit this age group. Data reported by UNICEF shows that young women aged 15-19 years in South Asia suffer from several types of malnutrition, including stunting (11%), wasting (39%), and anemia (55%) (Querol et al., 2021). The study of stunting in adolescent girls is underreported compared to other nutritional problem indicators aforementioned (Khara et al., 2015). However, in some countries, data show that half of the adolescent girls are stunted (Bush & Mates, 2017). Estimates of stunting in girls aged 15-19 range from 52% in Guatemala and 44% in Bangladesh to 8% in Kenya and 6% in Brazil (Black et al., 2013). While in Indonesia, according to the 2018 Riskesdas results, some adolescent girls are stunted at the age group of 13-15 years (24.9%) and 16-18 years (25%) (Ministry of Health, 2018).

Few studies investigated factors associated with stunting among adolescents, which are not much different from stunting determinants in children. Factors such as low socioeconomic status of the family (Abate et al., 2020; Maehara et al., 2019; Mostafa et al., 2021), poor access to clean water and sanitation (Abate et al., 2020; Gebregyorgis et al., 2016), low education level and age (Azupogo et al., 2021), geographical disadvantages including living rural, coastal (Alemu et al., 2021; Tariku et al., 2019; Van Tuijl et al., 2021), and mountainous areas (Blankenship et al., 2020) found to contribute to stunting among adolescents. Additionally, dietary intake greatly contributed to the occurrence of stunting in this group, including family food insecurity (Alemu et al., 2021; Hadush et al., 2021; Tariku et al., 2019) and low food diversity (Hadush et al., 2021; Kahssay et al., 2020).

Furthermore, dietary intake, especially zinc and iodine play a significant role in supporting the growth and neurobehavioral development of children. Many studies have shown that deficiency of these nutrients was associated with stunting, although in children population (Abbag et al., 2021; Abdollahi et al., 2019; Amarra et al., 2007; Gibson et al., 2007). Unfortunately, adolescent girls living in rural areas are likely to have lower iodine intakes, increasing the risk of being iodine deficiency for this group. A study in rural Tanzania demonstrated that adolescent girls in this area experienced lower urinary iodine concentration (UIC) (Bakar et al., 2017). It is important to further investigate whether it has associated with low diversity and food insecurity, which are typical of poor socioeconomic households.

Prevention of stunting in adolescents should have started to be considered because this group determines the future of the next generation (Christian & Smith, 2018). Teenage pregnancy is quite common worldwide and stunted among adolescent girls can have adverse implications for their health and their babies, increasing the risk of stunting. This situation will perpetuate the cycle of misfortune between generations (Chaparro & Lutter, 2016; Mason & Dorman, 2017).

West Sulawesi Province is one of the provinces in Indonesia with the second-highest prevalence of stunting in Indonesia, and Majene Regency is the district with the highest number of stunting within the province (Ministry of Health, 2018). The district is a large coastal area with many animal protein

food sources that the people can consume. Our previous school-based study in Mamuju Regency found that 34.1% of female adolescent girls were stunted (Patimah et al., 2019). This finding was slightly different from our research at another location (Maros Regency, South Sulawesi Province), which found that stunted among adolescent girls was only 23.6% (Patimah et al., 2016). However, we have ¹³ data to confirm whether low iodine intakes or other factors cause stunting among adolescent girls in this area. ³² Additionally, there is a dearth of research exploring stunting and locally stunting-driven factors among adolescent girls in this coastal area. Therefore, we aimed to investigate those predictors and focus on the contribution of iodine intake to stunting occurrence in adolescent girls.

Materials and Methods

Study Design and Setting

This study used a cross-sectional design in ⁹ four secondary schools in Majene Regency, West Sulawesi Province. The four schools consist of two junior high schools (Sekolah Menengah Pertama - SMP) and two senior high schools (Sekolah Menengah Atas - SMA). Each school strata is represented by schools under the auspices of the ministry of education & culture (SMPN 1 and SMAN 1) and the ministry of religion (MTS and MAN). This research is part of multi-year research that will last for three years, specifically for the variables that are the ²² focus of the study in this study collected since 2021 and have received research ethics permission from the health research ethics committee of Medical Faculty, Hasanuddin University (194/UII4. 6.4.5.31/ PP36/2020).

Sample Size, Data Collection and Analysis Procedure

A total of 360 students from classes VII and X in each school were selected ³⁷ to participate in this study. Prior to data collection, the research assistants were trained in ¹ anthropometric measurements and interviews to ²⁵ measure height and collect dietary intake information using a 2x24-hour recall ²⁴. The participants' height was measured using a stadiometer ($d = 0.1$ cm). We calculated the height-for-age z-score (HAZ) using WHO Anthro Plus software. Stunting is defined if the HAZ score is < -2 SD (Ministry of Health, 2020). Dietary intake from 24-hour recall data was analysed using Nutrisurvey software for Windows. ⁷ The results of the analysis of nutrient intake are categorised as adequate if consumption is $> 80\%$ of the recommended dietary allowance (RDA) for macronutrients and $> 77\%$ for micronutrient intake (Gibson, 2005).

