doi:10.31674/mjmr.2019.v03i03.003

MJMR

DIETARY DIVERSITY AND STUNTING AMONG 6-23 MONTHS CHILDREN: COMMUNITY CROSS-SECTIONAL STUDY IN EAST JAKARTA

Wan Nedra Komaruddin[1]*, Muhammad Juffrie[2], Hardiono Pusponegoro[3], Indwiani Astuti[4], Suryono Yudha Patria[2], Dian Mardhiyah[1]

[1]Division of Child Health Science, Faculty of Medicine, YARSI University, Jakarta, Indonesia
[2]Division of Child Health Science, Faculty of Medicine, Gajah Mada University, Yogyakarta, Indonesia
[3]Division of Child Health Science, Faculty of Medicine, Indonesia University, Jakarta, Indonesia
[4] Faculty of Medicine, Gajah Mada University, Yogyakarta, Indonesia

**Corresponding Author's Email: wan.nedra@yarsi.ac.id*

ABSTRACT

The period from birth to two years of age is a "critical window" of opportunity for the promotion of optimal growth, health and behavioral development of children. Dietary diversity is an important immediate determinant of stunting children also feeding patterns combined with household food insecurity can lead to stunting children which is a major public health problem in developing countries like Indonesia. A community based cross-sectional study that involved 120 participants from east Jakarta rural were conducted from February to March 2018. A consecutive sampling procedure was employed to select the required households. Multivariable logistic regression analyses were performed to compare stunting by feeding patterns and other characteristics. The prevalence of child stunting in the current study Dietary diversity and child stunting 44 was 43.5%. Dietary diversity has association with stunting especially in the poorest economic status. Dietary education would be the most effective strategy to deliver messages about infant and young child feeding practices, especially on dietary diversity.

Keywords: Dietary Diversity, Malnutrition, Stunting

INTRODUCTION

Stunting, which is defined as an attained height below −2 Standard Deviations (SD) of the World Health Organization (WHO) growth reference median is the most prevailing form of child undernutrition and affects around 165 million children globally before their 5th birthday (Ahmed *et al.*, 2018).Stunting syndrome is a constellation of growth retardation, delayed development, cognitive defect, and metabolic defect, which increases morbidity and mortality in young children (Poos *et al.*, 1999; Prendergast & Humphrey, 2014).The prevalence was 22.2% worldwide in 2017 (Aguayo & Menon, 2016). Stunting arises as a result of chronic restriction of a child's potential growth brought about by the cumulative effects of inadequate food intake and poor health conditions that result from endemic poverty. This restricted growth is an important cause of morbidity and mortality in infants and children (Black *et al.*, 2013; Baron *et al.,* 2015). Poor socioeconomic conditions and an increased risk of frequent and early exposure to adverse conditions, such as illness or inappropriate feeding practices may give rise to high levels of stunting. A decline in the national stunting rate is usually an indication of improvements in the overall socioeconomic conditions of a country (Willey *et al.*, 2009; Mushtaq *et al.*, 2011). According to Black *et al*. (2013), more than one-third of child deaths and more than 10% of the total global disease burden are attributed to maternal and child undernutrition, which may result in stunting among others. According to the 2018 Indonesia Demographic and Health Survey, 30.8% of Indonesia children aged less than five years are stunted (Ministry of Health Republic of Indonesia, 2018) and places Indonesia the fifth highest burden of stunted children in the world. In spite of a reduction, the prevalence of child stunting in Indonesia in 2018 was still 'unacceptably high', by World Health Organization (WHO) standards and greater efforts are thus required to decrease the prevalence of stunting among Indonesia children. Child undernutrition leads to reduction in school attendance, cognitive development resulting in massive loss of human potential leading to economic loss to individual and nation (Begum & Dewey, 2011; Fanzo & Reinhardt, 2014; Unicef, 2014; Demirchyan *et al.*, 2016; Walker *et al.*, 2015). Factors that may indirectly influence stunting levels among children in Indonesia including socio-economic status such as mother's education and occupation, household income and health expenditure (Ministry of Health Republic of Indonesia, 2018; Beal *et al.*, 2018; Seedhom, Mohamed & Mahfouz, 2014). In addition, factors such as micronutrient deficiencies, inadequate protein intake and infections may directly cause stunting (Siarif, Yuliarti & Iskandar, 2019). This study focuses on the effect of dietary diversity on stunting as it is an important immediate determinant of child undernutrition. The objective of the study was to find the prevalence of stunting among infants and young children aged 6–23 months and its association with dietary diversity.

