

Individual dietary diversity is strongly associated with stunting in infants and young children

Keanekaragaman makanan individu berhubungan erat dengan stunting pada bayi dan anak

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ABSTRACT

Background: The increased nutrient fulfillment is required for optimal growth and development during the first two years of life. Based on WHO, dietary diversity is one of core indicators for assessing diet quality and adequacy. **Objective:** This study aimed to understand the association between individual dietary diversity and stunting in infants and young children in Sedayu Subdistrict, Bantul District, Yogyakarta, Indonesia. **Method:** This study used cross-sectional design. It was conducted from February to March 2016 in Sedayu Subdistrict. Subjects were 189 infants and young children aged 6-23 months selected by probability proportional to size sampling technique. Individual dietary diversity was assessed by minimum dietary diversity with the consumption of 4 or more food groups of the total 7 food groups. Data were analyzed by using statistics descriptive, Chi-Square test, and multiple logistic regression. **Results:** Poor dietary diversity (OR=16,76; 95%CI: 6,77-41,51) was significantly related with stunting. Other factor associated with stunting was low birth weight (OR=5,12; 95%CI: 2,11-12,43). In addition, appropriate time of introducing complementary food (OR=0,32; 95%CI: 0,13-0,75) was a protective factor against stunting. Household economic status acted as an effect modifier and confounding factor between dietary diversity and stunting. **Conclusion:** Consumption of diverse diet at least 4 food groups reduced the risk of stunting in infants and young children. Efforts should be made to improve dietary diversity in complementary feeding practice.

KEYWORDS: dietary diversity; infants and young children; stunting

ABSTRAK

Latar belakang: Peningkatan pemenuhan zat gizi dibutuhkan untuk mencapai pertumbuhan dan perkembangan yang optimal selama dua tahun pertama kehidupan. Berdasarkan WHO, keanekaragaman makanan adalah salah satu indikator inti untuk mengkaji kualitas dan kuantitas diet. **Tujuan:** Mengetahui hubungan antara keanekaragaman makanan individu dan stunting pada bayi dan anak-anak di Kecamatan Sedayu, Kabupaten Bantul, Yogyakarta, Indonesia. **Metode:** Desain penelitian *cross-sectional* yang dilaksanakan pada bulan Februari-Maret 2016 di Kecamatan Sedayu. Subjek adalah bayi dan anak-anak berusia 6-23 bulan yang diambil dengan metode pengambilan sampel *probability proportional to size*. Keanekaragaman makanan individu diukur berdasarkan minimal keanekaragaman makanan, yaitu konsumsi minimal empat macam golongan makanan. Data dianalisis dengan menggunakan uji deskriptif statistik, *Chi-Square*, dan regresi logistik ganda. **Hasil:** Keanekaragaman makanan yang buruk berhubungan signifikan (OR=16,76; 95%CI: 6,77-41,51) dengan kejadian stunting. Faktor lain yang berhubungan dengan stunting adalah berat badan lahir rendah (OR=5,12; 95%CI: 2,11-12,43). Selain itu, waktu pemberian MP-ASI yang tepat bertindak sebagai faktor protektif (OR=0,32; 95%CI: 0,13-0,75) kejadian stunting. Status ekonomi rumah tangga bertindak sebagai *effect modifier* dan faktor pengganggu di antara hubungan keanekaragaman makanan dan stunting. **Simpulan:** Konsumsi diet yang beragam dengan minimal empat golongan makanan dapat menurunkan risiko stunting pada bayi dan anak-anak. Sejumlah upaya perlu dilakukan untuk meningkatkan keanekaragaman makanan pada MP-ASI.

KATA KUNCI: keanekaragaman makanan; bayi; anak-anak; stunting

INTRODUCTION

Stunting in children has been related with the decreased quality of human capital. Stunting is associated with child's cognitive ability, psychosocial development, social behavior, and obesity status (1-5). In later life, it is also linked with the risk of morbidity and mortality, and lower human development and economic productivity (6).

Globally, stunting affected 162 million of children under-five (7). The prevalence of stunting in young children in Indonesia was 37,2% in 2013. This prevalence increased slightly from previous survey in 2010 (35.6%) (8). Compared with WHO global target to reduce stunting by 40% in 2025 or approximately 3% per year, Indonesia need a serious effort to reduce stunting problem (7).

Stunting is caused by multisectoral problems. However, it is directly caused by inadequate chronic diet and infections. Dietary factors that were related to stunting included inadequate intake of energy, protein, vitamin B2, vitamin B6, iron, and zinc (9). Furthermore, children who had never received breastfeeding and children who did not continue breastfeeding after one year were also related with higher risk of stunting (10). Nonetheless, breastfeeding alone is not the only factor contributing to stunting in young children. A sufficient diet from complementary food should also be considered (11).

