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## Changes in Fiber Intake and Body Weight of Multi-Component Intervention Program among Bogor Obese Children, Indonesia

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**Abstract:** The study aimed to analyze the effect of multi-component intervention program on fiber intake and body weight of obese children in Bogor, Indonesia. Three schools of Bogor city were randomly selected (A, B, C). A multi-component intervention program was conducted for 5 weeks with a quasi-experimental design. School A received nutrition education and physical activity intervention, school B received nutrition education and fruit intervention and school C received nutrition education, physical activity and fruit intervention. Body weight, 24 h food recall and food frequency habit were measured at pre-and post-intervention. The data was analyzed using SPSS 17.0 for windows with Paired t-test and ANOVA. The study showed that the average of fiber intake was still low in all groups. After the intervention, the average of fiber intake in all groups was increased. The greatest contributor to total dietary fiber was cereal, both pre and post-intervention. Body weight significantly decreased in school A and C with the exception of school B. The highest body weight decrease was in school A, i.e., 0.71 kg in average. A multi-component intervention program used in this study could increase fiber intake among obese children and decrease body weight. The decrease in body weight was higher with moderate physical activity rather than without any physical activity.

**Key words:** Body weight, dietary fiber, obese children

### INTRODUCTION

The prevalence of excessive nutrition in school-aged children in Indonesia has been continued to increase nationally for the past 6 years. Balitbangkes data in (2007, 2010) showed overweight prevalence in boys and girls increased from 9.5 and 6.4 to 10.7% (boys) and 7.7% (girls), respectively. The number continued to increase up to 18.8% in 2013 (Balitbangkes, 2013). Obesity prevalence in children aged 6-12 years old in Bogor was also high, i.e., 15.4% in boys and 8.6% in girls (Kemenkes, 2007). Current research showed that overweight in Bogor is 18.79% (Madanijah *et al.*, 2013). Obesity is a multifactor health issue influenced by genetic, physical activity level, food intake and environmental factor, as well as psycho-social aspect (Mahan and Stump, 2004). Obesity should be addressed early since childhood to prevent worse risk in the future. This can be carried out through several means such as food consumption, physical activities and knowledge.

Food consumption pattern has changed significantly to be more practical foods and high fat-low fiber food consumption, become one of causing factors for obesity in children. Fiber sources related to obesity the most are vegetables and fruits (Sartika, 2011). Study by Johnson *et al.* (2008) shows that low-fiber consumption has relation to obesity in children.

Fruits and vegetables consumption as fiber sources in children is still below recommended standard

(Blanchette and Brug, 2005; Janssen *et al.*, 2005). Sartika (2011) stated that 90% Indonesian children consume fruits and vegetables with <3 servings/day, less than Balanced Nutrition Guidelines Recommendation (PGS. i.e., 4 servings/day). Study by Madanijah *et al.* (2013) found that 89.2% school-aged children in Bogor was lack of fiber intake and have low level of fruit and vegetable consumption.

Struempfer *et al.* (2014) succeed to increase fruit and vegetable consumption in children through nutrition education intervention emphasizing on fruits and vegetables, as well as tasting fruits and vegetables once a week. This is an important thing to be implemented in Indonesia because its high obesity prevalence and low level of fruit and vegetable consumption. However, fruit and vegetable preferences in children are not same. This is supported by Sandvik *et al.* (2005) who stated that children are more interested to fruits rather than to vegetables. Evans *et al.* (2012) using meta-analysis found that school-based intervention succeed to improve fruit consumption but not vegetables consumption in children.

In addition to food consumption, obesity is also strongly related to physical activity. Current technology developments has made children movement easier and a lot of movements are no longer required, thus lead to less energy expenditure. Such low physical activity in obese children should be increased to improve obesity prevalence (Webb, 2008).