METHODOLOGY

Study Participants and Settings

The study was cross-sectional design in east Jakarta and representative at the most populated area in Jakarta. It had a population of 2,817,994 at the 2014, making it the most populous of the five cities within Jakarta. Territory is characterized by several industrial sectors (World Population Review, 2019). The survey was done following a consecutive sampling scheme. In total, 120 households were selected. All children 6-23 months of age in the selected households were eligible for the survey. The children aged 6–23 months from registered health clinic were included in the study after obtaining consent from their mothers. The children with acute illness, congenital malformation, and aged 2 years and above were excluded from the study. If the household has more than one child of age 6–23 months, all the eligible children were included in the study. Sample size was determined by considering depend of the prevalence and absolute precision (L) = 5%. We also excluded those who were underweight (weight-for-age z-score less than-2 SD), wasted (weight-for-height/length z-score less than-2 SD), overweight (body mass index-for-age z-score more than 1 SD), or had height/length-for-age z-score between -2 and -1 SD. The exclusion criteria were determined to ensure that wasting and underweight do not bring a potential risk of confounding factors. Informed verbal consent was obtained, and the nature and consequences of the study were explained to the patient's mother. Confidentiality was assured.

Anthropometric Measurement

Stunting was defined as children who had height/length-for-age z-score less than-2 SD for their respective age and sex, according to the WHO 2006 standard growth chart. The z-scores were calculated using the WHO Anthro® software. Length in centimeters was measured in a supine position using SECA® length board for subjects under 2 years old, whereas height was measured in a standing position with SECA® stadiometer for those who are above 2 years old. Weight in kilograms was measured using SECA® digital scale in a standing position, and the subjects wore none or minimal light clothes. The enumerators (two associate nutrition experts) interviewed the parents using provided questionnaires, forms, and checklists. Prior to the interview, they have been trained by experts (3 nutritionists, 1 pediatrician, and 1 health analyst). We also assessed the eating habit by asking the parents to 3 days recall their children eating habit using Food Frequency Questionnaire. The food consumption data then converted into nutrients content using list of food ingredients and analyzed using Nutri Survey program. The principal investigator and team performed all anthropometric measurements with assistants on the infants and young children to eliminate inter-examiner error. Measurements taken include length and weight. To measure length was measured while child without shoes was kept in supine position with knees kept straight and feet positioned at 90° to the legs. Both length and head circumference were measured to the nearest 0.1cm. Weight of the lightly clothed infants and children were measured to the nearest 10g. Weight was measured using an electronic hanging scale (Seca, Hanover Germany). All instruments were calibrated before measurements took place.

Dietary Diversity

Feeding practice related variables were assessed using eight score and optional feeding practice indicators developed by the World Health Organization (2019) for assessing the adequacy of infant and young child feeding (IYCF) practices. One of the indicators is minimum dietary diversity, minimum meal frequency, minimum acceptable diet, and bottle feeding. Dietary diversity is minimum dietary diversity is defined as proportion of children 6–23 months of age who receive foods from 4 or more food groups (World Health Organization, 2019). WHO also defines optimal infant feeding as initiating breastfeeding within one hour of birth, breastfeeding exclusively for the first six months, starting complementary food at six months post-delivery, continuing to breastfeed for two years, breast feeding day and night at least 8 times, the giving of colostrum, no pre-lacteal feeds, no bottle feeding and responsive feeding of solid, semi-solid food? In our study sub-optimal feeding practice was defined as lack of compliance to any of these recommended practices and low protein and calorie on their food. Minimum dietary diversity is defined as proportion of children 6–23 months of age who receive foods from 4 or more food groups (Ahmed *et al.*, 2018). In this study, a single 24-hour maternal-reported food recall data was applied to the checklist of 12 food groups proposed by FAO. Presence or absence of the food groups consumed in the last 24 hours then determined the Household Dietary Diversity (HDD). Trained interviewers administered the HDD to 101 household members with children age 6-23 months. Consumption of nutrients in the house ladder divided by the number of nutritional adequacy households to get Nutrient scores Adequacy Ratio (NAR). Next is the sum of NAR will be divided by the amount of nutrients to get the NAR value and will categorized in two groups that is enough if it is greater or equal to 77 % and less if smaller 77%. In this study, the level of adequacy energy and nutrients of each house stairs that are at risk of food insecurity in the east Jakarta is determined based on consumption food for each household (Aiadeke *et al.*, 2000).