All anthropometric and dietary intake data were inputted into SPSS for windows for further analysis. We performed chi-square and logistical regression tests with a significance level of $p < 0.05$ to determine ³⁵ predictor factors for stunting in adolescent girls. The condition for the variables to be included in the logistic regression test model is if the results of the bivariate test have a p-value < 0.25 .

Results and Discussion

Table 1 shows that from 360 samples, there were 114 (31.7%) adolescent girls suffering ²⁹ from stunting, which was more widely distributed in the middle-aged group (13-15 years), aligning ³⁴ with a study conducted in Northwestern Ethiopia (Birru et al., 2018). The high stunted rate in adolescent girls indicates a major public health problem. Stunted adolescent girls generally experience growth deficits since childhood (Lassi et al., 2017). Additionally, stunted adolescent girls are more likely to

occur in low socioeconomic status families characterised by low levels of parental education (Junior high school and below) and work in the non-formal sector. Parents' employment and father's education were significantly different ($p < 0.05$) between stunted adolescents and their adolescent counterparts.

Meanwhile, maternal education²⁶ was not significantly different between stunted and non-stunted adolescent girls. This result was in line with a study in Nepal that found that maternal education was not associated with stunting (Van Tuijl et al., 2021). As a chronic nutritional problem, stunting is not only related to inadequate intake but also socioeconomic conditions, including parents' education and occupation (GAIN, 2018).

Table 1. Characteristic of Sample and Their Family

Variable	Stunting (n=114)	Normal (n=246)	P Value
Age (years)			
10-12	17 (14.9)	26 (10.6)	0.000
13-15	54 (47.4)	136 (55.3)	
16-18	43 (37.7)	46 (18.7)	
Father's Occupation (Non formal)	94 (82.5)	180 (73.2)	0.035
Mother's Occupation (Non formal)	101 (88.6)	197 (80.1)	0.030
Father's Education (Low)	60 (52.6)	101 (41.1)	0.026
Mother's Education (Low)	56 (49.1)	99 (40.2)	0.071

Based on the intake of nutrients that contribute to bone growth, it was found that almost all types of nutrients consumed were lower in the stunting group of adolescent girls except for protein, vitamin A and iron. The only significant differences between stunted and non-stunted participants were vitamin D and iodine intakes (Table 2). The frequency of foods with high bioavailability, such as marine fish consumed 2-3 times per day, was lower in the stunting group than in the non-stunted group (24.6% vs. 28.5%), which could also result in inadequate iodine consumption. Inadequate iodine intake for a long period will cause low iodine accumulation in the body, which can affect growth and development. This finding is supported by a study in Saudi Arabia which reported that the proportion of stunted students with low UIC was significantly higher than those with a high UIC (Abbag et al., 2021). Similarly, milk consumption (powdered milk and sweetened condensed milk) was rarely consumed by stunted girls as a source of vitamin D. Around 38.6% never consume sweetened condensed milk, and 41.2% never consume powdered milk. Although the study location has diverse animal-source foods, low consumption of iodine and vitamin D among adolescent girls may be associated with the knowledge and understanding of the importance of consuming these foods. Therefore, it is essential to provide nutrition education for this population.

The deficiency of nutrients (macro and micronutrients) is a direct factor most often involved in post-natal growth retardation. Adequate intake of energy, protein, or various micronutrients is needed to maintain normal nutritional status; however, it is also important to consider bioavailability of those nutrients as this factor influence the absorption in the body. For example, consuming nutrients derived from plants, which have low bioavailability, may affect their utilisation (Branca & Ferrari, 2002; Mikhail et al., 2013).

The achievement of the nutritional adequacy rate from the intake of each nutrient by adolescent girls, it appears that almost all of them who have an intake below the nutritional adequacy rate is more common in adolescent girls who are classified as stunting except that low calcium intake is more commonly found in adolescent girls who were not stunted. Based on chi-square test results, energy intake, iodine, and wasting are the three factors significantly related to the incidence of stunting in adolescent girls, such as (Table 3). The deficiency of energy and iodine might cause growth retardation (Branca & Ferrari, 2002). The energy deficit will increase protein requirements to use as energy. The protein that was previously higher in the female adolescent group will decrease to meet the energy needs of those experiencing a deficit. Moreover, the participants also consumed more plant-based protein with low bioavailability, which can decrease the concentration of the IGF-1 hormone. Thus, strengthening its relationship with the incidence of stunted (Tessema et al., 2018). This finding was in line with a study on children in Ethiopia, which found that those who were stunted had a lower daily energy intake than those who were not stunted ($p < 0.05$). Additionally, inadequate energy intake was positively related to children's linear growth failure ($b = 0.0003$, $p = 0.04$) (Tessema et al., 2018). Inadequate intake of iodine will have an impact on the occurrence of hypothyroidism because insufficient serum thyroid hormone secretion can interfere with somatic growth (skeleton and peripheral tissue), which is closely related to the action of the growth hormone IGF (Farebrother et al., 2018).