Result of meta-analysis by Evans *et al.* (2012) proved that multi-component school-based intervention program was better than one-component intervention program. This is similar to Singhal *et al.* (2010) who stated that multi-component nutritional intervention succeed to improve students' knowledge, nutritional behavior and anthropometric aspect. Therefore, multi-component intervention will be conducted in this study, i.e., fruit provision, physical activity and nutrition knowledge in obese students in Bogor. The aim of this study was to increase fiber intake, as well as to decrease the weight of obese students among those who treated with the multi-component intervention.

## MATERIALS AND METHODS

The study was conducted from August until November 2014 at 3 Integrated Islamic Primary School (Sekolah Dasar Islam Terpadu-SDIT) in Bogor, i.e., SDIT UmmulQuro, SDIT Insan Kamil and SDIT Aliya. This study is a part of Cross-Faculty Leading University Research (PUPT *lintas fakultas*) by Madanijah *et al.* (2014) entitled "Fiber Source and Nutritional Education Food Interventions in Overnutritional Children in Bogor". The research used quasi-experimental design with intervention treatment of over 5 weeks (Bogart *et al.*, 2014).

Subjects were divided into three groups by school. The treatment on each groups were randomized with treatment (school) A was nutrition education treatment (NE) and physical activity (PA), treatment (school) B was nutrition education (NE) and fruits (F) and treatment (school) C was nutrition education (NE), physical activity (PA) and fruits (F).

**Number of subject and sampling method:** The subjects were selected following PUPT study method, i.e., Integrated Islamic Primary School (SDIT) male and female students of grade 5 and 6 as subjects. They were purposively selected based on the permission of the subjects and their parents, in addition to meet the inclusion criteria. Subjects' inclusion criteria consist of obese nutritional status, parents' middle and high socio-economic status based on their education and income, not suffering from chronic disease, not being involved in similar activities, not taking supplements or drugs to lose weight and not in a lose weight diet programme.

Subjects were calculated based on the formula of Sastroasmoro and Ismael (2008) with  $\alpha$  5% ( $Z \alpha = 1.960$ ),  $\beta$  80% ( $Z \beta = 0.842$ ), BMI standard deviation (sd) according to Schaefer *et al.* (2011) (i.e., 0.34) and the average difference of preferred BMI ( $\Delta$ ) (i.e., 0.27). See the following to see the subject calculation:

$$n > 2: \frac{Sd^2 (Z\alpha + Z\beta)^2}{\Delta^2}$$

$$n > 2: \frac{(0.34)^2 (1.960 + 0.842)^2}{0.27^2}$$

: n > 25

According to the calculation, the minimum number of subject is 25. The number of subject was increased to anticipate the possibility of drop out, thus the final number of subjects was 30 students for each treatment group.

**Types and methods of data collection:** The primary data collected consist of subject characteristics, parents characteristics, father and mother Body Mass Index (BMI), nutritional knowledge, body weight, 24 h-physical activities on holidays and school days and fruit consumption pattern (frequency and preference). All of the primary data were obtained through interviews using questionnaire, except for body weight which was obtained by direct measurement.

**Data processing and analysis:** The obtained data were processed through data entry and cleaning using Microsoft Office Excel 2010. The data were analyzed in descriptive (frequency, average and standard deviation) and inference manners using SPSS (Statistical Product and Service Solution) programme for Windows version 17. The analysis of inferencia data consists of Paired t-test and ANOVA test.

**Implementation of the intervention:** Intervention of fruit was conducted every school day (5 times/week) with 1-2 servings of fruit. Intervention of physical activity was conducted every 3 times/week for 30 min. The physical activity was given such as football, handball, aerobics and traditional games. Nutrition education intervention was conducted for 30 min every week. The media used were poster, video and handout.