Paternal or maternal education status was classified as primary school, junior high school, senior high school, and undergraduate. Family economic status was classified based on monthly family income (World Bank Data Team, 2017): low (less than IDR 785.000), lower middle (IDR 786.000–2.500.000), upper middle (IDR 2.500.000–9.654.000), and high (more than IDR 9.654.000).

Data were analyzed using SPSS 20. The prevalence of stunting with confidence interval was derived using Wald's statistics. Height for age distribution of study population was described in terms of Z-scores. Bivariate and multivariate logistic regression (LR) using stepwise backward LR method was used to test association between dietary diversity and stunting. $P < 0.05$ was considered as significant.

Ethics

This study was conducted according to the guidelines specify in the Declaration of Helsinki and all procedures involving human subjects were approved by the Medical and Health Research Ethics Committee (MHREC) Faculty of Medicine, Public Health, and Nursing, Gadjah Mada University. Written informed consent was obtained from all parents or guardians of the participants.

RESULTS

Sociodemographic Profile of The Study Population

The study includes 101 children aged 6-23 months. The subjects' profiles are shown in Table 1. The participants were then divided into two groups, namely stunted group (*n*=44) and normal stature (control) group (*n*=57). These two groups had similar demographic characteristics, except for the variables studied. One hundred and one children completed the study (response rate of 84.2%). The prevalence of child stunting in the current study 'Dietary Diversity and child stunting' 44 was 43.5% which was slightly higher than the national prevalence. Since the prevalence of child stunting was way above 5% (Rosenkranz, Sumarmi & Mahmudiono , 2017), it was less likely that the observed stunting was due to "healthy shortness" where child's shortness was attributable solely due to inherited genes and not because of inadequate nutrition or repeated bouts of infection (Prendergast & Humphrey, 2014). Maternal short stature has been associated with child stunting (Deborah *et al.*, 2015; Melaku *et al.*, 2018) and lends weight to the healthy shortness narrative. Unfortunately, we did not measure maternal height this hypothesis in our study.

Bivariate analysis results showed that there were several variables that had a significant association with stunting, such as poor dietary diversity (OR=6.76; 95%CI:0.65-33.35), low protein from complementary food (OR=0.86; 95%CI: 0.45-3.05), and low energy from complementary food (OR=0.85; 95%CI: 0.54-4.08), Maternal education (OR=0,44; 95%CI:0,55-1,25), economy of paternal (OR=3.5; 95%CI: 2.55-11.22). On the other hand, exclusive breastfeeding, paternal education status was not related to stunting. Multivariate analysis showed that stunting was strongly related with individual dietary diversity in young children. Subjects who had poor dietary diversity or consumption of food groups less than four were associated with 6.76 times higher chance of becoming stunting (95%CI: 6.77-41.51) than children who had good dietary diversity. Table 2 below showed a final model after applying stepwise-backward elimination. Stratification analysis was conducted based on household economic status to see whether there was an effect modification in the association between individual dietary diversity and stunting. The variable of household economic status was considered because several studies showed it was related to both dietary diversity and stunting ((Fanzo & Reinhardt, 2014; Walker *et al.*, 2015; Rosenkranz, Sumarmi & Mahmudiono, 2017).