Severe and repeated wasting can be associated with stunting, despite the fact that these nutritional problems can occur concurrently. In addition, there is growing evidence of a reciprocal relationship between wasting and stunting, in which episodes of wasting determine the risk of stunting. To a lesser extent, stunting can also promote wasting (Thurstans et al., 2022). The study results in Nigeria showed a temporal relationship between wasting and stunting in children under the age of 2 years (Kohlmann et al., 2021).

Table 2. The Differences in Nutritional Intake among Adolescent Girls

Nutrients Intake	Stunting (n = 114)	Normal (n = 246)	P value
Energy (Kcal)	1178.4±531.19	1293.8±560.0	0.065
Protein (g)	55.2±58.22	51.6±25.6	0.536
Calcium (mg)	324.7±359.26	376.9±439.6	0.268
Vitamin D (mg)	5.0±5.2	6.2±5.1	0.048
Vitamin A (mg)	528.8±2543.8	345.9±336.8	0.446
Iodine (mg)	93.4±149.1	139.1±190.2	0.014
Iron (mg)	6.2±5.4	6.1±5.2	0.870
Zinc (mg)	4.3±2.8	4.9±2.9	0.100

Table 3. Intake of Nutrients Related to Stunting in Adolescent Girls

Variable	Stunting (n=114)	Normal (n=246)	P Value ^a
Energy Intake*	97 (85.1)	182 (74.0)	0.012
Protein Intake*	67 (58.8)	127 (51.6)	0.125
Vitamin A Intake#	94 (82.5)	185 (75.2)	0.080
Zinc Intake#	97 (85.1)	202 (82.1)	0.295

Iodine Intake#	82 (79.6)	142 (67.9)	0.020
Calcium Intake#	102 (89.5)	221 (89.8)	0.525
Iron Intake#	96 (85.0)	202 (82.1)	0.307
Vitamin D Intake#	100 (87.7)	203 (82.5)	0.135
Wasting	10 (8.8)	9 (3.7)	0.042

*($<80\%$ RDA); #($<77\%$ RDA); a= Chi Square test

The main predictor of stunting in adolescent girls is low iodine intake. According to the results of logistic regression tests, low iodine intake (below the RDA) is 1.9 times more likely to be stunted (OR 1.895; 95% CI: 1.076 to 3.337; p-value 0.027) compared to adequate iodine intake (Table 4). About 80% of young women who have insufficient intake of iodine (below the RDA) are stunted, while among young women who are not stunted there are 67.9% have inadequate intake (Table 3). The study results by Simbolon and Hapsari (2018) also found that about 73.1% of children under five who did not have insufficient iodine intake were stunted (Simbolon & Hapsari, 2018). It is known that adolescents are more independent in their food choices and are more likely to be influenced by their peers who consume contemporary foods such as junk and fast food with low nutritional quality. At the same time, the intake of fruits and vegetables, which is micronutrient-rich sources, was very low. The results of this study are in line with the results of a review of various studies from low-middle income countries showing that there is a greater likelihood of iodine deficiency in girls and older age due to dietary pattern transition, which is higher in energy-dense foods, processed and micronutrient-poor foods, both in children and adolescents (Wrottesley et al., 2022).

Table 4. Predictor Factors of Stunted based on Logistic Regression Test

	B	S.E.	Wald	Sig.	Exp(B)	95% C.I. for EXP(B)	
						Lower	Upper
Wasting	-0.943	0.509	3.434	0.064	0.389	0.144	1.056
Iodine Intake	0.639	0.289	4.905	0.027	1.895	1.076	3.337
Constant	-0.295	0.526	0.314	0.575	0.745		

Conclusion

This study concluded that the stunting among adolescent girls was a community nutritional problem in this coastal area, where inadequate iodine intake is the main predictor of stunting. This study has limitations because it does not examine the level of iodine in the urine to strengthen the results of this study. Nutrition promotion is needed, especially regarding the importance of consuming animal-sourced foods from the sea. We also recommend promoting iodised salt fortification to prevent stunting in adolescent girls. In addition, further investigations of iodine salt fortification with larger samples are warranted to evaluate the effectiveness of this intervention to prevent stunting among adolescent girls in this community.

