Correlation of Energy Intake, Sex and Physical Activity with Fat Mass in Stunting Teenagers

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Keywords: Physical Activity, Energy Intake, Fat Mass, Stunting, Teenagers.

Abstract: Stunting remains a global health problem. Indonesia is one of the country with the highest stunting prevalence. Stunting can cause an increase fat mass which is a risk factor for the diseases related to metabolic disorders. Fat mass is influenced by epigenetic, environmental and genetic factors. This study analyzed the relationship of energy intake, sex, physical activity with fat mass in stunting teens. Quantitative cross-sectional study design, conducted from April to July 2015 in 8 schools (elementary, junior high schools) in Jatinangor sub-district at students aged 10-14 years old (112 people).). Energy intake and physical activity was interviewed using a 24 hour recall questionnaire. Measurement of fat mass using Bioimpedance Analyzer TANITA SC-240MA, height with Seca-213 stadiometer. The results showed subjects had less energy intake (53.52%), light physical activity (79.34%) but fat mass was not high. There was a significant correlation between energy intake and fat mass (p=0.02), significant correlation between sex and fat mass (p = 0.00) but no significant association between physical activity and fat mass in stunting teens (p> 0.05). In conclusion any changes in energy intake in stunting teenagers will affect the fat mass, as well as sex, but physical activity does not affect the fat mass.

1 INTRODUCTION

Teenager stated stunting if his height is lower than other adolescents of the same age and sex (<-2 standard deviation (SD) based on the WHO (World Health Organization) growth chart, 2006. Stunting is still a health problem in the world, especially in developing countries and low income. Indonesia is the country with the high prevalence stunting (37.2%) and West Java is the province with stunting prevalence almost equal to the national rate (33.8%). (Riskesdas, 2014). Stunting is an important indicator for public health because it describes chronic energy malnutrition in children. The impact of these poor nutrients can last a lifetime, resulting in poor quality of life, school performance declining due to brain development disorders, reduced productivity and impended of intellectual and social development.

Onis's research shows stunting can also lead to an increase in fat mass. The high fat mass is a risk factor for chronic diseases such as diabetes mellitus, obesity and coronary heart disease in an adult age. Stunting adolescents allegedly experiencing changes in metabolism that causes increased body fat mass as a result of chronic nutritional conditions. (Onis, M, 2011). Research on stunting teens in South America proves that stunting children will grow into adolescents and short adults with high fat mass, low muscle mass and metabolic changes that are permanent. The mechanisms that explain the causes of high fat mass in children and adolescents stunting until now still being studied. (Onis, 2011; Hoffman; 2000, Martins, 2004).

In normal teenagers the formation of fat mass is influenced by epigenetic, environmental and genetic factors. Environmental factors consist of gender, food intake and physical activity. (Cromer, 2011; Guyton, 1991) but data on fat mass and the factors that affect it in adolescent stunting in Indonesia are not known. It is important to predict the presence of metabolic disease related to risk factors to provide opportunities for intervention such as preventive and promotive.

2 METHODS

This research was part of Jatinangor cohort Study. Quantitative research design with cross sectional strategy of early adolescent age 10-14 years old, stunting, residing and attending elementary school or junior high school in Jatinangor sub-district. School selection was done by stratified random sampling. Research subjects were randomly selected in each school with the provision of healthy subjects and did

Megawati, G., Herawati, D. and Fatimah, S.
Correlation of Energy Intake, Sex and Physical Activity with Fat Mass in Stunting Teenagers.
In *Proceedings of the 2nd International Conference on Sports Science, Health and Physical Education (ICSSHPE 2017) - Volume 1*, pages 188-192
ISBN: 978-989-758-317-9
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not have chronic diseases and have permission from parents. Subjects who have abnormal body posture so it was not possible to check the height and have an edema excluded from the study. The subject of this was 112 stunting teens. Data collection was conducted in April - July 2015.

Stunting was determined by category in WHO Growth Chart 2006 which is height curve based on gender and age. Adolescence stated stunting if he has a measurement of <-2 SD. Measurements of height were performed using SECa 215 stadiometer then converted on Height on aged with WHO Anthro Plus software. (WHO, 2006)

Fat mass examination using data of height, date of birth and gender. The requirements of examination are: not exercising in the last 24, not consuming alcohol for the last 24-48 hours, and not using diuretics for the last 7 days. The examination was performed after the subjects urinate maximum 30 minutes before examination, requested to remove all the metal material attached to the body, such as belts, rings, necklaces, coins, glasses and other metals, weighed without the use of footwear and socks and wear minimal clothing. Fat mass measurements were performed using Tanita SC-240MA Bioimpedance Analyzer (Gibson, 2005).