Quantity and quality of diet can be predicted by the diversity of food consumed. Dietary diversity reflects the nutrient quality and adequacy either at household or individual level. Specifically, individual dietary diversity aims to assess nutrient adequacy (12). If the nutritional deficiency happens in a long-term period, it may increase the risk of stunting (13).

Poor quality of complementary food contributed to higher stunting prevalence (10). Otherwise, the consumption of diverse diet has been proven to be associated with stunting reduction (14,15). Based on previous study, food habit with variety protein (such as dairy products, meat products, and legumes) and carbohydrate was linked to decrease the risk of becoming stunting in children (16). However, there was still inconsistency in some areas, including Indonesia (17-19). In Indonesia, there was also very few studies assessing the relationship between dietary diversity and stunting. Therefore, a further study is needed to deepen

the understanding between those variables. This study aimed to address the association between individual dietary diversity and stunting in young children.

METHODS

This study used cross-sectional design. It was conducted in February – March 2016 in Sedayu Subdistrict, Bantul District, Daerah Istimewa Yogyakarta. Population was a total of 1.217 young children aged 6-23 months who lived in Sedayu Subdistrict. Based on sample size calculation, we obtained 185 minimum samples. Subjects were selected by using probability proportional to size where Posyandu used as clusters. This study had ethical clearance approval by institutional review board from Universitas Alma Ata Number KE/AA/I/05/EC/2016. Informed consent was obtained from subjects' parent.

Stunting was defined as anthropometric status of length for age less than -2 SD z-score (20). Child's birth weight was obtained by both interview and looking at Maternal and Child Handbook. Variables such as mother's education, mother's occupation, father's education, father's occupation, household economic income (by income and expenditure), child's history of infections, exclusive breastfeeding, and complementary feeding time were collected by interview with structured questionnaire. The questionnaire had been tested for its validation and reliability.

Food intake data such as energy and protein intake was obtained from mother/caretaker by using 24 hour food recall. For dietary diversity, all food items listed in one day 24 hour food recall were then classified into seven food groups based on World Health Organization (WHO) indicator: 1) Grains, roots, and tubers; 2) Legumes and nuts; 3) Dairy products; 4) Meat, fish, poultry, and liver/organ meats; 5) Eggs; 6) Vitamin A rich fruits and vegetables; and 7) Other fruits and vegetables. We included all food items without minimum quantity, except for condiments (21). Individual dietary diversity score (IDDS) was calculated by the sum of food groups. "Good" category is when subjects consumed more than 4 food groups and "poor" category is when food groups consumed less than 4. The cut off was chosen because it

indicated that the child had consumed staple food and at least one animal-source food and one fruit or vegetable on the previous day (22).

Analysis used in this study were descriptive statistics, Chi-Square test, and multiple logistic regression. Final model was made based on stepwise-backward elimination. All the analyses used significance level of 0,05 with STATA 20.0.

RESULTS

Subjects were 189 young children aged 6-23 months in Sedayu Subdistrict, Bantul District, Daerah

Istimewa Yogyakarta. Subjects were dominated by male children (59,26%). Subjects' mother were mostly aged 25-34 years (78,31%), completed minimum senior high school education (65,61%), and did not have any job (55,56%). In the other side, most of subjects' father worked as private or public employee, army, police, or entrepreneur (68,25%). The prevalence of stunting in young children in this study was 30,69%, whereas low birth weight was 24,34%. Exclusive breastfeeding coverage only reached half of subjects (50,26%). Most of subjects had adequate energy (56,61%) and protein (92,59%) intake, and good dietary diversity (62,43%).