## RESULTS AND DISCUSSION

**Subjects' characteristics:** Subjects were ranged between 10-15 years old with the most of them were of age 10-12 years (Table 1) and boys in all groups. Yoshinaga *et al.* (2004) found the same result, i.e., the prevalence of obesity in school-aged children is significantly increased and higher in boys than in girls. This is allegedly because girls started puberty earlier than boys, so they started to pay attention to their appearance and tend to adjust their dietary habit than boys (Karimah, 2014).

In each group, more than 50% subjects were of moderate level of nutritional knowledge. Subjects' nutritional knowledge level showed no significant difference between each group. The subjects in all groups did light physical activity and only a few of them were of moderate level, i.e., 3.3% in group B and 6.7% in group A. These results are in accordance with Annisa

Table 1: Subjects' characteristics

Characteristics	---- Group A ----		---- Group B ----		---- Group C ----		P*
	n	%	n	%	n	%	
Age							
10-12 years	30	100	30	100	27	90	0.205
13-15 years					3	10	
<b>Sex</b>							
Boy	16	53.3	19	63.3	22	73.3	0.413
Girl	14	46.7	11	36.7	8	26.7	
<b>Allowance</b>							
<9,800	14	46.7	11	36.7	8	26.7	0.306
9,800-13,200	13	43.3	13	43.3	17	56.7	
>13,200	3	10	6	20	5	16.7	
<b>Nutritional knowledge</b>							
Less (<60%)	8	26.7	7	23.3	3	10	0.682
Moderate (60-80%)	17	56.7	17	56.7	23	76.7	
Good (>80%)	5	16.7	6	20	4	13.3	
<b>Physical activities</b>							
Light (1.40-1.69)	30	100	29	96.7	28	93.3	0.360
Moderate (1.70-1.99)			1	3.3	2	6.7	
<b>Father's BMI</b>							
Thin (BMI<18.5)	8	26.7	6	20	5	16.7	0.456
Normal (BMI≥18.5-<24.9)	7	23.3	4	13.3	7	23.3	
Overweight (BMI≥25.0-<27.0)	15	50	20	66.7	18	60	
<b>Mother's BMI</b>							
Thin (BMI<18.5)	11	36.7	2	6.7	5	16.7	0.143
Normal (BMI≥18.5-<24.9)	4	13.3	8	26.7	9	30	
Overweight (BMI≥25.0-<27.0)	15	50	20	66.7	16	53.3	

\*Result of ANOVA test between groups

Table 2: Fruit consumption frequency

Fruit type	----- Group A -----				----- Group B -----				----- Group C -----				P*
	--- Rare ---		--- Often ---		--- Rare ---		--- Often ---		--- Rare ---		--- Often ---		
	n	%	n	%	n	%	n	%	n	%	n	%	
Orange	20	66.7	10	33.3	17	56.7	13	43.3	13	43.3	17	56.7	0.193
Papaya	25	83.3	5	16.7	22	73.3	8	26.7	17	56.7	13	43.3	0.073
Apple	21	70	9	30	24	80	6	20	19	63.3	11	36.7	0.362
Banana	23	76.7	7	23.3	24	80	6	20	14	48.3	15	51.7	0.017
Mango	20	71.4	8	28.6	19	73.1	7	26.9	13	52	12	48	0.214
Others	3	75	1	25									

\*Results of ANOVA test between groups

Table 3: Fruit serving preference

Serving	Group A		Group B		Group C		P*
	n	%	n	%	n	%	
Uncutted fruit	18	60	18	60	16	53.3	0.591
Juice	7	23.3	8	26.7	7	23.3	
Salad	1	3.3	2	6.7	3	10	
Fruit soup	4	13.3	2	6.7	4	13.3	

\*Results of ANOVA test between groups

(2014), i.e., most of overnutritional students in Bogor (7.8%) have lifestyle with light or sedentary physical activities. According to Chaput *et al.* (2006), light physical activities are significantly associated with children obesity. Most of nutritional status of subjects parents (≥50%), in both father and mother, were categorized into overweight and there was no significant difference in all groups. He *et al.* (2000) stated that parents BMI of over 25 is an obesity risk factor for pre-school children in China.