Acknowledgement

Thank you to the Ministry of Education, Culture and Higher Education for providing financial support for the study. We also thank all the research participants, including the teachers and school staff, who assisted in the data collection process.

1 **Declaration of Interest Statement**

All authors have no conflict of interest in this manuscript.

Reference

- Abate, B. B., Kassie, A. M., Kassaw, M. W., Zemariam, A. B., & Alamaw, A. W. (2020). Prevalence and determinants of stunting among adolescent girls in Ethiopia. *Journal of Pediatric Nursing*, 52, e1–e6.
- Abbag, F. I., Abu-Eshy, S. A., Mahfouz, A. A., Alsaleem, M. A., Alsaleem, S. A., Patel, A. A., Mirdad, T. M., Shati, A. A., & Awadalla, N. J. (2021). Iodine deficiency disorders as a predictor of stunting among primary school children in the aseer region, southwestern Saudi Arabia. *International Journal of Environmental Research and Public Health*, 18(14), 1–9. <https://doi.org/10.3390/ijerph18147644>
- Abdollahi, M., Ajami, M., Abdollahi, Z., Kalantari, N., Houshiarrad, A., Fozouni, F., Fallahrokni, A., & Mazandarani, F. S. (2019). Zinc supplementation is an effective and feasible strategy to prevent growth retardation in 6 to 24 month children: A pragmatic double blind, randomized trial. *Heliyon*, 5(11), e02581. <https://doi.org/https://doi.org/10.1016/j.heliyon.2019.e02581>
- Alemu, T. G., Muhye, A. B., & Ayele, A. D. (2021). Under nutrition and associated factors among adolescent girls attending school in the rural and urban districts of Debark, Northwest Ethiopia: A community-based comparative cross-sectional study. *PloS One*, 16(8), e0254166.
- Amarra, M. S. V, Bongga, D. C., Peñano-Ho, L., Cruz, F. B., Solis, J. S., & Barrios, E. B. (2007). Effect of iodine status and other nutritional factors on psychomotor and cognitive performance of Filipino schoolchildren. *Food and Nutrition Bulletin*, 28(1), 47–54. <https://doi.org/DOI:10.1177/156482650702800105>
- Azupogo, F., Abizari, A.-R., Aurino, E., Gelli, A., Osendarp, S. J. M., Bras, H., Feskens, E. J. M., & Brouwer, I. D. (2021). Trends and factors associated with the nutritional status of adolescent girls in Ghana: a secondary analysis of the 2003–2014 Ghana demographic and health survey (GDHS) data. *Public Health Nutrition*, 1–16.
- Bakar, S. M., Lee, K. W., & Song, W. O. (2017). Iodine Status and Its Determinants among Adolescent School Girls in Rural Tanzania. *The FASEB Journal*, 31(S1), 786.5-786.5. https://doi.org/https://doi.org/10.1096/fasebj.31.1_supplement.786.5
- Birru, S. M., Belew, A. K., & Tariku, A. (2018). One in three adolescent schoolgirls in urban northwest Ethiopia is stunted. *Italian Journal of Pediatrics*, 44(1), 1–8.
- Black, R. E., Victoria, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., & de Onis, M. (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet*, 382(9890), 427–451. [https://doi.org/https://doi.org/10.1016/S0140-6736\(13\)60937-X](https://doi.org/https://doi.org/10.1016/S0140-6736(13)60937-X)
- Blankenship, J. L., Cashin, J., Nguyen, T. T., & Ip, H. (2020). Childhood stunting and wasting in Myanmar: Key drivers and implications for policies and programmes. *Maternal & Child Nutrition*, 16, e12710.
- Branca, F., & Ferrari, M. (2002). Impact of micronutrient deficiencies on growth: the stunting syndrome. *Annals of Nutrition and Metabolism*, 46(Suppl. 1), 8–17.
- Bush, A., & Mates, E. (2017). Synthesis of evidence to date , key gaps and opportunities for adolescent nutrition. *Irish Aid*, December, 1–20.
- Chaparro, C., & Lutter, C. (2016). Underweight, Short Stature and Overweight in Adolescents and Young Women in Latin America and the Caribbean. 1–12.

