The Association of Balanced Nutrition Practices with Stunting Among Adolescent Girls in School

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***Abstract*—Long-term inadequate intake of balanced nutrition can cause stunting. In West Sulawesi, the prevalence of stunting among girls is substantially high (38.1%) and very limited study in exploring the association between balanced nutrition practice with stunting among girls. This study aims to investigate the association of balanced nutrition practices with stunting among school girls. The cross-sectional study design was conducted in 4 senior high schools in Mamuju District. All girls from 4 schools (455 students) have participated in this study. Balanced diet practice data were collected by using questionnaire, while body height measured by microtoice (d = 0.1 cm). Data were analyzed was using the chi-square test. There were 34.1% adolescent girls classified as stunting, and have poor balanced diet practice was 21.5%. Adolescent girls who have poor balanced nutrition practices are even more stunted (44.9%) than those who have good practices (31.1%). Some foods as sources of protein, calcium, zinc, and iron such as milk (49.7%), beef (92.3%), chicken (60%), cheese (79.4%), nut (58.7%), and fruit (47.3%) were never and seldom consumed by some girls. Most of them do sport only one to two days a week (58.5%), while 89.1% of girls' student never and seldom monitoring body weight every month. There was an association between poor balanced diet practice with stunting in adolescent girls (p = 0.012). Poorly balanced diet practice influence of stunting in adolescent girls. The intervention by educating adolescent girls in school-related balance nutrition practice is urgently needed.**

***Index Terms*—adolescent girls, balanced diet practice, stunting**

I. Introduction

Adolescent girls are a critical period as well as unique among several phases in the human life cycle, including unique nutritional vulnerabilities, however they are almost invisible in many regions of the world including their nutritional status is often overlooked, even though the nutritional status of adolescent girls plays an important role in breaking the cycle of malnutrition intergeneration in society [1]-[3].

The neglected of nutritional needs of young girls can cause growth retardation (stunting) and poor health [4], which can contribute to the morbidity and mortality globally, even in the next generation's health, especially in the low and middle income countries [1], Thus, if young girls have access to nutritious foods before, during, and after pregnancy, chronic diseases or non-communicable diseases can be reduced in the future [3].

Although eventually, young girls get global attention through the SDGs adopted by the United Nations in 2015 and on the agenda in the world health assembly, however, greater attention is not translated into meaningful programs or implementation of interventions in the field, and experts said that focus in young girls is not effective, because malnutrition undermines the physical and cognitive development that occurs when young people continue to grow, which has implications for their ability to develop, including their children in the future, which helps maintain the cycle of malnutrition [5].

Based on the results of monitoring nutritional status in Indonesia in 2016 it was found that 31.6% of young girls aged 12-18 years who experienced chronic stunting problems and especially in West Sulawesi province, was much higher than the national prevalence (38.1%)[6]. Linear growth failure is a marker of multiple pathological disorders associated with increased morbidity and mortality, loss of potential for physical growth, decreased neuronal development and cognitive function and an increased risk of chronic disease in adulthood. Severe and irreversible physical and neurocognitive damage that accompanies stunted growth is a major threat to human development [7].

Issues about stunting in young girls are very important to consider because teenage pregnancy is very prevalent in the world [8], can cause pregnancy complications, morbidity and maternal mortality, and give birth to malnourished babies characterized by low birth weight and prematurity [9,10], and the risk of transmission malnutrition to the next generation[10]. In addition, poor growth of adolescent girls is an important determinant of future health, work capacity, and cognitive function that all contribute to human capital [8]. Therefore, reaching

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out to adolescent girls is an important point, because during pregnancy if young girls facing malnutrition they are at higher risk of poor birth outcomes that can cause stunting in children[11].

Adolescence is probably the appropriate time to facilitate and encourage rapid growth because nearly 40% of peak bone mass is achieved during puberty[8]. The less optimal quantity, quality, and diet diversity are one of the causes of poor adolescent nutritional status [12]. The nutritional status of young girls has not been well studied [3], including studies of adolescent eating behavior is very limited, especially in adolescents who live in low-middle income countries[1].

In Indonesia, in 2014 a balanced nutrition guideline with 4 pillars was launched, namely (1); consuming various foods; (2) familiarize clean and healthy life behaviors; (3) doing physical activities and sports; (4) maintaining and monitoring normal weight [13]. The guideline has been socialized throughout Indonesia through various media, so this study is important to do to review the implementation of balanced nutrition guidelines by adolescent girls to achieve optimal nutritional status. This study aims to examine the association between nutritional balanced practices with the incidence of stunting in adolescent girls.