**Fruit consumption pattern:** Fruit consumption pattern accessed in this study was fruit consumption frequency

and subject preference towards to fruit serving. This study found subjects' fruit consumption behavior, i.e., fruits often consumed were orange, papaya, apple, banana and mango (Table 2). This result is similar with Nurhayati (2013) who stated that the most consumed fruits by Indonesian children are banana, orange, papaya, apple and watermelon. In the present study, watermelon was substituted with mango due to mango season.

The most frequently consumed fruit by subjects in group A, B and C were orange while the rarest were apple. Preference of orange consumption was allegedly because of preferences, availability and public perception (i.e., orange contains high vitamin C). Apple was rarely consumed allegedly due to its price which tend to be more expensive than other fruits.

Table 2 showed that subjects' fruit consumption tend to be in low level, indicated by 'rare category' which has higher percentage than 'often category' in each group. Low fruit consumption was allegedly due to fruit unavailability at subjects' school. Based on direct

Table 4: Fiber intake sources

Food group	Group A		Group B		Group C	
	Pre	Post	Pre	Post	Pre	Post
	Mean	Cont. (%)	Mean	Cont. (%)	Mean	Cont. (%)
	stdev		stdev		stdev	
Cereals, tubers and their processed products	0.64±0.63	52.85	1.32±1.23	67.31	0.87±1.02	70.83
Beans and their processed products	1.02±0.88	5.60	1.59±3.06	8.27	0.59±0.59	2.01
Meats, poultry and their processed products	0.13±0.89	2.53	0.01±0.08	0.20	0.00±0.00	0.00
Eggs and their processed products	0.02±0.09	0.17	0.00±0.00	0.00	0.00±0.00	0.00
Fish, clam, prawn and their processed products	0.05±0.17	0.25	0.00±0.00	0.00	0.02±0.05	0.07
Vegetables and their processed products	0.87±1.03	19.73	1.27±2.06	18.28	0.79±1.58	9.59
Fruits and their processed products	2.76±3.16	12.76	0.00±0.00	0.00	1.42±1.35	8.93
Milk and their processed products	0.00±0.00	0.00	0.00±0.00	0.00	0.00±0.00	0.00
Fats, oil and their processed products	0.00±0.00	0.00	0.00±0.00	0.00	0.00±0.00	0.00
Sugar, syrup, seasoning ingredient	0.47±0.88	1.00	0.14±0.38	1.19	0.13±0.58	2.29
Snacks	0	5.10	1.06±2.02	4.74	0.65±1.35	6.28
Water	0	0.00	0.00±0.00	0.00	0	0.00
Cont.: Contribution						
	Mean	Cont. (%)	Mean	Cont. (%)	Mean	Cont. (%)
	stdev		stdev		stdev	
Cereals, tubers and their processed products	1.05±0.79	59.91	1.20±1.07	62.77	0.78±0.87	59.91
Beans and their processed products	1.39±3.63	2.08	0.01±0.01	0.01	0.41±0.49	2.08
Meats, poultry and their processed products	0.00±0.00	1.38	0.03±0.17	0.47	0.06±0.37	1.38
Eggs and their processed products	0.01±0.04	0.00	0.00±0.00	0.00	0.00±0.00	0.00
Fish, clam, prawn and their processed products	0.03±0.08	0.11	0.00±0.00	0.00	0.00±0.00	0.00
Vegetables and their processed products	0.80±0.63	14.10	1.29±2.88	18.13	0.96±0.84	12.79
Fruits and their processed products	1.46±0.91	3.35	1.73±1.44	12.16	1.60±2.00	9.77
Milk and their processed products	0.00±0.00	0.00	0.00±0.00	0.00	0.00±0.00	0.00
Fats, oil and their processed products	0.00±0.00	0.00	0.00±0.00	0.00	0.00±0.00	0.00
Sugar, syrup, seasoning ingredient	0.34±0.53	4.02	0.12±0.35	1.57	0.10±0.33	1.10
Snacks	0.95±1.95	13.31	0.62±0.71	4.89	1.21±1.99	12.98
Water	0.00±0.00	0.00	0.00±0.00	0.00	0	0.00