Tabel 1. Bivariate analysis between main variables and stunting

Variable	Stunting				OR	p	95% CI
	Yes		No				
	n	%	n	%			
Individual dietary diversity							
Poor (<4)	44	61,97	27	38,03	12,11	0,00*	5,83-25,10
Good (≥4)	14	11,86	104	88,14	1		
Birth weight							
LBW ¹ (<2500 g)	28	60,87	18	39,13	5,86	0,00*	2,88-11,93
Normal (≥2500 g)	30	20,98	113	79,02	1		
Exclusive breastfeeding							
Yes	27	28,42	68	71,58	0,81	0,50	0,44-1,49
No	31	32,98	63	67,02	1		
Complementary feeding time							
Appropriate (6 months)	15	18,29	67	81,71	0,33	0,00*	0,17-0,65
Not appropriate (< or >6 months)	43	40,19	64	59,81	1		
Energy from complementary food							
Adequate	27	25,23	80	74,77	0,56	0,06	0,30-1,03
Inadequate	31	37,80	51	62,20	1		
Protein from complementary food							
Adequate	54	30,86	121	69,14	1,12	0,86	0,35-3,51
Inadequate	4	28,57	10	71,43	1		
Infection diseases							
Yes	6	18,18	27	81,82	0,44	0,09	0,18-1,12
No	52	33,33	104	66,67	1		
Household economic status							
By income							
Low	13	28,89	32	71,11	1		
Middle	25	31,65	54	68,35	1,18	0,68	0,54-2,61
High	20	30,77	45	69,23	1,10	0,83	0,48-2,49
By expenditure							
Low	17	28,33	43	71,67	1		
Middle	16	24,62	49	75,38	0,83	0,64	0,37-1,82
High	25	39,06	39	60,94	1,62	0,21	0,77-3,42

¹ LBW = low birth weight

Table 2. Multivariate analysis of factors associated with stunting

Variable	OR	p	95% CI
Individual dietary diversity			
Poor (<4)	16,76	0,00*	6,77-41,51
Good (≥4)	1		
Birth weight			
LBW (<2500 g)	5,12	0,00*	2,11-12,43
Normal (≥2500 g)	1		
Complementary feeding time			
Appropriate (6 months)	0,32	0,01*	0,13-0,75
Not appropriate (< or >6 months)	1		

*= significant (p<0,05)

Table 3. Stratification analysis between individual dietary diversity and stunting based on household economic status

Stratum	Individual dietary diversity	Stunting				OR	p	95% CI
		Yes		No				
		n	%	n	%			
Household economic status (by expenditure)								
Low	Poor (<4)	16	59,26	11	40,74	46,55	0,00*	2,99-723,76
	Good (≥4)	1	3,03	32	96,97	1		
Middle	Poor (<4)	12	50,00	12	50,00	9,25	0,00*	2,11-40,39
	Good (≥4)	4	9,76	37	90,24	1		
High	Poor (<4)	16	80,00	4	20,00	15,56	0,00*	3,10-77,89
	Good (≥4)	9	20,46	35	79,54	1		
Crude OR						12,11	0,00*	5,83-25,10
MH OR						16,25	0,00*	6,00-43,99

*= significant (p<0,05)

Bivariate analysis results showed that there were several variables that had a significant association with stunting, such as poor dietary diversity (OR=5,22; 95%CI: 3,09-8,83), low birth weight (OR=2,90; 95%CI: 1,96-4,30), and appropriate time of complementary feeding (OR=0,46; 95%CI: 1,96-4,30) (Table 1). On the other hand, exclusive breastfeeding, energy and protein adequacy from complementary feeding, infection diseases, and household economic status were 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 16,76 times higher chance of becoming stunting (95%CI: 6,77-41,51) than children who had good dietary diversity. Other variables that significantly associated with stunting including low birth weight

(OR=5,12; 95%CI: 2,11-12,43) and appropriate time of complementary feeding (OR=0,32; 95%CI: 0,13-0,75). Table 2 below showed a final model after applying stepwise-backward elimination.

Stratification analysis was conducted based on household economic status (by expenditure) 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 (12,16,23). Based on Table 3, there was quite different odd ratios obtained across household economic levels. The highest odd ratio score was from low economic status (OR=46,55; 95%CI: 2,99-723,76). It showed that household economic status (by expenditure) was an effect modifier. In addition, there was also a significant difference between crude and mantel-haenzel odd ratios indicating that household

economic status (by expenditure) was a confounding factor in the relationship between individual dietary diversity and stunting.

DISCUSSION

Individual dietary diversity and stunting

Sedayu Subdistrict reflected semi-urban living area that the prevalence of stunting was still high (30,69%). This prevalence was slightly below stunting prevalence in Indonesia (37,2%) (8). Nutrient adequacy, such as energy and protein intake, was not a problem in this study and was not related with stunting in subjects. Exclusive breastfeeding coverage might be low (50,6%) but it was not associated with stunting. A previous study using national secondary data in Indonesia also did not result in significant association between exclusive breastfeeding and stunting (22). Thus, stunting problem in young children may not be caused by nutrient adequacy only, either from exclusive breastfeeding or complementary feeding. The quality of complementary feeding should also be considered.

