Determinant factors of under-five years severely wasted children in rural and sub-urban areas of Indonesia

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Abstract:

BACKGROUND: Understanding the determinant factors contributing to severely wasted is crucial in decreasing the problem and meeting the World Health Global Nutrition Target by 2025. This study investigated the determinants of severely wasted among children under five years old in Indonesia's rural and sub-urban areas.

MATERIALS AND METHOD: This was a cross-sectional study of severely wasted children in rural and sub-urban areas in East Java, Indonesia. Collected data on individual characteristics, socio-economic status, nutrient intake, environmental and food sanitation, and health service utilization were obtained by structured questionnaires. An ordinal regression and Chi-square test were applied to determine the factors with a significance level 0.05.

RESULTS: As many as 25 respondents in rural areas and 30 in sub-urban areas were included after receiving informed consent. Age and household environmental and food sanitation were associated with severely wasted in rural and sub-urban areas, with $P < 0.05$. Meanwhile, family members, income, and calcium intake were only in rural areas. Birth spacing, nutrient intake, except calcium intake, and health care utilization were the only factors in sub-urban areas. The low-birth-weight history, sex, mother's education, and the parent's occupation did not correlate with the severely wasted in rural and sub-urban areas.

CONCLUSION: The determinant factors of under-five years of severely wasted children in rural and sub-urban areas of Indonesia are different, so it is vital to design regional-based approaches to tackle the problem.

Keywords:
Children, rural, severely wasted, sub-urban

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Introduction

Wasting is an under-nutrition type measured by weight for height; it refers to a child who is too thin for the height. Wasting is a more transient form, the result of recent rapid weight loss or failure to gain weight. Children with wasting have an increased risk of pathological situations and death, but treatment is possible.[1] The joint UNICEF–WHO–World Bank global estimates that 45 million or 6.8% of children under 5 are affected by wasting and 13.7 million are threatened by severe wasting in 2022, where 70% of all children under 5 are affected by severe wasting and wasting lived in Asia. South-eastern Asia, including Indonesia, has a prevalence of approximately 7.8%.[2] National Indonesian Statistics 2018 reported that the prevalence of under-nutrition in 5 years children is 13.8%.[3]

Reducing wasting in under-five children is one of the major concerns globally as the target of the global Sustainable Development Goals (SDGs) for 2025 is to reduce and maintain child wasting to below 5%.[2,4] Therefore, identifying the driving

factors associated with wasting in children under 5 is pivotal to addressing the problem.[5] Determination of these factors to improve the nutrition status based on the epidemiological study has become the main challenge. A single factor rarely causes wasting, and it commonly results from an interaction among factors, that is, genetics, individual behavior, social factors, environmental and physical factors, and health services, which vary by its setting.[6] Studies conducted in developing countries identified several factors associated with wasting.[7-15] There remains a gap in our understanding of the drivers of wasting specific to different geographies and regions of the world, possibly related to social context. Access to clean water was a vital determinant in Asia, while low birth weight was a major problem in Latin America, and adult literacy was an essential factor in sub-Saharan Africa.[8,13-16]

The Indonesian government has committed to reducing wasting prevalence; although there was a decrease in wasting and severe wasting numbers, the progress in overcoming the problem has been slow.[3] Several factors need to be understood to design effective strategies to tackle this problem. This study aimed to analyze the determinants of severely wasted children under 5 in rural and sub-urban areas in Indonesia, including individual, behavioral, socio-economic, and environmental factors, and health services utilization since most Indonesian residents live in rural and sub-urban areas, where the prevalence of severely wasted children under 5 is high.[3]

Materials and Methods

Study design and setting
The study was a cross-sectional analytic study conducted in Banyuwangi district, East Java Province, Indonesia, located in the eastern part of Java island. The characteristic of the study site is a rural area where people mostly worked in the agricultural sector. Some areas are sub-urban, located at the district's center, and people work in various sectors. Banyuwangi has a higher under-five years under-nutrition rate than East Java Province, although the district has a higher economic growth rate than East Java Province.[3] The study was conducted from July to December 2020.