- Christian, P., & Smith, E. R. (2018). Adolescent undernutrition: global burden, physiology, and nutritional risks. *Annals of Nutrition and Metabolism*, 72(4), 316–328.
- Farebrother, J., Naude, C. E., Nicol, L., Sang, Z., Yang, Z., Jooste, P. L., Andersson, M., & Zimmermann, M. B. (2018). Effects of iodized salt and iodine supplements on prenatal and postnatal growth: a systematic review. *Advances in Nutrition*, 9(3), 219–237.
- GAIN. (2018). Review of evidence on the nutritional status of adolescent girls and boys in Pakistan. <https://documents1.worldbank.org/curated/en/105751559633434854/pdf/Review-of-Evidence-on-the-Nutritional-Status-of-Adolescent-Girls-and-Boys-in-Pakistan.pdf>
- Gebregyorgis, T., Tadesse, T., & Atenafu, A. (2016). Prevalence of thinness and stunting and associated factors among adolescent school girls in Adwa town, North Ethiopia. *International Journal of Food Science*, 2016.
- Gibson, R. S. (2005). Principles of nutritional assessment. Oxford university press, USA.
- Gibson, R. S., Manger, M. S., Krittaphol, W., Pongcharoen, T., Gowachirapant, S., Bailey, K. B., & Winichagoon, P. (2007). Does zinc deficiency play a role in stunting among primary school children in NE Thailand? *British Journal of Nutrition*, 97(1), 167–175. <https://doi.org/10.1017/S0007114507250445>
- Hadush, G., Seid, O., & Wuneh, A. G. (2021). Assessment of nutritional status and associated factors among adolescent girls in Afar, Northeastern Ethiopia: a cross-sectional study. *Journal of Health, Population and Nutrition*, 40(1), 1–14. <https://doi.org/10.1186/s41043-021-00227-0>
- Kahssay, M., Mohamed, L., & Gebre, A. (2020). Nutritional Status of School Going Adolescent Girls in Awash Town, Afar Region, Ethiopia. *Journal of Environmental and Public Health*, 2020. <https://doi.org/10.1155/2020/7367139>
- Khara, T., Mates, E., & Mason, F. (2015). Adolescent nutrition: policy and programming in SUN+ countries. London: Save the Children.
- Kohlmann, K., Sudfeld, C. R., Garba, S., Guindo, O., Grais, R. F., & Isanaka, S. (2021). Exploring the relationships between wasting and stunting among a cohort of children under two years of age in Niger. *BMC Public Health*, 21(1), 1–9.
- Lassi, Z., Moin, A., & Bhutta, Z. (2017). Nutrition in Middle Childhood and Adolescence. In et al Bundy DAP, Silva Nd, Horton S (Ed.), Child and Adolescent Health and Development. 3rd edition (3rd editio). The International Bank for Reconstruction and Development / The World Bank. https://doi.org/10.1596/978-1-4648-0423-6_ch11
- Maehara, M., Rah, J. H., Roshita, A., Suryantan, J., Rachmadewi, A., & Izwardy, D. (2019). Patterns and risk factors of double burden of malnutrition among adolescent girls and boys in Indonesia. *PloS One*, 14(8), e0221273.
- Mason, F., & Dorman, P. (2017). ADOLESCENCE IS A CRITICAL WINDOW TO COMBAT STUNTING. Save The Children UK. <https://www.savethechildren.org.uk/blogs/2017/adolescence-critical-window-combat-stunting>
- Mikhail, W. Z. A., Sobhy, H. M., El-Sayed, H. H., Khairy, S. A., Abu Salem, H. Y. H., & Samy, M. A. (2013). Effect of nutritional status on growth pattern of stunted preschool children in Egypt. *Academic Journal of Nutrition*, 2(1), 1–9.
- Ministry of Health. (2018). Riskendas 2018. Laporan Nasional Riskesndas 2018, 44(8), 181–222. [http://www.yankes.kemkes.go.id/assets/downloads/PMK No. 57 Tahun 2013 tentang PTRM.pdf](http://www.yankes.kemkes.go.id/assets/downloads/PMK%20No.%2057%20Tahun%202013%20tentang%20PTRM.pdf)
- Ministry of Health. (2020). Peraturan Menteri Kesehatan Republik Indonesia Nomor 2 Tahun 2020 tentang Standar Antropometri Anak. Nomor, 2, 1–78.