II. METHOD

The cross-sectional was conducted in 2018 in four high schools in Mamuju Regency, West Sulawesi Province, namely SMAN 1 Mamuju, SMAN 2 Mamuju, SMAN 3 Mamuju, and MAN Mamuju District. All adolescent girls from class X registered in 4 schools were used as the subject of the study consisting of SMAN 1 = 206 students, SMAN 2 = 119 students, SMAN 3 = 40 students, MAN = 90 students.

Body height data obtained through height measurements using microtoise (d = 0.1 cm). Data on the characteristics of adolescent girls and their families, and also the practice of 4 pillars of balanced nutrition were obtained through interviews using questionnaires. Data on adolescent girls' height were used to assess the nutritional status of adolescent processed using WHO Anthro Plus software, stunting if the value of Height for Age Z (HAZ)-Score < -2 SD, while others data was processed and analyzed using SPSS for Windows. The chi-square test was used to assess the relationship between balanced nutrition practices and the nutritional status of adolescent girls with a significance level of 95% (p-value <0.05).

This research was carried out after obtaining ethical approval from the Health Research Ethics Commission of Hasanuddin University with No. 189/ H4.8.4.5.31/ PP36-KOMETIK/2018.

III. RESULT

The average age of adolescent girls involved in this study was 15.4 years with the highest distribution at the age of 15 years (57.4%). Adolescent girls have 3 siblings person. The education level of parents (father and mother) was high (Table I).

The pillar 1 of balanced nutrition practiced by adolescent girls in daily life showed that consumption of carbohydrate sources was varied, not only rice but also several other food sources including noodles (60.9%) and bread (61.9%), while cassava, sweet potatoes, and corn were rarely and never even consumed by more than ¾ adolescent girls.

TABLE I. CHARACTERISTIC OF GIRLS ADOLESCENT AND THEIR FAMILY

Variable	mean ±SD	n(%)
Age (years)	15.39 ±0.655	
• 14		19 (4.2)
• 15		261 (57.4)
• 16		153 (33.6)
• 17		21(4.6)
• 18		1(0.2)
Number of Sibling (person)	3.01±1.9	
• <2		87 (19,1)
• ≥2		368 (80.9)
Father's education level		
• Low		223 (49.0)
• High		232 (51.0)
Mother's education level		
• Low		219 (48.1)
• High		236 (1.9)

Food sources of protein, calcium, zinc and iron that were often consumed by subjects were fish (88.1%), tempeh (soya bean) (80.7%), egg (80.2%), milk (55.2%), while chicken, cheese, nut, and beef are foods which was rarely consumed by adolescent girls (> 60%). More than half of adolescent often consumed vegetables and fruit to meet their vitamin and mineral needs, 84.4% and 62.6% respectively. The eating frequency of adolescent girls mostly 2-3 times per day (55.8%). Every meal, adolescent girls were consumed complete meal (rice + fish + vegetable + fruit + water) only 48.1%, there were more than half of the girls drank water ≥ 8 glasses (Table II).

TABLE II. BALANCED DIET PRACTICES IN ADOLESCENT GIRLS

Pillar 1 : Eat a variety of foods						
Food Items	**Frequency**					
	Frequently		Seldom		Never	
	n	%	n	%	n	%
Consume of rice	449	98,7	6	1,3	0	0
Consume of cassava	76	16,7	260	57,1	119	26,2
Consume of sweet potato	70	15,4	247	54,3	138	30,3
Consume of corn	125	27,5	256	56,3	74	16,3
Consume of noodle	277	60,9	169	37,1	9	2,0
Consume of bread	286	62,9	154	33,8	15	3,3
Consume of fish	401	88,1	47	10,3	7	1,5
Consume of tempe	367	80,7	80	17,6	8	1,8
Consume of egg	365	80,2	85	18,7	5	1,1
Consume of milk	251	55,2	167	36,7	37	8,1
Consume of chicken	191	42,0	237	52,1	27	5,9
Consume of nut	173	38,0	217	47,7	65	14,3
Consume of cheese	110	24,2	227	49,9	118	25,9
Consume of beef	36	7,9	307	67,5	112	24,6
Consume of vegetable	384	84.4	66	14.5	5	1.1
Consume of fruit	285	62.6	163	35.8	7	1.5
	1-2 times		2-3 times		>3 times	
Taking meal a day	n	%	n	%	n	%
	144	31.6	254	55.8	57	12.6
	Rice+Fish+water		Rice+Fish+Beverage+Water		Rice+Fish+Beverage+Fruit+Water	
Food consumed every meal	n	%	n	%	n	%
	45	9.9	191	42.0	219	48.1
	1-3 glass		4-7 glass		≥8 glass	
Amount of water drink consumed in a day	n	%	n	%	n	%
	109	24.0	219	48.1	127	27.9
Pillar 2: clean and healthy lifestyle						
	Every time		Seldom		Never	
	n	%	n	%	n	%
Washing hand with soap and water flow before and after eat	376	82.6	62	13.6	17	3.8
Washing hand with soap and water flow after defecation	428	94.0	18	4.0	9	2.0
Pillar 3 : do physical activity and exercise						
	1-2 times		2-3 times		≥3 times	
Frequency of exercise in a week	n	%	n	%	n	%
	266	58.5	44	9.6	145	31.9
Pillar 4 : Body weight monitoring						
	1 times		2 times		3-4 times	
Frequency of weighing in a month	n	%	n	%	n	%
	45	9.9	261	57.4	149	32.7