Study participants and sampling
The study included 25 severely wasted children under 5 in the rural area, who were covered by Gitik Primary Health Center, and 30 under-five years severely wasted children in the sub-urban area who were covered by Kertosari Primary Health Center. The respondent was the mother of under-nutrition children who had signed written informed consent after receiving a clear explanation about the study.

Data collection tool and technique
The data were collected using a structured questionnaire adapted from several questionnaires and subjected to a validation process. The validity and reliability tests were performed at the Tembokrejo Public Health Center on 30 respondents who met inclusion and exclusion criteria. The reliability of the questionnaire ranged from Cronbach's alpha 0.790 to 0.906 for a different part of the questionnaire. It was reliable if $\alpha > 0.60$.

The questionnaire consists of five major categories: 1) child characteristics, 2) family characteristics, 3) nutrient intake patterns, 4) environmental factors, and 5) healthcare utilization.

The child characteristics include 1) age, 2) sex, and 3) birth history (with or without low birth weight = LBW). Familial characteristics include 1) mother's education, 2) father's occupation, 3) mother's occupation, 4) birth spacing (time duration of the current birth from immediate previous birth), 5) family members, and 6) family income.

The questionnaire on nutrient intake patterns adopted from Recommended Dietary Allowances (RDA) for Indonesians is based on the Indonesian Ministry of Health Regulation No. 28/2019. It consists of 1) energy consumption rate, 2) protein consumption rate, 3) fat consumption rate, 4) carbohydrate consumption rate, 5) zinc (Zn) consumption rate, and 6) calcium (Ca) consumption rate.[17] The consumption rate was determined by food recall form 2×24 hours.[18]

The questionnaire for environmental factors includes 1) household environmental sanitation and 2) food hygiene and sanitation practices. The household environmental sanitation questionnaire was adopted from Indonesian Basic Health Research (2013).[19] It includes 1) household conditions such as roof, wall, floor, bedroom window, family room window, ventilation, kitchen smoke ventilation, and home lighting; 2) clean water facilities, toilets and latrines, sewer system, and garbage disposal; and 3) respondents' practices such as opening the bedroom's window, opening the family room's window, house cleaning, toileting, and garbage throwing. The household environmental sanitation was then classified into two categories: good and poor. The food hygiene and sanitation practice questionnaire consists of 1) personal hygiene (clean clothes, short nails, clean hands, no hands accessories, frequent hand washing), 2) tableware sanitation (clean, good washing, drying, clean saving equipment, insect-free saving equipment, no crack equipment), and 3) premises and room sanitation (kitchen, no insect, close food container, close garbage bin). Food hygiene and sanitation were

classified into three categories: good, moderate, and poor.

The health care utilization was described as the ability of the family to gain healthcare facilities based on the price, distance, and service facilities. It was classified into three levels: high, moderate, and low usage.

Data analysis and statistic

Data were processed using Statistical Package for the Social Sciences (SPSS) software, version 26.0. Each variable was presented descriptively, and the correlation between variables was analyzed using multiple logistic regression with a significant level of $P = 0.05$. The Chi-square test was used to evaluate the bivariate relationship of sex, father's occupation, and mother's occupation variables due to their data type.

Ethical consideration

The study has received approval from the Ethical Committee of Faculty of Medicine University of Jember with the reference number 896/UN25.8/KEPK/ DL/2020.

Results

In this study, the determinant factors of severely wasted children under 5 have been investigated among 55 children in Banyuwangi, Indonesia, of whom 25 children lived in a rural area and 30 lived in a sub-urban area. Table 1 presents respondents' individual and socio-economic characteristics, including child and family characteristics. In a rural area, the majority (44%) of severely wasted children were 25–36 months but 37–59 months in sub-urban areas (43.33%). There was a sex preference for severely wasted children, where male children were more prevalent than females in both areas. For the family characteristic factors, the majority of respondents in a rural area had a low mother education level but a moderate education level in a sub-urban area, and the majority of parents were self-employed and had under minimum wage income in both areas.

Table 2 shows the child nutrient intake patterns of severely wasted children. The majority of severely wasted children in both rural and sub-urban areas had a low energy, protein, carbohydrate, Zn, and Ca consumption rate. The only difference is the fat consumption rate in rural areas, with the majority at a moderate level.