- Mostafa, I., Hasan, M., Das, S., Khan, S. H., Hossain, M. I., Faruque, A., & Ahmed, T. (2021). Changing trends in nutritional status of adolescent females: a cross-sectional study from urban and rural Bangladesh. *BMJ Open*, 11(2), e044339.
- Patil, S., Mohite, R., Banvali, U., Devrukhakar, P., Jadhav, D., Dervankar, O., & Joglekar, C. (n.d.). Stunting is A Reflection of Poor Dietary Diversity Among Adolescent Girls in Rural KONKAN Region (DERVAN-6).
- Patimah, S., A. H., & Sundari. (2019). The Association of Balanced Nutrition Practices with Stunting Among Adolescent Girls in School. *International Journal of Food Engineering*, 5(2).
- Patimah, S., Imam Arundhana, A., Royani, I., & Razak Thaha, A. (2016). Low socioeconomic status among adolescent schoolgirls with stunting in Maros district, South Sulawesi in Indonesia. *Int Proc Chem Biol Environ Eng*, 95(10.7763).
- Querol, S. E., Gill, P., Iqbal, R., Kletter, M., Ozdemir, N., & Al-Khudairy, L. (2021). Adolescent undernutrition in South Asia: A scoping review. *Nutrition Research Reviews*, 1–29.
- Simbolon, D., & Hapsari, T. (2018). Iodine Consumption and Linear Growth of Children Under Five Years Old in Malabero Coastal Area, Bengkulu City. *KEMAS: Jurnal Kesehatan Masyarakat*, 14(1), 140–146.
- Sparrow, R., Agustina, R., Bras, H., Sheila, G., Rieger, M., Yumna, A., Feskens, E., & Melse-Boonstra, A. (2021). Adolescent Nutrition—Developing a Research Agenda for the Second Window of Opportunity in Indonesia. *Food and Nutrition Bulletin*, 42(1_suppl), S9–S20.
- Tariku, A., Belew, A. K., Gonete, K. A., Hunegnaw, M. T., Muhammad, E. A., Demissie, G. D., Bikis, G. A., Awoke, T., Gelaye, K. A., & Zeleke, E. G. (2019). Stunting and its determinants among adolescent girls: findings from the nutrition surveillance project, northwest Ethiopia. *Ecology of Food and Nutrition*, 58(5), 481–494.
- Tessema, M., Gunaratna, N. S., Brouwer, I. D., Donato, K., Cohen, J. L., McConnell, M., Belachew, T., Belayneh, D., & De Groote, H. (2018). Associations among high-quality protein and energy intake, serum transthyretin, serum amino acids and linear growth of children in Ethiopia. *Nutrients*, 10(11), 1776.
- Thurstans, S., Sessions, N., Dolan, C., Sadler, K., Cichon, B., Isanaka, S., Roberfroid, D., Stobaugh, H., Webb, P., & Khara, T. (2022). The relationship between wasting and stunting in young children: A systematic review. *Maternal & Child Nutrition*, 18(1).
- Van Tuijl, C. J. W., Madjdian, D. S., Bras, H., & Chalise, B. (2021). Sociocultural and economic determinants of stunting and thinness among adolescent boys and girls in Nepal. *Journal of Biosocial Science*, 53(4), 531–556.
- Wrottesley, S. V., Mates, E., Brennan, E., Bijalwan, V., Menezes, R., Ray, S., Ali, Z., Yarpavar, A., Sharma, D., & Lelijveld, N. (2022). Nutritional status of school-age children and adolescents in low- and middle-income countries across seven global regions: a synthesis of scoping reviews. *Public Health Nutrition*, 1–33.

6._IODINE_INTAKE_DEFICIENCY_AS_A_KEY_PREDICTOR.pdf

ORIGINALITY REPORT

14%

SIMILARITY INDEX

%

INTERNET SOURCES

14%

PUBLICATIONS

%

STUDENT PAPERS

PRIMARY SOURCES

- 1

Sitti Patimah, Sundari Sundari, Hasta Handayani Idrus, Reny Noviasy. "Effect of School-Integrated Interventions on Improvement of Nutrition-Health Knowledge and Nutritional Status among Adolescent Girls: A Quasi-Experimental Study", Current Research in Nutrition and Food Science Journal, 2023

Publication

1%
- 2

Robert Sparrow, Rina Agustina, Hilde Bras, Grace Sheila, Matthias Rieger, Athia Yumna, Edith Feskens, Alida Melse-Boonstra. "Adolescent Nutrition—Developing a Research Agenda for the Second Window of Opportunity in Indonesia", Food and Nutrition Bulletin, 2021

Publication

1%
- 3

Parul Christian, EmilyR. Smith. "Adolescent Undernutrition: Global Burden, Physiology, and Nutritional Risks", Annals of Nutrition and Metabolism, 2018

Publication

1%

4

Gebrehiwot Hadush, Oumer Seid, Abel Gebre Wuneh. "Assessment of nutritional status and associated factors among adolescent girls in Afar, Northeastern Ethiopia: a cross-sectional study", Journal of Health, Population and Nutrition, 2021

Publication

1 %

5

Biniyam Sahiledengle, Kingsley E. Agho, Pammla Petrucka, Abera Kumie et al. "Concurrent wasting and stunting among under-five children in the context of Ethiopia: A generalised mixed-effects modelling", Maternal & Child Nutrition, 2023

Publication

1 %

6

Stephanie V Wrottesley, Emily Mates, Eilise Brennan, Vasundhara Bijalwan et al. "Nutritional status of school-age children and adolescents in low- and middle-income countries across seven global regions: a synthesis of scoping reviews", Public Health Nutrition, 2022

Publication

1 %

7

"Vitamins and Minerals Biofortification of Edible Plants", Wiley, 2020

Publication

<1 %

8

Elise Beijer, Stefan F. van Wonderen, Wietse P. Zuidema, Marieke C. Visser et al. "Sex Differences in Outcome of Trauma Patients

<1 %

Presented with Severe Traumatic Brain Injury:
A Multicenter Cohort Study", Journal of
Clinical Medicine, 2023

Publication

9

Zainuddin, Zainuddin. "The Effect of
Cooperative Integrated Reading and
Composition Technique on Students' Reading
Descriptive Text Achievement", English
Language Teaching, 2015.