Furthermore, interviews were conducted on food intake using the 24 hours recall method. Interviews were conducted in three different occasions, two days on school day and one on holiday. The amount of nutrient intake was calculated by converting a large food intake in household size form to gram first, then calculating the amount of nutrient intake (in grams).

Physical activity was known from the questionnaires filled by the subject. Its provide data about the type, frequency and duration of activities usually done in one week. The activity was differentiated between school days and holidays. Physical Activity Level (PAL) calculation based on PAL calculation according to FAO / WHO / UNU (WHO Technical Report Series on Human energy requirements 2001). The total calory spent in physical activity is determined based on the Physical Activity Ratio (PAR) value table and included in the Physical Activity Level (PAL) formula according to the following formula:

$$\text{Physical Activity Level (PAL)} = \frac{\sum \text{duration} \times \text{Physical Activity Ratio}}{24\ \text{hr}} \quad (1)$$

PAL = Physical Activity Level
PAR= Physical Activity Ratio (energy spent for the type of activity per unit of time)
Source: WHO, 2001

Table 1: PAR

Activity	PAR /time
Sleep	1.0
Driving in bus/mobil	1.2
Leisure Activity (watch TV and talk)	1.4
Eat	1.5
Sit down	1.5
Cooking	2.1
Standing , caring	2.2
Bath, clothing	2.3
Washing without machine	2.3
Walking	3.2
Gardening	4.1
Workout	4.2

The calculation results are categorized according to the physical activity category table

Table 2: Category of physical activity

Category of Physical Activity	PAL Score
Light	1.40 – 1.69
Medium	1.70 - 1.99
Heavy	2.00 – 2.40

Source: WHO, 2001

This study received ethical approval from the Medical Research Ethics Committee of Faculty of Medicine Universitas Padjadjaran. Test of normality data by using Kolmogorov-Smirnov, the data was not normally distributed (p = 0.127).

3 RESULTS

Characteristics of subjects in the form of sex and age data listed in table 3. Female gender slightly more than men (55.3%) while the age spread almost evenly at the age of 10-14 years.

Table 3: Characteristics of study subjects.

Variabel	Category	∑	%
Sex	Female	62	55,36
	Male	50	44,64
Age(years)	10	9	8,02
	11	17	15,2
	12	30	26,78
	13	32	28,57
	14	24	21,43

Energy intake, physical activity and fat mass of study subjects is shown in Table 4. Most subjects (54.58%) had deficiency energy intake (<80% of

NutritionalNumbers), had mild physical activity (79.47%) and underdat (53,57%).

Table 4: Description of research subjects based on energy intake, physical activity and fat mass.

Variabel	Kategori	∑	%
[a] Energy Intake	Deficiency (<80% AKG)	61	54,58
	Normal (80-110% AKG)	41	36,71
	Over (>110% AKG)	9	8,71
[b]Physical Aktivity Level	Light	89	79,47
	Medium	20	17,85
	Heavy	3	2,68
[c]Fat Mass	*Underfat*	60	53,57
	Normal	47	41,97
	Overfat	3	2,68
	Obesity	2	1,78

Information:
[a]AKG = Nutritional Nutrition Rate based on Nutritional Nutrition Value of National Widya Karya Food and Nutrition 2013
[b]Based on Physical Activity Level
[c]Classification fat mass for children and adolescents based on age and gender

3.1 Correlation of Energy Intake with Fat Mass

Data from the measurement of energy intake and fat mass were tested by Spearman correlation to know the correlation between energy intake with fat mass in short teenager in Jatinangor. Table 5 shows the correlation test that shows significant correlation between energy intake and fat mass (p = 0.02), very weak correlation strength (r<0,2) and positive correlation direction.

Table 5: Correlation of Energy Intake with Fat Mass.

		Fat Mass				n	R	*P*
		a	b	c	d			
Energy Intake	Def	42	19	-	-	61	0,18	0,02
	Nml	15	26	1	0	41		
	ovr	3	2	2	2	9		
Total		60	47	3	2	112		

Information:
p = Spearman's correlation test significance, significant test at p <0.05
Fat mass: a: underfat, b: normal, c: overfat, d: obesity

3.2 Correlation of Sex with Fat Mass

Spearman correlation test was performed to determine the correlation between sex and fat mass Table 6 shows the correlation test showing significant correlation between sex with fat mass (p = 0,00), strong correlation strength (r <0,73) and negative correlation direction.

Table 6: Correlation of Sex and Fat Mass.