The environmental factors and healthcare utilization are shown in Table 3. Rural and sub-urban areas had poor household environmental sanitation, food hygiene, and sanitation and moderately to highly used healthcare facilities.

Table 1: Individual and socioeconomic characteristics of study participants in rural areas (*n*=25) and suburban areas (*n*=30)

Variables	Rural area		Suburban area	
	n	%	*n*	%
Child Characteristics				
Age (month)				
0-24	4	16	9	30
25-36	11	44	8	26.67
37-59	10	40	13	43.33
Sex				
Male	14	56	18	60
Female	11	44	12	40
Birth History				
No LBW (>=2500 g)	22	88	28	93.33
LBW (<2500 g)	3	12	2	6.67
Family Characteristics				
Mother's education				
Primary	16	64	13	43.33
Secondary	8	32	16	53.33
Higher	1	4	1	3.33
Father's occupation				
Merchant	11	44	9	30
Farmer	0	0	0	0
Civil servant	0	0	1	3.33
Military	0	0	0	0
Retired person	0	0	0	0
Self-employed	14	56	20	66.67
Mother's occupation				
Merchant	9	36	15	50
Farmer	0	0	0	0
Civil servant	0	0	1	3.33
Military	0	0	0	0
Retired person	0	0	0	0
Self-employed	16	64	14	46.67
Birth spacing				
<=2 y	6	24	7	23.33
>2 y	19	76	23	76.67
Family member				
Small family	4	16	4	13.33
Moderate family	18	72	18	60
Big family	3	12	8	26.67
Family's income				
< District minimum wage	20	80	20	66.67
>=District minimum wage	5	20	10	33.33

Statistical analysis is demonstrated in Tables 4 and 5. Regression analysis showed that child age was associated with the severely wasted prevalence in rural and sub-urban areas with $P = 0.014$ and $P = 0.030$, respectively. Family members and family income were associated with severe wasted in rural areas, and birth spacing was only associated with severe wasted prevalence in sub-urban areas. One interesting finding is all child nutrient intake determinants, including energy, protein, fat, carbohydrate, and zinc consumption rate, except for calcium consumption

Table 2: Nutrient intake pattern of study participants in rural (*n*=25) and suburban areas (*n*=30)

Variables	Rural area		Suburban area	
	n	%	*n*	%
Nutrient intake pattern				
Energy consumption rate				
High	0	0	0	0
Moderate	10	40	14	46.67
Low	15	60	16	53.33
Protein consumption rate				
High	2	8	0	0
Moderate	5	20	11	36.67
Low	18	72	19	63.33
Fat consumption rate				
High	2	8	0	0
Moderate	12	48	11	36,67
Low	11	44	19	63,33
Carbohydrate consumption rate				
High	1	4	0	0
Moderate	9	36	10	33,33
Low	15	60	20	66,67
Zinc (Zn) consumption rate				
High	6	24	0	0
Moderate	5	20	12	40
Low	14	56	18	60
Calcium (Ca) consumption rate				
High	2	8	0	0
Moderate	9	36	11	36,67
Low	14	56	19	63,33

Table 3: The environmental factors and health care utilization of study participants in rural areas (*n*=25) and suburban areas (*n*=30)

Variables	Rural area		Suburban area	
	n	%	*n*	%
Environmental factors				
Household environmental sanitation				
Good	6	24	8	26.67
Poor	19	76	22	73.33
Food hygiene and sanitation				
Good	4	16	3	10
Moderate	8	32	9	30
Poor	13	52	18	60
Health care utilization				
Highly used	14	56	11	36.67
Moderately used	10	40	10	33.33
Low used	1	4	9	30

rate, were associated with severe wasting in sub-urban areas. In contrast, only calcium consumption rate was associated with severe wasting in rural areas. However, all environmental factors were significantly associated with the severely wasted prevalence in rural and sub-urban areas. Health service utilization was associated with severely wasted prevalence only in sub-urban areas.

Table 5 presents the Chi-square analysis for the variables sex and fathers' and mothers' occupations. None of the variables was associated with wasted in rural and sub-urban areas.