If differentiated based on the HAZ-score status of adolescent girls, it was seen that stunting among girls were more likely to never and rarely consumed beef (93.3%), chicken (60%), milk (49.7%), cheese (79.4%), and fruit (41.3%) compared to adolescent girls who were not stunted (92%, 57%, 42.4%, 74%, and 35.4%) respectively (Table III).

The application of pillar 2 of the balanced nutrition guidelines by adolescent girls showed that there were 13.6% of adolescent rarely wash their hands with soap before and after meals, and some of them never do so (3.8%). The adolescent girls were rarely (4%) and never (2%) washed their hands with soap after defecation. Based on the nutritional status, stunted adolescent girls rarely and never washed their hands with soap before and after eating more likely (20%) than normal girls (16%), as well as the practice of washing hands with soap after defecation, was found that adolescent girls who rarely and never washed their hands after defecating were more likely stunted (6.5%) than normal girls (5.7%) (Table III).

The implementation of pillar 3 and 4 of balanced nutrition guideline, showed that most adolescents (58.5%) do activities and sport 1-2 times/week. The adolescents were weighing each month (67.4%) and mostly done only once per month (66.0%) (Table II).

TABLE III. BALANCED DIET PRACTICE BASED ON NUTRITIONAL STATUS IN ADOLESCENT GIRLS

Variable	Nutritional Status			
	Normal (n = 300)		Stunting (n = 155)	
	n	%	n	%
Consume of beef				
• Frequently	24	8.0	12	7.7
• Seldom	209	69.7	98	63.2
• Never	67	22.3	45	29.1
Consume of chicken				
• Frequently	129	43.0	62	40.0
• Seldom	159	53.0	78	50.3
• Never	12	4.0	15	9.7
Consume of milk				
• Frequently	173	57.7	78	50.3
• Seldom	107	35.7	60	38.7
• Never	20	6.7	17	11.0
Consume of cheese				
• Frequently	78	26.0	32	20.6
• Seldom	157	52.3	70	45.2
• Never	65	21.7	53	34.2
Consume of nut				
• Frequently	109	36.3	64	41.3
• Seldom	154	51.3	63	40.6
• Never	37	12.3	28	18.1
Consume of fruit				
• Frequently	194	64.7	91	58.7
• Seldom	104	34.7	59	38.1
• Never	2	0.7	5	3.2
Handwash before & after meal				
• Frequently	252	84.0	124	80.0
• Seldom	36	12.0	26	16.8
• Never	12	4.0	5	3.2
Handwash after defecation				
• Frequently	283	94.3	145	93.5
• Seldom	12	4.0	6	3.9
• Never	5	1.7	4	2.6
Sport / exercise a week				
• ≥ 3 times	131	43.6	58	37.4
• 1-2 times	169	56.3	97	62.6
Monitoring Body weight monthly				
• 1-2 times	183	89.7	87	85.3
• ≥3 times	21	10.3	15	14.7

According to nutritional status, more than adolescent girls stunting (62.6%) did exercise 1-2 times a week than normal girls (56.3%), whereas the adolescent girls weighed 1-2 times a week, more found in normal nutritional status (89.3%) compared to stunting (85.3%) (Table III).

The results of this study showed that there were 34.1% of adolescent girls who were stunting. Young women who have well-balanced nutrition practices less suffer stunting (31.1%) than those who have poor- balanced nutrition practices (44.9%). Statistically, there was a significant relationship (p = 0.002) between balanced nutritional practices and the incidence of stunting in adolescent girls (Table IV).

TABLE IV. THE RELATIONSHIP BETWEEN BALANCED DIET PRACTICES WITH STUNTING

Balanced diet practice	Nutritional Status				*P* Value
	Normal		Stunting		
	N	%	n	%	
Good	246	68.9	111	31.1	
Poor	54	55.1	44	44.9	0.012
Total	300	65.9	155	34.1	

IV. DISCUSSION

Stunting is a cumulative process that begins in the womb and continues for the first two years of life after birth [7,14]. However, the acceleration of linear growth can occur in adolescence to improve stunting[15].

The results of this study indicated that adolescent girls stunting (34.1%) much higher compared in India (27.3%[16]. However, it is similar to the prevalence of stunting that occurs in South Asian countries, rural areas (range 30-60%) and from urban areas (15-39%) [17].