Publication

<1 %

10

"The Sanitation Triangle", Springer Science
and Business Media LLC, 2022

Publication

<1 %

11

Charlotte J. W. van Tuijl, Dónya S. Madjdian,
Hilde Bras, Binaya Chalise. "Sociocultural and
economic determinants of stunting and
thinness among adolescent boys and girls in
Nepal", Journal of Biosocial Science, 2020

Publication

<1 %

12

Dónya S. Madjdian, Elise Talsma, Niva
Shrestha, Kenda Cunningham, Maria Koelen,
Lenneke Vaandrager. "'Like a frog in a well'. A
qualitative study of adolescent girls' life
aspirations in Western Nepal", Journal of
Youth Studies, 2022

Publication

<1 %

13

Dónya S. Madjdian, Fusta Azupogo, Saskia
J.M. Osendarp, Hilde Bras, Inge D. Brouwer.

<1 %

"Socio-cultural and economic determinants and consequences of adolescent undernutrition and micronutrient deficiencies in LLMICs: a systematic narrative review", Annals of the New York Academy of Sciences, 2018

Publication

14

Getachew Arage, Mekonnen Assefa, Teshager Worku. "Socio-demographic and economic factors are associated with nutritional status of adolescent school girls in Lay Guyint Woreda, Northwest Ethiopia", SAGE Open Medicine, 2019

Publication

15

Humphery Garti, Anthony Wemakor, Alexander Badu, Mohammed Bukari. "Magnitude of undernutrition and its associated factors in children attending Child Welfare Clinics in Techiman Municipal, Ghana", Nutrition & Food Science, 2023

Publication

16

Inés Velasco, Mar Sánchez-Gila, Sebastián Manzanares, Peter Taylor, Eduardo García-Fuentes. "Iodine Status, Thyroid Function, and Birthweight: A Complex Relationship in High-Risk Pregnancies", Journal of Clinical Medicine, 2020

Publication

<1 %

<1 %

<1 %

17

Lenora P. Goodman, David W. Walsh, Alicia Kunin-Batson, Nancy E. Sherwood, Katherine R. Arlinghaus. "Adolescent sources of stress, stress levels, and associations between stress and changes in weight outcomes at the time of COVID-19 related school closure in March 2020", Preventive Medicine Reports, 2023

Publication

<1 %

18

Salsa Bening, Ani Margawati, Ali Rosidi. "Zinc deficiency as risk factor for stunting among children aged 2-5 years", Universa Medicina, 2017

Publication

<1 %

19

Tyler J.S. Smith, Ana Navas-Acien, Sarah Baker, Caryn Kok et al. "Anthropometric measures and arsenic methylation among pregnant women in rural northern Bangladesh", Environmental Research, 2023

Publication

<1 %

20

Diôgo Vale, Maria Eduarda da Costa Andrade, Natalie Marinho Dantas, Ricardo Andrade Bezerra et al. "Social Determinants of Obesity and Stunting among Brazilian Adolescents: A Multilevel Analysis", Nutrients, 2022

Publication

<1 %

21

Kristin Kohlmann, Christopher R. Sudfeld, Souna Garba, Ousmane Guindo, Rebecca F. Grais, Sheila Isanaka. "Exploring the

<1 %

relationships between wasting and stunting among a cohort of children under two years of age in Niger", BMC Public Health, 2021

Publication

22

Lara Ayu Lestari, William Ben Gunawan. "Sago Caterpillar (*Rhynchophorus ferrugineus*) Flour Improve Insulin-Like Growth Factor 1 (IGF-1) Levels in Low-Protein Diet Rats", Jurnal Aisyah : Jurnal Ilmu Kesehatan, 2022

Publication

23

Lilik Hidayanti, Mohammad Zen Rahfiludin, Sri Achadi Nugraheni, Retno Murwani.