Discussion

This study investigated the factors of severely wasted among children under 5 in rural and sub-urban areas of Indonesia using five important health determinants, including biological factors, individual behavior, social factors, environmental and physical factors, and health services utilization. Age is the only biological factor representing child characteristics associated with severe wasting in rural and sub-urban settings. This result is similar to studies on factors associated with wasting in South Asian and African countries, including Bangladesh, India, the Maldives, Nepal, Pakistan, Afghanistan, and Ethiopia, which showed that younger children were one of the main factors.[8,9,11-15,20-22] In rural areas, the majority of severely wasting children was 25–36 months, while in sub-urban settings, it was 37–59 months. This age is the period of toddlerhood with dramatic growth and change. It needs more nutrients to gain weight, increase gross motor development, and transform into a mobile and energetic child. This period is also the early childhood phase, which follows toddlerhood and precedes formal schooling. A child transforms into a busy learner, gains a sense of self, and begins to learn the physical world working.[23] A child starts playing and observing the surrounding environment and decreases the nap time. This study found that our respondents were likely to consume low nutritional food, as shown by all nutrient consumption rate data, making them lose appetite and further under-nutrition. Respondents also had poor hygiene and sanitation due to less attention from the mother or caregiver and poor environmental sanitation, making higher infection risk. It is known that wasting is a transient under-nutrition condition resulting from recent rapid weight loss or failure to gain weight, probably due to infection.

Sex has no significant association with severely wasted prevalence in both areas. However, data revealed that severely wasted prevalence was higher in boys than girls in both settings, which implicated the sex preference of severely wasted children. A boy under 5 has faster gross motor development and does more physical activities than a girl, needing more energy. It is known that sex-specific hormones are related to various infectious diseases, auto-immune diseases, asthma, and other conditions, including under-nutrition. Testosterone is a potential candidate; it is produced in early infancy and tends to disappear later and increase again in adolescence. Another candidate is the dynamic difference between luteinizing hormone (LH) and

Table 4: Multiple logistic regression analysis of factors associated with severely wasted children under five in rural and suburban areas

	Rural area					Suburban area				
	R^2	β	SE	*t*	*P*	R^2	β	SE	*t*	*P*
Age	0.234	0.484	0.126	2.651	0.014*	0.158	0.397	0.098	2.291	0.030*
Birth history	0.010	-0.101	0.313	-0.484	0.633	0.013	0.112	0.358	0.598	0.555
Mother's education	0.014	0.120	0.374	0.582	0.567	0.041	0.202	0.159	1.093	0.284
Birth spacing	0.118	0.344	0.225	1.758	0.092	0.355	0.596	0.171	3.927	0.001*
Family number	0.188	0.433	0.174	2.306	0.030*	0.006	0.075	0.161	0.399	0.693
Family income	0.167	0.408	0.233	2.145	0.043*	0.020	0.140	0.223	0.748	0.461
Energy consumption rate	0.140	0.374	0.197	1.935	0.065	0.154	0.393	0.166	2.261	0.032*
Protein consumption rate	0.000	0.000	0.255	0.000	1	0.165	0.407	0.171	2.356	0.026*
Fat consumption rate	0.010	-0.098	0.203	-0.473	0.641	0.165	0.407	0.171	2.356	0.026*
Carbohydrate consumption rate	0.140	0.374	0.197	1.935	0.065	0.199	0.446	0.171	2.634	0.014*
Zinc consumption rate	0.001	0.027	0.171	0.131	0.897	0.138	-0.372	0.171	-2.118	0.043*
Calcium consumption rate	0.160	0.400	0.176	2.093	0.048*	0.030	0.174	0.184	0.937	0.357
Household environmental sanitation	0.287	0.535	0.202	3.039	0.006*	0.144	0.380	0.188	2.174	0.038*
Food hygiene and sanitation	0.175	0.418	0.125	2.208	0.037*	0.174	0.417	0.122	2.431	0.022*
Health care utilization	0.007	-0.085	0.177	-0.411	0.685	0.157	0.396	0.102	2.280	0.030*

Note: *a statistically significant if *P*<0.05

Table 5: Chi square analysis of sex, father's and mother's occupation factors associated with severely wasted children under five in rural and suburban areas

	Rural area P	Suburban area P
Sex	0.515	0.705
Father's occupation	0.167	0.600
Mother's occupation	0.351	0.814

follicle-stimulating hormone (FSH) among boys and girls. FSH tends to diminish among boys after 6 months of age, but it is steadily high in girls until 3 to 4 years, which matches the wasting-stunting condition.[24]

History of LBW is not associated with severely wasted children in both settings. This finding contrasts with previous results, which reported a robust association between LBW and malnutrition in Bangladesh and Malawi children, while LBW leads to an increased risk of malnutrition-related disease morbidity and mortality growth.[8,25,26] Our finding indicated that the wasting condition results from poor nutrition after birth and possibly due to infection.