Table 1: Analysis variables and characteristics of children stunting and normal stature

VARIABLE		STUNTING		NORMAL		*p**
		N	%	N	%	
Diatery Diversity						
	Poor (<4)	29	48.30%	31	51.70%	0.00*
	Good (>4)	15	36.60%	26	63.40%	
Exclusive Breastfeeding						0.811
	Yes	35	44.90%	43	55.10%	
	No	9	39.10%	14	60.90%	
Protein from Complementary Food						0.00*
	Adequate	7	15.20%	39	84.80%	
	Inadequate	37	67.30%	18	32.70%	
Energy from Contemporary Food						0.00*
	Adequate	14	15.20%	39	84.80%	
	Inadequate	30	67.30%	18	32.70%	
Family Economic Status						0.00*
	Low	24	54.54%	20	35.10%	
	Middle	15	34.10%	29	50.87%	
	High	5	11.36%	8	14.03%	
Paternal Education Status						
	<Junior high school	11	57.70%	26	42.30%	
	Senior high school >	46	38.70%	75	61.30%	
Maternal Education Status						0.00*
	<Junior high school	42	44.70%	52	53.30%	
	Senior high school >	2	28.60%	5	71.4%	

* *Proportion difference test, Chi Square*

Table 2: Multivariate Analysis of Factors Associated With Stunting

VARIABLE		OR	*p*	95% CI
Poor dietary diversity		6.76	0.00*	0.65-33.35
Inadequate Protein from complementary food		0.86	0.00*	0.45-3.05
Inadequate Energy from complementary food		0.85	0.00*	0.54-4.08
Maternal education status		0.44	0.00*	0.55-1.25
Economy Status		3.5	0.00*	2.55-11.22

**= significant (p<0,005)*

DISCUSSION

The objective of the current study was to determine the relationship between children stunting with dietary diversity as measured using household dietary diversity score, was a protective factor for child stunting. The proportion of food groups that were rich in growth-promoting nutrients such as animal protein was low, with only less than 70% of households consuming meat/poultry in the last 24 hours. This association aligns with the results of study conducted by Damayanti Syarif - and T. Mardiono in East Java (Rosenkranz, Sumarmi & Mahmudiono , 2017) also Cambodia that showed children who consumed animal source food were less likely to be stunted. A previous study in Indonesia highlighted the association between higher proportions of total household expenditure on animal foods with decreased likelihood of child stunting-. Another analysis showed a significant unadjusted association between Dietary Diversity and child stunting. This relationship remained significant in the final model, after adjustment for total energy intake, and protein intake. A similar study using 12 food groups via dietary diversity score in Cambodia showed no significant association, despite a lower mean DDS score, compared with our study . Our results were also in accord with a study in a Malaysia and Bangladesh.

The strength of association between DDS and child stunting in our study was relatively small (OR=0.89; 95% CI=0.80–0.99) compared with the previous study in east Java (OR=0.89; 95% CI=0.80–0.99) Bangladesh for children aged 24-59 months (OR=0.69; 95% CI=0.66–0.73) (Foote *et al.*, 2013) , but slightly greater than the study from Cambodia (OR=0.95; 95% CI=0.91–0.99) (Ey Chua *et al.*, 2012). Unfortunately, the odds ratio from the study Malaysian population was not available for comparison.

There are a few limitations to this study. First, our study only focused on dietary and diversity of stunting children to know risk factor of stunting children base on one of WHO standard. There are no assessed sources of protein that are commonly consumed in Indonesia. Second, we did not assess the quantitative intake (g/day) but use an ordinal scale based on the estimation of the daily portion and food frequency per week instead. Quantitative dietary analysis using g/day could probably give a more precise recommendation.

CONCLUSION

It should be considered that stunting is a multifactorial disorder affected not only by dietary factors, but also genetics, birth weight, and metabolic conditions. Based on the result of this study, individual dietary diversity score can be used as an indicator of dietary quality from complementary feeding in infants and young children. It is also a strong predictor of stunting. Dietary diversity has association with stunting especially in the poorest economic status. Dietary education would be the most effective strategy to deliver messages about infant and young child feeding practices, especially on dietary diversity. Exception should be made in food-insecure population which is to provide enriched complementary feeding products in addition to education and counselling. Finally, efforts have to be done in order to support dietary diversification such as promotion of local food production, home gardening, small-animal production, and dietary modification to provide diverse diet within households. This shows that provision of adequate dietary diversity may help in overcoming the burden of stunting among children.