"Association of malnutrition and main-meal- and snack-predominant intake among female adolescent students in boarding schools in Tasikmalaya, Indonesia", Nutrition and Health, 2023

Publication

24

Maha Hoteit, Hala Mohsen, Nour Yazbeck, Sarah Diab, Jessica Sarkis, Yonna Sacre, Lara Hanna-Wakim, Khlood Bookari. "Household Food Insecurity, Anemia, Malnutrition and Unfavorable Dietary Diversity among Adolescents: Quadruple Whammies in the Era of Escalating Crises in Lebanon", Nutrients, 2022

Publication

<1 %

<1 %

<1 %

- | | | |
|----|---|------|
| 25 | Merym Elif Öztürk, Nurcan Yabancı Ayhan. "EVALUATION OF MALNUTRITION AND SCREENING TOOLS IN HOSPITALIZED CHILDREN", Clinical Nutrition ESPEN, 2023
Publication | <1 % |
| 26 | Suryadi Limardi, Dini Mutia Hasanah, Ni Made Dwiayathi Utami. "Dietary intake and stunting in children aged 6-23 months in rural Sumba, Indonesia", Paediatrica Indonesiana, 2022
Publication | <1 % |
| 27 | Tiffany Cornelia Angelin, Saptawati Bardosono, Dewi Shinta, Umi Fahmida. "Growth, Dietary Intake, and Vitamin D Receptor (VDR) Promoter Genotype in Indonesian School-Age Children", Nutrients, 2021
Publication | <1 % |
| 28 | Amare Tariku, Aysheshim Kassahun Belew, Kedir Abdela Gonete, Melkamu Tamir Hunegnaw et al. "Stunting and Its Determinants among Adolescent Girls: Findings from the Nutrition Surveillance Project, Northwest Ethiopia", Ecology of Food and Nutrition, 2019
Publication | <1 % |
| 29 | Biruk Beletew Abate, Ayelign Mengesha Kassie, Mesfin Wudu Kassaw. "Prevalence and determinants of early initiation of sexual | <1 % |

intercourse among youth girls in Ethiopia",
Journal of Pediatric Nursing, 2020

Publication

30

Damitie Kebede, Reddy P. C. J. Prasad, Degnet Teferi Asres, Hayat Aragaw, Eyerusalem Worku. "Prevalence and associated factors of stunting and thinness among adolescent students in Finote Selam Town, Northwest Ethiopia", Journal of Health, Population and Nutrition, 2021

Publication

<1 %

31

Edith J. M. Feskens, Regan Bailey, Zulfiqar Bhutta, Hans-Konrad Biesalski et al. "Women's health: optimal nutrition throughout the lifecycle", European Journal of Nutrition, 2022

Publication

<1 %

32

Kidanemariam Berhe, Gebrehiwot Gebremariam. "Magnitude and associated factors of undernutrition (underweight and stunting) among school adolescent girls in Hawzen Woreda (District), Tigray regional state, Northern Ethiopia: Cross-sectional study", BMC Research Notes, 2020

Publication

<1 %

33

Samuel Derby Habtegiorgis, Pammla Petrucka, Animut Takele Telayneh, Daniel Shitu Getahun et al. "Prevalence and associated factors of anemia among

<1 %

adolescent girls in Ethiopia: A systematic review and meta-analysis", PLOS ONE, 2022

Publication

34

Kassahun Tamene Andargie, Temesgen Mohammed Toma, Rahel Abera Alula, Bahiru Mulatu Kebede, Mesrach Hailu.

"Undernutrition and associated factors among rural adolescent girls in Daramalo district, Southern Ethiopia: a community-based cross-sectional study", Research Square Platform LLC, 2022

Publication

<1 %

35

Marieke M. ter Wee, Birgit I. Lissenberg-Witte. "A Quick Guide on How to Conduct Medical Research", Springer Nature, 2019

Publication

<1 %

36

Derese Bekele Daba, Tamrat Shaweno, Kefyalew Taye, Abdulhalik Workicho.

"Magnitude of under nutrition and Associated Factors among Adolescent Street Children at Jimma Town, South West Ethiopia", Research Square, 2019

Publication

<1 %

37

Masresha Tessema, Hugo De Groote, Inge D Brouwer, Marthe De Boevre et al. "Exposure to aflatoxins and fumonisins and linear growth of children in rural Ethiopia: a

<1 %

longitudinal study", Public Health Nutrition, 2021

Publication

38

Nyovani J. Madise. "Determinants of Infant Mortality in Malawi: An Analysis to Control for Death Clustering within Families", Journal of Biosocial Science, 01/1995

Publication

<1 %

39

Susan Thurstans, Natalie Sessions, Carmel Dolan, Kate Sadler et al. "The relationship between wasting and stunting in young children: A systematic review", Maternal & Child Nutrition, 2021

Publication

<1 %

40

Tsgehana Gebregyorgis, Takele Tadesse, Azeb Atenafu. "Prevalence of Thinness and Stunting and Associated Factors among Adolescent School Girls in Adwa Town, North Ethiopia", International Journal of Food Science, 2016

Publication

<1 %

Exclude quotes On

Exclude matches Off

Exclude bibliography On