Result in this study showed that individual dietary diversity score (IDDS) was strongly associated with stunting in infants and young children aged 6-23 months. Infants and young children who consumed low dietary diversity (or less than 4 food groups) had 16,67 higher chance to become stunting compared to those who had high dietary diversity (4 or more food groups). This result was in accordance with previous studies in Cambodia and Bangladesh (15,16). Diet quality need to be considered for assessing infant and young child feeding practice. Nutritional quality of the diet can be reflected by IDDS (13).

The 7 food groups in WHO minimum dietary diversity was used as it links to the diet quality both in breastfed and non-breastfed children. Dietary diversity is related to the consumption of food groups from at least one animal source and one fruit or vegetable source, besides staple food (22). In addition, it indicates individual intake of calorie in a previous day and adequate nutrition for infant and young children (24,25). Thus, prolonged poor dietary diversity may contribute to lower quality of complementary food and inadequate calorie intake, then combined with other risk factors, it

will increase the chance of infants and young children becoming stunting.

Although household economic status, both by income and by expenditure, did not show a significant relationship with stunting in bivariate and multivariate analyses, the result from stratification analysis showed a unique trend between household economic (by expenditure) levels. We stratified the association between dietary diversity and stunting based on economic status. Every level of household economic status gave quite different odd ratios indicating that there was a variation in the association between individual dietary diversity and stunting among economic status levels.

Individual dietary diversity was significantly related with stunting especially at the lowest level of economic status. This result proved that dietary diversity was a strong predictor of stunting, especially in young children with poor economic status. A study in Cambodia also showed that dietary diversity was a protective factor against stunting children after adjusting for socioeconomic factors (15). Dietary diversity can take a snapshot of household purchasing power for a variety of food (14). It has been stated that dietary diversity can also be an indicator to measure household food security, both in rural and urban living areas, and across different seasons (26). There was also an evidence showing that food consumption with minimum four food groups consumed was higher in food secure population than in food insecure population (18). Although this study did not collect food security data, our stratification analysis indicated that food security might act as a mediating factor between household economic status and dietary diversity. In conclusion, dietary diversity can be used as an indicator to reflect food security status within households.

Other factors associated with stunting

Low birth weight was associated with stunting significantly. Infants and young children who had low birth weight history (less than 2500 g) were at risk to become stunting 5,12 times higher than those who had normal birth weight. Other studies also showed similar results (12,24,25,27). This result underlined the evidence that stunting is a chronic condition. It can be caused

by previous nutritional status since pregnancy or even preconception period. This intergenerational malnutrition problem was indicated by the history of low birth weight or having short stature mother (12). Short stature mothers who did not improve their nutritional status would have the same inadequate nutritional exposure during pregnancy, thus giving birth to low birth weight babies. Low birth weight babies who failed to catch up growth during the first two life of their life would have higher risk of stunting.

Inappropriate time to introduce complementary feeding was related with higher risk of stunting. Infants and young children who received complementary food too early (before 6 months) or late (more than 6 months) had 3,13 times higher to become stunting than those who receive complementary food timely (at 6 months). Besides ensuring the adequacy of complementary food, the time to introduce the first complementary food to infants is important to reduce stunting (28-30).

Subjects in this study who received complementary food timely were only 43,39%. This proportion was categorized as poor based on WHO rating on timely complementary feeding. World Health Organization (WHO) stated that one of appropriate ways to give complementary feeding is to introduce food timely. It means that food have to be given to child when exclusive breastfeeding cannot fulfill energy and nutrients (31). Infants and young children who had complementary food too early may have higher risk to contamination exposures and lower quality of nutrient intake. Moreover, late introduction of complementary food will increase inadequacy of nutrient intakes due to prolonged exclusive breastfeeding. Therefore, it is important to provide complementary food that is timely, adequate and safe for infants and young children.

Stengths and limitations

There very few studies assessing the relationship between dietary diversity and stunting in Indonesia. This study may contribute to fill the gap in the stunting problem related to the quality of complementary food. It gives a new sight on how individual dietary diversity gives an impact on stunting in young children. However, this study used cross-sectional design so it could not provide causal-

effect relationship between two variables. In addition, food consumption data was obtained by 24hr food recall so it did not reflect habitual intake of subjects.

CONCLUSION

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. The relationship between dietary diversity and stunting does not differ across household economic level. However, dietary diversity has the strongest association with stunting especially in the poorest economic status. This evidence supports the previous theory that dietary diversity may be related with household food security.

Consumption of diverse diet with minimum four food groups may improve the quality of complementary food. 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.

CONFLICTS OF INTERESTS

The author states no conflict of interest.

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