ACKNOWLEDGEMENT

This study is an original research at Faculty of Medicine, Public Health, and Nursing, Gadjah Mada University. The author would like to express the gratitude to the supervisors, Chair of primary health

REFERENCES

Aguayo, V.M. & Menon, P. (2016). Stop Stunting: Improving Child Feeding, Women's Nutrition and Household Sanitation in South Asia. *Maternal & Child Nutrition*, 12(Supple 1), pp 3-11

Ahmad, I., Maroof, M., Khalique, N. Khalil, S.& Urfi. (2018). Dietary Diversity and Stunting Among Infants and Young Children: A Cross-Sectional Study in Aligarh. *Indian Journal of Community Medicine*, (43)1, pp 34-36

Aiadeke, C., Levin,C.E., Maxwell, D.G., Armar-Klemesu, M., Ruel, MT.& Morris ,S.(2000) Urban Livelihoods and Food and Nutrition Security in Greater Accra, Ghana . Retrived from: https:// www.who.int/nutrition/publications/WHO_multicountry_%20study_Ghana.pdf

Baron, J., Sävendahl, L., De Luca, F., Dauber, A., Phillip, M., Wit, J.M.& Nilsson, O. (2015). Short and Tall Stature: A New Paradigm Emerges. *Nature Reviews Endocrinology*, (11)12, pp 735-746

Beal, T., Tumilowicz, A., Sutrisna, A., Izwardy, D. & Neufeld, L.M. (2018). A Review of Child Stunting Determinants in Indonesia. *Maternal & Child Nutrition*, Pages 10

Begum, K. & Dewey, K. (2011). Long-Term Consequences of Stunting in Early Life. *Maternal & Child Nutrition*, (3)5, pp 5-18

Black, R.E., Victora, C.G., Walker, S.P., Bhutta, Z.A., Christian, P., de Onis, M., Ezzati, M., Grantham-McGregor, S., Katz, J., Martorell, R., Uauy, R. & Maternal and Child Nutrition Study Group. (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet*, 382(9890), pp 427-451

Deborah, C., Lulu, C., Mbwana, H., Rose, V., Sabas, K., Issaka,A.I., Baines, S.K., Dibley, M.J.& Agho, K.E.(2015). Determinants of stunting and severe stunting among under-fives in Tanzania: evidence from the 2010 cross-sectional household survey. *BMC Pediatrics*, Pages 13

Demirchyan, A., Hekimian ,K., Petrosyan, V.&

Sargsyan, V.(2016). Predictors of Stunting Among Children Ages 0 To 59 Months in a Rural Region of Armenia. *Journal of Pediatric Gastroenterology and Nutrition*, 62(1),pp 150–156.

Ey Chua, EY., Zalilah, M.S., Ys Chin, Y.S. & Norhasmah, S.(2012). Dietary Diversity is Associated with Nutritional Status of Orang Asli Children in Krau Wildlife Reserve, Pahang. *Malaysian Journal of Nutrition*, (18)1 ,pp 1-13.

Fanzo, J.& Reinhardt,K.(2014). Addressing Chronic Malnutrition Through Multi-Sectoral, Sustainable Approaches: A Review of Causes and Consequences. *Frontiers in Nutrition*, Pages 11

Foote, D., Paintal, K., Zarrelli, A. & Begin, F.(2013). Multisector action to promote nutrition security in five countries in Asia. Annals of Nutrition and Metabolism. Retrived from https://insights.ovid.com/annals-nutrition-metabolism/anumds/2013/09/001/multisector-action-promote-nutrition - security-five/2242/00000595

McDonald, C.M., McLean, J.,Talukdar,A., Lynd, L.D. & Green ,T.J. (2015). Household Food Insecurity and Dietary Diversity as Correlates of Maternal and Child Undernutrition in Rural Cambodia. *European Journal of Clinical Nutrition*, 69(2), pp 242-246