Social factor determinant was investigated based on family characteristics. The number of family members and family income are significantly associated with severe wasting in rural areas, but birth spacing was associated in sub-urban setting. Family income determines the ability to fulfill daily consumption needs, which refers to food insecurity in this study[27]. The optimum birth spacing helps the mother recover from childbirth adequately, leading to comfort and a good parenting style. Other determinants, such as the mother's education and the mother's and father's occupations, were not

significantly associated with wasting. This contrasts with another study on factors associated with wasting, which reported the top three factors, that is, short maternal height, lack of maternal education, and poorest household wealth.[13,15] A study in Pakistan reported that no mother's education and low mother's BMI are the determinant factors of wasting,[11,12] and studies in South Asia countries, including Bangladesh, India, the Maldives, Nepal, Pakistan, and Afghanistan, determined younger children age, low mother's BMI,[9-12,22] later birth order, male, maternal illiteracy, short maternal stature, lack of improved water source, and household poverty were also associated with wasting in various countries.[12]

The behavioral factors of nutritional problems, such as nutrient intake patterns, including energy, protein, fat, carbohydrate, zinc, and calcium consumption rates, were investigated. Interestingly, all child nutrient intake determinants except Ca intake were associated with severe wasting only in sub-urban areas. Based on the Indonesia Ministry of Health 2019, the energy consumption rate for 12–36 months of children is 1350 kcal/day. However, this study demonstrated that the energy consumption rate was 1125 kcal/day in rural and 1000 kcal/day in sub-urban areas, categorized as Recommended Dietary Allowance (RDA) insufficiency.[17] Factors contributing to this phenomenon are household food insecurity due to low family income and family members. Several studies have reported a positive association between food insecurity and child wasting in children under 5 years.[27]

All environmental factors, including household environmental factors and food hygiene and sanitation, were significantly associated with severe wasting in rural and sub-urban areas. WHO reported that 39–61% of global malnutrition is linked to the environment, especially poor

water, sanitation, and hygiene conditions.[28] Poor water, sanitation, and hygiene conditions increased infection risk, and vice versa[29]. Children who live without adequate sanitation, hygiene, and clean drinking water do not grow as well as children who do. Health services utilization is associated with severe wasting only in sub-urban areas, so the awareness of the need to use health care services in sub-urban areas needs to improve. First point of care in the primary health care is an important public issue, especially in developing countries. Primary health care utilization should be improve as part of health indicator.[30] Healthcare service accessibility is vital in disease prevention; it includes child immunization, pregnant woman assessment, child growth and development assessment, and nutrition counseling. Health promotion strategy is an effective method to control behavioral related to nutrition problem including wasting.[31]

Limitation and recommendation

The study participant is limited to a small district area of Indonesia, which must be considered when extending the study findings to other regions. However, the urban and sub-urban settings reflect the different characteristics of respondents. The study has investigated five important health determinants, including biological factors, individual behavior, social factors, environmental and physical factors, and health services utilization, to analyze the factors of severe wasting in children under 5 in two different settings where wasting becomes prevalent. The findings of the study are useful for planning interventions to reduce wasting and severe wasting based on dominant factors in specific settings.

Conclusions

This study has provided evidence of age and environmental factors as determinant factors associated with severe wasting of children under 5 years in both rural and sub-urban areas. However, family members and family income were determinant factors in rural areas, while birth spacing, nutritional intake, and health service utilization were determinant factors in sub-urban areas. Therefore, different approaches based on region are needed to address the severe wasting problem.

Conflicts of interest

There are no conflicts of interest.