observations, cafeterias in all study sites did not sell fruits. Similarly, Meynsse *et al.* (2013) stated that 82% subjects did not consume fruit as daily dietary and only 21% subjects consume fruit 2-3 times/day. According to Peltzer and Pengpid (2012), 76.3% teenagers in South Africa do not consume fruit adequately (less than 5 servings/day). Both studies suggested intervention to increase fruit consumption. Perikkou *et al.* (2013) stated that nutritional knowledge given by teachers is more effective to increase fruit consumption in children. Fruit consumption in obese children is influenced by various factors such as environmental conditions (the presence of fruit shop) (Brunt *et al.*, 2007), socio-economic aspect (Storey and Anderson, 2014), parent involvement (Ohly *et al.*, 2013; Sophia and Madanijah, 2014) and government role to determine food price (Beydoun *et al.*, 2008). Table 3 showed the most preferred fruit servings by subjects were evenly distributed between groups with uncutted fruit as the most preferred. This finding then used as the foundation of fruit intervention method to subjects in group B and C, i.e. by serving uncutted fruit.

**Fiber consumption patterns:** The largest fiber source consumed by subjects in this study was cereals, tubers and their processed products (Table 4). Similarly, Jahari and Sumarno (2001) stated that cereals have the biggest contribution towards fiber intake in Indonesian people. Both studies showed that fiber source in Indonesia has not changed since 2001 to 2014, because it is still dominated by cereals, tubers and their processed products. Reicks *et al.* (2014) also stated that the largest fiber contribution is from grains (17.8%) due to their status as staple food and are consumed in large quantities. In addition, fiber in cereals was adequately high, making them as the biggest contributor in fiber intake. The Balanced Nutrition Guidelines suggest to consume adequate fruits and vegetables as fiber sources to meet fiber needs. Based on Table 4, fruits gave less contribution on fiber than cereals and vegetables, indicating that subjects' fruit consumption level was relatively low. See Table 2 for subjects' low fruits consumption level. Those conditions became the backgrounds of fruit intervention in the present study. Subjects' fiber intake level was categorized with 5 g interval (Jahari and Sumarno, 2001). The result showed that in early intervention most of subjects' fiber consumption level was 5-10 g in all groups (Table 5). At the end of intervention, most of subjects' fiber consumption level was equal with the initial data, i.e., 5-10 g. However, there were several subjects in group B and C who had high consumption level, i.e., 20-15 g, indicating that fruit intervention in group B and C increased potential fiber intake although it was not significant. Burrows *et al.* (2008) stated that intervention for 6 months succeed to improve food intake, but it was

Table 5: Fiber consumption level

FC level	Group A				Group B				Group C				P*	P**
	Pre		Post		Pre		Post		Pre		Post			
	n	%	n	%	n	%	n	%	n	%	n	%		
1 (<5)	6	20.0	12	40	11	36.7	11	36.7	9	30.0	9	30	0.341	0.979
2 (5-10)	17	56.7	9	30	15	50.0	12	40	17	56.7	14	46.7		
3 (10-15)	5	16.7	4	13.3	1	3.3	4	13.3	4	13.3	6	20		
4 (15-20)	2	6.7	3	10	3	10.0	0	0	0	0	0	0		
5 (20-25)	0	0	2	6.7	0	0	2	6.7	0	0	1	3.3		
6 (> = 25)	0	0	0	0	0	0	1	3.3	0	0	0	0		
P***	0.73				0.471				0.314					

FC: Fiber consumption. \*Results of ANOVA test of pre intervention between groups