Melaku, Y.A., Gill, T.K., Taylor, A.W., Adams, R., Shi, Z.& Worku, A. (2018). Associations of Childhood, Maternal and Household Dietary Patterns With Childhood Stunting In Ethiopia: Proposing An Alternative And Plausible Dietary Analysis Method To Dietary Diversity Scores. *Nutrition Journal*. Pages 15

Ministry of Health Republic of Indonesia. (2018). Potret Sehat Indonesia dari Riskesdas 2018. Retrieved from: http://www.depkes.go.id/ article/view/18110200003/potret-sehat-indonesia-dari-riskesdas-2018.html

Mushtaq, M.U., Gull, S., Khurshid, U., Shahid, U., Shad, M.A.& Siddiqui, A.M. (2011). Prevalence and Socio-Demographic Correlates of Stunting and Thinness among Pakistani Primary School Children. *BMC Public Health*, pages 11

Poos, M.I., Costello, R., Carlson-Newberry, S.J.& Institute of Medicine (US) Committee on Military Nutrition Research. (1999). The Role of Protein and Amino Acids in Sustaining and Enhancing Performance. Retrieved from: https://www.ncbi.nlm.nih.gov/books/NBK224683/

Prendergast, A.J.& Humphrey, J.H. (2014) The Stunting Syndrome in Developing Countries. *Paediatrics and International Child Health*, 34(4), pp 250-265

Rosenkranz, R.R., Sumarmi, S.& Mahmudiono ,T.(2017). Household Dietary Diversity and Child Stunting In East Java, Indonesia. *Asia Pacific Journal of Clinical Nutrition*, 26(2) ,pp 317–325.

Sari, M., de Pee, S., Bloem, M.W., Sun, K., Thorne-Lyman, A.L., Moench-Pfanner, R., Akhter, N., Kraemer, K.& Semba, R.D. (2010). Higher Household Expenditure on Animal-Source and Nongrain Foods Lowers the Risk of Stunting among Children 0–59 Months Old in Indonesia: Implications of Rising Food Prices. *The Journal of Nutrition*, 140(1), pp 195S-200S

Seedhom, A.E., Mohamed, E.M.& Mahfouz, E.M. (2014). Determinants of stunting among preschool children, Minia, Egypt. *International Public Health Forum*, 1(2), pp 6-9

Sjarif, D.R., Yuliarti, K. & Iskandar, W. J. (2019). Daily Consumption of Growing-Up Milk Is Associated with Less Stunting Among Indonesian Toddlers. *Medical Journal of Indonesia*, (28)1, pp 70-76.

Sutrisna, A., Tumilowicz, A., Izwardy, D., Neufeld, L.M. & Beal, T.(2018). A Review of Child Stunting Determinants in Indonesia. *Maternal and Child Nutrition*, (14)4

UNICEF. (2014). Improving Child Nutrition: The Achievable Imperative for Global Progress. Retrieved from: https://www.unicef.org/ publications /index_68661.html

Walker, S.P., Chang, S.M., Wright, A., Osmond, C. & Grantham-McGregor, S.M. (2015). Early Childhood Stunting is Associated with Lower Developmental Levels in the Subsequent

Generation of Children. *The Journal of Nutrition*, (145)4, pp 823-828

Willey, B.A., Pettifor, J.M., Cameron, N., Griffiths, P.L. & Norris, S.A. (2009). Socio-Economic Predictors of Stunting in Preschool Children - A Population-Based Study from Johannesburg and Soweto. *South African Medical Journal*, (99)6, pp 450-466

World Bank Data Team. (2017). New country classifications by income level. Retrieved from: https://blogs.worldbank.org/opendata/new-country-classifications-income-level-2017-2018

World Health Organisation. (2019). Indicators for Assessing Infant and Young Child Feeding Practices.Retrivedfrom:https://www.who.int/maternal_child_adolescent/documents/9789241599757/en/

World Population Review. (2019). World Population by Country. Retrieved from: http://worldpopulationreview. com/