References

1. WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards based on length/height, weight and age. Acta Paediatr Suppl 2006;450:76-85.
2. United Nations Children's Fund (UNICEF), World Health Organization (WHO), International Bank for Reconstruction and Development/The World Bank. Levels and trends in child malnutrition: UNICEF/WHO/World Bank Group Joint Child Malnutrition Estimates: Key findings of the 2023 edition. New York: UNICEF and WHO; 2023. Available from: https://www.who.int/publications/i/item/9789240073791. [Last accessed on 2024 Feb 06].
3. [BPS] Central Bureau of Statistics. Prevalence of undernourished children under five by Province in Indonesia (PSG) 2016-2018. 2018. Available from: https://www.bps.go.id/indicator/30/1777/1/prevalensi-balita-kekurangan-gizi-menurut-provinsi-di-indonesia-psg-.html. [Last accessed on 2024 Feb 06].
4. Riset Kesehatan Dasar. Laporan Nasional Riskesdas 2018. Jakarta: Lembaga Penerbit Badan Penelitian dan Pengembangan Kesehatan; 2019.
5. Rüegg SR, McMahon BJ, Häsler B, Esposito R, Nielsen LR, Speranza CI, *et al*. A blueprint to evaluate one health. Front Public Heal 2017;5:1-5.
6. WHO-Air Quality, Energy and Health (AQE). Determinants of health. WHO. 2017. Available from: https://www.who.int/news-room/questions-and-answers/item/determinants-of-health. [Last accessed on 2024 Feb 06].
7. Lenters LM, Wazny K, Webb P, Ahmed T, Bhutta ZA. Treatment of severe and moderate acute malnutrition in low- and middle-income settings: A systematic review, meta-analysis and Delphi process. BMC Public Health 2013;13:S23. doi: 10.1186/1471-2458-13-S3-S23.
8. Rahman MS, Howlader T, Masud MS, Rahman ML. Association of low-birth weight with malnutrition in children under five years in Bangladesh: Do mother's education, socio-economic status, and birth interval matter? PLoS One 2016;11:1-16. doi: 10.1371/journal.pone. 0157814.
9. Hossain MM, Abdulla F, Rahman A. Prevalence and determinants of wasting of under-5 children in Bangladesh: Quantile regression approach. PLoS One 2022;17:1-16. doi: 10.1371/journal.pone. 0278097.
10. Kumar P, Chauhan S, Patel R, Srivastava S, Bansod DW. Prevalence and factors associated with triple burden of malnutrition among mother-child pairs in India: A study based on national family health survey 2015–16. BMC Public Health 2021;21:1-12. doi: 10.1186/s12889-021-10411-w.
11. Sand A, Kumar R, Shaikh BT, Somrongthong R, Hafeez A, Rai D. Determinants of severe acute malnutrition among children under five years in a rural remote setting: A hospital based study from district Tharparkar-Sindh, Pakistan. Pakistan J Med Sci 2018;34:260-5.
12. Harding KL, Aguayo VM, Webb P. Factors associated with wasting among children under five years old in south asia: Implications for action. PLoS One 2018;13:1-17.
13. Li Z, Kim R, Vollmer S, Subramanian SV. Factors associated with child stunting, wasting, and underweight in 35 low- and middle-income countries. JAMA Netw Open 2020;3:e203386. doi: 10.1001/jamanetworkopen. 2020.3386
14. Derso T, Tariku A, Biks GA, Wassie MM. Stunting, wasting and associated factors among children aged 6-24 months in Dabat health and demographic surveillance system site: A community based cross-sectional study in Ethiopia. BMC Pediatr 2017;17:1-9.
15. Tariku A, Bikis GA, Woldie H, Wassie MM, Worku AG. Child wasting is a severe public health problem in the predominantly rural population of Ethiopia: A community based cross-sectional study. Arch Public Heal 2017;75:1-9. doi: 10.1186/s13690-017-

0194-8.

16. Akombi BJ, Agho KE, Hall JJ, Wali N, Renzaho AMN, Merom D. Stunting, wasting and underweight in Sub-Saharan Africa: A systematic review. Int J Environ Res Public Health 2017;14:1-18. doi: 10.3390/ijerph 14080863.