Stunting incidence in adolescent girls in this study was related to balanced nutrition practices (p = 0.012). Adolescent girls who have poor balanced diet practices were 44.9% suffer from stunting.

According to WHO, the causes of multifactorial stunting are low food intakes, poor hygiene practices and infectious diseases, poor maternal health conditions, and social and community factors [18].

Balanced nutrition practices intended in this study were the application of 4 pillars of balanced nutrition launched by the Ministry of Health of the Republic of Indonesia. Based on the application of the first principle of balanced nutrition guidelines by teenage girls, found that more than half of young women (55.8%) ate 2-3 times per day, higher than in India as much as 49.3% [19]. The results of this study also showed that girls who ate a full dish every meal (4-5 types of food) did not reach half of the study sample, a similar act found in Ethiopia that 45% of adolescent girls consumed 4 to 5 different groups of food [20].

This study showed variations in dietary sources of protein, zinc, iron, and calcium (chicken, cheese, nut, and beef) were still very poor (> 60%), because of some reasons, such as the limited availability of food in households, a large number of siblings (> 80%) which makes food distribution reduced, and poor appetite, so they sometimes did not eat after arriving home. These findings are the same as findings found in Bangladesh [21] and in India [16] and most of the adolescent girls have a low diet diversity. Dietary factors such as the frequency of eating, skipping meals and food diversity are the factors related to the nutritional status of adolescent girls [22]. Poor eating habits in adolescents often occur in stunting children significantly, especially in the group that does not eat (p = 0.009) [23]. Poor diet choices hinder the benefits of nutrition, pose a significant threat to the body of adolescents to meet their needs in growing and developing [24].

On top of eating a variety of foods that can affect nutritional status, proper care practices, adequate health services, and a healthy environment, including clean water, sanitation and good hygiene practices are also needed [25]. This study also shows that the hygiene practices of teenage girls seen 16% rarely even wash their hands before and after meals, and 6% did not wash their hands with soap after defecating. This may occur because they cannot access clean water and soap. This event has an impact on the nutritional status, by three direct pathways: diarrheal disease, intestinal parasitic infections, and environmental enteropathy. Enteric pathogens can interfere with nutritional status even in the absence of symptoms such as diarrhea. Chronic consumption of pathogens can cause recurrent inflammation and damage the intestine, which causes malabsorption of nutrients [25]. Washing hands with soap with the right technique significantly reduces E. coli and total coliform contamination in the hands among the 173 primary caregivers in Zimbabwe [26].

It is difficult to get a reliable global estimate of handwashing with soap because there is no global mechanism for monitoring handwashing practices in homes and communities. But there were 19% of people worldwide washing their hands after potential contact with feces [25], [27].

On top of eating patterns, physical activity is also a factor that influences the health and nutritional status of adolescents[8]. The results of this study showed that more than half of adolescent girls were classified as lacking in exercise or physical activity (1-2 times per week), and were carried out only at school. This is in accordance with their knowledge about exercise carried out 1-2 times a week (57.1%). According to the Ministry of Health, physical activity or sports were categorized enough if someone does physical exercise or exercise for 30 minutes every day or at least 3-5 days a week [13]

Globally, more than 80% of adolescents aged 11-17 years have inadequate physical activity [24]. Sport or physical exercise can affect linear growth, growth of bone tissue in children and adolescents through induction of the GH/ IGF-1 axis, and results of the study showed that children and adolescents with short stature who do sports with determination of volume and intensity exercise as a strategy for achieving better results in the mechanical function of the movement, proved to reach definitive conclusions with respect to the effects of sport or physical exercise on achieving final height [28], [29]. The lack of balanced nutritious food intake accompanied by less physical activity from adolescent girls can affect their unexpected future problems during maternal times and obstruct the cognitive development of the brand [30].

The final pillar of balanced nutrition guidelines carried out by adolescent girls in this study was to monitor body weight regularly for nutritional status and maintain a normal weight according to height. The results of this study indicated that from 406 (67.3%) samples of adolescent girls who weighed weight every month, most of them were done only once a month (66%). Some studies recommended measuring weight once a week to prevent weight gain and every day for weight loss, because the longer the pause is when someone weighs, the more likely it is to experience weight gain[31]. Weighing, eating diverse and doing sports/activities are closely related in the lives of adolescents [32]. Maintaining normal body weight is by maintaining a food consumption pattern with a balanced and diverse nutritional arrangement and maintaining regular physical exercise/sports habits [13].

It was concluded that poor balanced nutrition practices were significantly associated with stunting in adolescent girls, so it was suggested that there should be balanced nutrition education in schools to improve balanced nutrition knowledge in children so that they can behave properly in an effort to achieve optimal nutritional status.

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