\*\*Results of ANOVA test of post intervention between groups

\*\*\*Results of paired sample t-test based on the score changes at the pre-post in one group

Table 6: Change in fiber intake

Fiber intake	Group A		Group B		Group C		P*
	Pre	Post	Pre	Post	Pre	Post	
Mean±SD	7.92±3.68	8.31±6.14	6.87±4.22	7.60±6.44	6.54±2.48	7.39±4.25	0.95
Delta	0.39±5.57	0.39±5.57	0.73±7.11	0.73±7.11	0.86±4.19	0.86±4.19	
P**	0.701		0.58		0.272		

\*Results of ANOVA test between groups

\*\*Results of paired sample t-test based on the score changes at the pre-post in one group

Table 7: Change in body weight

Body weight	Group A		Group B		Group C		P*
	Pre	Post	Pre	Post	Pre	Post	
Mean±SD	56.95±6.38	56.24±6.38	58.56±9.77	59.16±9.83	54.32±8.68	53.98±8.31	0.002
Delta	-0.71±1.25	-0.71±1.25	0.6±1.53	0.6±1.53	-0.34±1.5	-0.34±1.5	
P**	0.004		0.042		0.229		

\*Results of ANOVA test between groups

\*\*Results of paired sample t-test based on the score changes at the pre-post in one group

not significant between various groups (intervention and control). The three treatments (NE+PA+F) for group C resulted that the group had higher fiber intake improvement than group A and B.

Table 6 showed that all groups increased their fiber intake after multi-component intervention. Group C, which was given NE + PA + F treatments, showed the highest increase in fiber intake, followed by group B (NE + F) and group A (NE+PA), respectively. The result indicates that the intervention of nutrition education and fruits gave more impact to increase fiber intake than nutrition education and physical activity. Nutrition education, particularly on fruit consumption, should be supported by concrete examples to give more influence on subjects' behaviours. Another study by Struempfer *et al.* (2014) also succeed to increase fruit consumption through nutritional education intervention which was supported by adding fruit during intervention.

**Body weight:** In this study, the multi-component intervention also decreased subjects' weight in group A followed by group C (Table 7), which were both received physical activity intervention. Consistent with Webb (2008) who stated that the prevalence of obesity can be decreased through increasing physical activity and decreasing fat intake. According to Friedrich *et al.* (2012), physical activity intervention combined with nutritional education gave more positive impact to decrease BMI in

school-aged children. Schaefer *et al.* (2011) also conducted effective lifestyle intervention through nutritional education, physical activity and counseling that succeed to decrease weight in obese children.

Group B in this study gained weight, in contrast to group A and C, indicating that nutritional education and fruits interventions without physical activity will fail to decrease weight. Contrast to Du *et al.* (2010) who stated that consumption of 10 gram fiber/day can decrease weight of 39 g/year although it was not significant. Brauchla *et al.* (2012) also stated that with sufficient fiber intake, the risk of obesity in children decreased up to 17%.

This study showed that multi-component intervention did not always give better results than one intervention, indicated by higher weight loss in group A than in group C. Moreover, this result was allegedly because of high sugar content and energy in the fruits given to the subjects, in addition to uncontrolled variables such as subjects' allowance. In a previous data (Table 1), subjects in Group C were allegedly spend more because their allowance tend to be higher than group A and B. Therefore, the influence of multi-component intervention requires further studies to determine more proper fruit intervention design to address obesity in children.

**Conclusion and recommendation:** Subjects' fruit consumption preference was still low, while uncutted

fruit is the most preferred fruit serving. Multi-component intervention increased fiber intake although it was not significant and can decrease weight in groups that given physical activity treatment. However, the multi-component intervention showed no better results than one intervention. Therefore, further studies are needed to determine the right combination of multi-component intervention to address obesity in children. Nutritional education should be supported by concrete examples to give more influence on behavioral change.

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