17. Indonesian Ministry of Health. Peraturan Menteri Kesehatan Republik Indonesia No. 28 tahun 2019. Angka Kecukupan Gizi yang Dianjurkan untuk Masyarakat Indonesia. Jakarta. 2019. Available from: https://peraturan.bpk.go.id/Details/138621/permenkes-no-28-tahun-2019. [Last accessed on 2024 Feb 06].

18. National Institute of Health (NIH). National Cancer Institute. Dietary Assessment Primer. 24-hour Dietary Recall (24HR) At a Glance. USA. 2017;1-2. Available from: https://dietassessmentprimer.cancer.gov/profiles/recall/. [Last accessed on 2024 Feb 06].

19. Indonesia Agency of Health Research and Development-Ministry of Health of Republic Indonesia. Basic Health Research 2013. Jakarta. 2013. Available from https://repository.badankebijakan. kemkes.go.id/id/eprint/4519/1/Basic_Health_Research_Riskesdas.pdf. [Last accessed on 2024 Feb 06].

20. Baykeda TA, Negash WD, Belachew TB, Fetene SM, Addis B, Kidie AA, *et al*. Trends of socioeconomic and geographic inequalities in severe wasting among under-five children in Ethiopia from 2000 to 2019: Using the WHO health equity assessment toolkit. Sci Rep 2024;14:1-9. doi: 10.1038/s41598-023-51081-5.

21. Khura B, Mohanty P, Gandhi AP, Patnaik L, Mewara A, Pradhan KB, *et al*. Mapping concurrent wasting and stunting among children under five in India: A multilevel analysis. Int J Public Health 2023;68:1-11. doi: 10.3389/ijph. 2023.1605654.

22. Sunuwar DR, Singh DR, Pradhan PMS. Prevalence and factors associated with double and triple burden of malnutrition among mothers and children in Nepal: Evidence from 2016 Nepal demographic and health survey. BMC Public Health 2020;20:1-11. doi: 10.1186/s12889-020-8356-y.

23. Balasundaram P, Avulakunta ID. Human growth and development. StatPearls. Treasure Island (FL): StatPearls Publishing; 2024. Available from: https://www.ncbi.nlm.nih.gov/books/NBK567767/. [Last accessed on 2024 Feb 06].

24. Garenne M, Myatt M, Khara T, Dolan C, Briend A. Concurrent wasting and stunting among under-five children in Niakhar, Senegal. Matern Child Nutr 2019;15:1-8. doi: 10.1111/mcn. 12736.

25. Ntenda PAM. Association of low birth weight with undernutrition in preschool-aged children in Malawi. Nutr J 2019;18:1-15. doi: 10.1186/s12937-019-0477-8.

26. Khan S, Zaheer S, Safdar NF. Determinants of stunting, underweight and wasting among children <5 years of age: Evidence from 2012-2013 Pakistan demographic and health survey. BMC Public Health 2019;19:1-15. doi: 10.1186/s12889-019-6688-2.

27. Maitra C. A review of studies examining the link between food insecurity and malnutrition. Food and Agriculture Organization of the United Nation (FAO). Rome. 2018. Available from: http://www.fao.org/3/CA1447EN/ca1447en.pdf. [Last accessed on 2024 Feb 06].

28. WHO. WHO global water, sanitation and hygiene: annual report 2018. World Health Organization. Geneva. 2019. Available from: https://iris.who.int/bitstream/handle/10665/327118/WHO-CED-PHE-WSH-19.147-eng.pdf?sequence=1. [Last accessed on 2024 Feb 06].

29. Schmidt CW. Beyond malnutrition: The role of sanitation in stunted growth. Environ Health Perspect 2014;122:A298-303.

30. Sivanandan A, Kumar SG, Krishnamoorthy Y. Awareness and preference in utilizing primary health-care services from rural health center as first point-of-care: A community-based cross-sectional study in South India. J Edu Health Promot 2020;9:85.

31. Soviyati E, Sulaeman ES, Sugiharto I, Wiboworini B. Effect of applying the health promotion model in stunting prevention and behavior control in Indonesia. J Edu Health Promot 2023;12:227. doi: 10.4103/jehp.jehp_276_23.