		Fat Mass				n	r	*P*
		a	b	c	d			
ex	♀	17	40	3	2	62	-0,73	0,00
	♂	43	7	-	-	50		
Total		60	47	3	2	112		

Information:
p = Spearman's correlation test significance, significant test at p <0.05
Fat Mass: a: *underfat,* b: normal, c: *overfat,*d: obesity

3.3 Correlation of Physical Activity with Fat Mass

Table 7 shows no correlation between physical activity and fat mass in stunting teenagers in Jatinangor (p> 0.05).

Table 7: Correlation Physical Activity with Fat mass.

		Fat Mass				n	r	*P*
		a	b	c	d			
Physical activity	Light	47	37	3	2	89	0.13	0.16
	Medium	11	9	0	0	20		
	Heavy	2	1	0	0	3		
Total		60	47	3	2	112		

Information:
p = Spearman's correlation test significance, significant test at p <0.05
Fat Mass: a: *underfat,* b: normal, c: *overfat,*d: obesity

4 DICUSSIONS

Fat mass will accumulate if high energy intake or low energy expenditure or a combination of both. But Research Hoffman et al., In Brazil shows the opposite phenomenon in adolescent stunting. The results showed that energy intake per kilogram of body weight was significantly higher and the ratio of energy intake and resting energy expenditure was also significantly higher. The results of this study indicate

a metabolic change in children of stunting with normal weight (Wilson, 2012, Hoffman, 2000).

Longitudinal studies and cohorts that observed metabolic changes in stunting generally observed the changing conditions on stunting subjects who were previously undernourished but later recovered and had good nutritional status.

In the Jatinangor study, there was strong suspicion that stunting teenagers in Jatinangor also have metabolic changes such as data presented in Brazil, but in this study there is no history of growth and nutritional status of the study subjects at first growth acceleration (age 0-2 years) although suspected nutritional status of respondents when under 2 years of age does not vary much with the current condition considering stunting was a picture of chronic malnutrition (Martorell, 2010). It appears that stunting of teenagers in Jatinangor at this time of study has not undergone a nutritional improvement, so there has not been a catch-up fat phenomenon as occurs in short teenagers in other countries. This may explain why the fat mass of stunting teens in this study was mostly underfat (53.57%) (table 4).

Sawaya et al, who conducted research in Brazil from 1990 to 2004, found that children with less nutrition (skinny and short) grew into adolescents and obese adults. In Indonesia, it seems that atunting teenagers have not experienced increased fat mass because of the absence of nutritional improvements, although this condition needs to watch out, assuming that when short teenagers grow up and experience improved nutritional status or energy intake so excessive then at that time an increase in body fat mass causing an increased risk of metabolic-related illness (Hoffman, 2000; Martin, 2004; Wilson HJ, 2012).

In this study known as 89 people (79.47%) have mild activity level. World Health Organization (WHO) in 2010 stated that around 81% of adolescents aged 11-17 years have less physical activity when compared with WHO recommendations in that age group. This data is consistent with data from Basic Health Research (RISKESDAS) in 2013 which shows the prevalence of physical inactivity in children and adolescents aged 10-14 years is 66.9% (WHO, 2015).

According to WHO, the prevalence of lack of physical activity is higher in countries with increased automation of work and the use of vehicles as a means of transportation. Some environmental factors associated with urbanization may cause the population to become less active (Kenneth, 2000, WHO, 1995). Behavior sedentari or sit-down behavior, lying in the daily at home, (front computer, reading, watching TV, playing video games) and travel / transportation by motor vehicle looks much done by teenagers in Jatinagor.

There is an interesting data in this study,, although the average research subject has a low level of physical activity but not high fat mass. This is supported by data that teen energy intake of stunting in Jatinangor is generally low. If this teenager's energy intake is improved according to his needs, then physical activity also needs to be adjusted with the WHO recommendation that there is no increase in excess fat mass and growth of adolescents short stature can be optimal.

The Fin Twin Study analyzing 5 consecutive cohort studies in 4343 subjects aged 22 to 27 stated that physical activity would significantly increase muscle mass compared to subjects with sedentary lifestyles and would decrease the genetic effect on the risk of obesity and abdominal obesity (Clemente, 2011; Wilson, 2012)

Physical activity will increase the body's energy requirements, so increased physical activity will cause a decrease in body mass index. Physical activity may inhibit the risk of obesity, especially in individuals with genetic susceptibility. Physical activity performed regularly and measurably over a relatively long time will increase fat-free (bone and muscle) mass, decrease fat mass and increase Growth Hormone. This increase in the hormone stimulates the bone growth center of the epiphyseal plate. From the results of the study found sedentari lifestyle or lifestyle with very minimal activity will cause linear growth is not optimal, muscle mass is smaller and increased fat mass (Cromer, 2011; Guyton, 1991).

5 CONCLUSION

Any change in energy intake in a stunting adolescent will affect the fat mass, as well as sex, but physical activity does not affect the fat mass.

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