PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

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Pakistan Journal of Nutrition 15 (6): 572-579, 2016
ISSN 1680-5194

Effect of Nutritional Education, Fibre Food Source and Physical Activity on Nutritional Status of Obese Students in Integrated Islamic Elementary School, Bogor

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Abstract: The aim of the study was to analyze the effect of nutritional education, physical activity and dietary fibre intake on nutritional status of obese students in integrated Islamic Elementary School, Bogor. Quasi-experimental study design was used with a total of 84 students from three integrated Islamic elementary school in Bogor as samples. The samples were divided into three groups, group A with nutritional education and physical activity intervention, group B with nutritional education and fibre source interventions and group C with nutritional education, physical activity and fibre source interventions. The results indicated that nutritional knowledge and fibre intake increased in all, physical activity increased in group A and C and Body Mass Index (BMI) by age decreased in all groups. Paired sample t-test indicated that nutritional knowledge and fibre intake between three groups were significantly different ($p<0.05$) while physical activity and BMI by age between group A and C were also significantly different ($p<0.05$). ANOVA tests indicated that physical activity, fibre intake and BMI by age were significantly different between all groups. ANCOVA test showed nutritional education and physical activity decreased BMI for age.

Key words: Fibre intake, nutritional education, obese student, physical activity

INTRODUCTION

Obesity is a condition in which body weight exceeds 20% from normal, characterized by excessive accumulation of fat in various body parts, particularly waist, hip and upper arm (Kyriazis *et al*., 2012). Obesity becomes a cause of global public health problem both in developed and developing countries where its growth is alarming and has health implications in long run (Ventura and Garst, 2013). In particular, obesity in children leads to degenerative diseases such as diabetes mellitus type 2, hypertension, dyslipidemia, coronary heart disease and other degenerative diseases (Brown *et al*., 2011).

In 2007 to 2013, the prevalence of obesity in Indonesian children increased where the prevalence in 2007 was 9.5% in boys and 6.4% in girls (Ministry of Health, 2007). In 2010, the prevalence of obesity increased both in boys (to 10.7%) and girls (to 7.7%) (Ministry of Health, 2010) while in 2013 the prevalence in children increased to 18.8% (Ministry of Health, 2013). By living place, the prevalence of obesity in children living in urban areas was higher than those living in rural areas. Bogor Town was one of urban areas with the highest prevalence of obesity in children, i.e., 23.9% (Ministry of Health, 2007). WHO (2010) stated that the main causes of obesity are genetic factors, food consumption patterns and physical activity. A study conducted by Mann and Truswell (2014) indicated that overweight older people or have an excessive nutritional status can pass on their obesity to their children up to 60-84%. The change in food consumption pattern towards more practical and high-fat and low-fiber foods is one of the causes of obesity in children. Poor nutritional knowledge leads to poor diet pattern on community groups, indicated by high-calorie, high-fat and high-cholesterol diet patterns, particularly fast food, which give impact on the increase in obesity risk (Heird, 2002).

In general, fast food contains high energy, salt and fats, in addition to cholesterol and contains only little amount of fibre (Bowman *et al*., 2004). According to Levy *et al*. (2012), 86% obese children consume fast food every day and >80% do not consume fruits and vegetables. The results of Johnson's study (2008) indicated that low fiber consumption is associated with obesity in children. Fiber-rich foods are beans, vegetables and fruits with benefits for health (Whitney *et al*., 2011). Low physical activity is an important factor to gain weight. Individuals with low physical activity have weight gain risk 5 kg (Reilly *et al*., 2005).

This present study generally aims to analyze the effect of nutritional education, fibre food source and physical activity on the nutritional status (BMI/U) of obese students of SDIT in Bogor. The specific objectives of this study were to analyze the differences in BMI z-score/U, nutritional knowledge, physical activity and fiber intake of obese students during baseline and end line

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intervention; to analyze the differences between all treatment groups on nutritional knowledge, fibre intake and physical activity of obese students and to analyze the effect of nutritional knowledge, fibre intake and physical activity on the nutritional status (BMI/U) of obese students.

MATERIALS AND METHODS

Subjects: This study used Quasi Experimental design and was conducted in August 2014 to February 2015 in Integrated Islamic Elementary School (SDIT), Bogor Town. SDITs were selected using purposive sampling, taken into account that students of private schools such as SDITs are averagely from families with middle to high in comes obese students are most likely can be found there, study sites are easily accessible and only few researches have been conducted on providing nutritional education, fiber food source and physical activity for obese students of elementary school in Bogor. Population of this study consisted of all 5 and 6 grader students of SDIT Aliya, SDIT Insam Khamil and SDIT Ummul Quro. Purposive sampling of 5 and 6 grader students was conducted with taken into account assumption that they are capable of doing communication well, understanding questions in questionnaires and answering questionnaire well:

$$n \geq \left\{\left(2x\, sd^2\, (Z\beta + Z\alpha)^2 / \Delta^2\right)\right\}$$

where:

- n = Total samples per group treatment
- sd = Standard deviation of the decrease in the nutritional status (BMI/U) (0.34) (Schaefer, 2011)
- $Z\beta$ = Normal distribution with 80% power (0.84)
- $Z\alpha$ = Normal distribution with 95% confidence interval (1.96)
- Δ = The difference of decrease in average of BMI/U desired (0.27) (Schaefer *et al*., 2013):

$$n \geq \left\{\left(2x0.34^2 x\, (0.84 + 1.96)^2 / 0.27^2\right)\right\}$$

$$n \geq 25$$

Samples of this study were students who meet the criteria and have comprehensive data. The criteria were obese nutritional status, from family with middle and high economic status, not suffering from chronic diseases, physically fit, not taking any diet drugs, not being sampled in other studies and are willing to be sampled. The minimum number of sample is calculated by Sastroasmoro and Ismael (2008) formula. See the following to see the calculation.

By taking into account the possibility 10% drop out, the number of samples required were 28 students per group. The groups were randomly determined resulting SDIT Aliya students as group A which received nutritional education and physical activity (PG+O) interventions, SDIT Insan Kamil students as group B with nutritional education and fibre food source (PG+PS) interventions and SDIT Ummul Qurostudents as group C with nutritional education, physical activity and fibre food sources (PG+O+PS) interventions.

Data types and collection method: Primary data were collected twice, i.e., baseline (before intervention) and end line (after intervention). Primary data consist of family characteristics, student characteristics, genetic factors (parent's BMI), nutritional knowledge, physical activity, fibre intake and nutritional status, while secondary data consist of school general condition. All the data, both primary and secondary, were obtained by interviewing samples using questionnaires, except for genetic factors and student nutritional status, which was measured using bathroom body scales and Microtoise. Parent nutritional status data were obtained using BMI. Student nutritional knowledge data were obtained using questionnaires consisting 20 questions each. Physical activity level was measured following FAO/WHO/UNU (2001). Fibre intake data were obtained using 2 x 24 h food recall questionnaires. Student nutritional status data were provided in BMI/U by age using WHO Anthroplus software 2007.

Intervention implementation: Interventions were conducted for eight weeks (two months). Bogart *et al*. (2013) stated that the intervention of nutritional education and the provision of fruits and vegetables for five weeks can improve the pattern of consumption habit, in addition to prevent and decrease the incidence of obesity in children. Nutritional education was carried out for 30 min/week, containing materials from eight aspects, i.e., (1) the importance of nutrition and physical activity as well as their role for health and achievement, (2) guidelines for balanced nutrition, (3) the importance of fruit and vegetable consumption, (4) the importance of breakfast, (5) whole grain, (6) fast food and soft drink, (7) snacks and (8) healthy snacks and healthy packed meals. Media used in this intervention were posters, videos and power point slides.

Food fibre sources such as fruits (1st month) and snackbar (2nd month) were provided every school day, i.e., five times/week. Physical activity intervention in school consisted of football, handball, aerobics, skipping, "galah" (pole) traditional game and others with the help of physical education teacher and trained research team. Media used were sport equipments, videos and instructor.

Data processing and analysis: The data were processed and analyzed descriptively (average and standard deviation) and inferentially (Kruskal Wallis test, paired sample t-test, one-way ANOVA and ANCOVA) using Microsoft Excel 2013 and SPSS version 20

software. To analyze whether data obtained, such as sex data, among treatment groups were ordinal or categorical data, Kruskal-Wall is test was used. Paired sample t-test was used to analyze increase in nutritional knowledge, physical activity, the level of fibre intake and decrease in BMI/U during baseline and end line of treatment for each group. One-way ANOVA was used to analyze differences in parental status score during baseline intervention, in addition to score of student nutritional knowledge, physical activity, dietary fiber intake and BMI/U during baseline and end line intervention. If one-way ANOVA resulted any significant difference ($p<0.05$), a following test using post hoc Tukeyshall be carried out. In addition, ANCOVA test was used to analyze the effect of nutritional education, food fibre source and physical activity on nutritional status (BMI/U) of obese students.

RESULTS

Student characteristics: Most of the students in group A group B and C were male, i.e., 57.1, 67.9 and 71.4%, respectively (Table 1). Based on Kruskal Wallis test, there was no significant difference ($p>0.05$) for sex variable between all groups. The students ranged from 10 to 13 years old, i.e., students in group A were mostly 11 years old (46.5%), while group B (42.9%) and group C (53.6) were 12 years old. ANOVA test indicated no significant difference ($p>0.05$) for age variable between all groups (Table 1). Most of students in group A (92.9%), group B (60.7%) and group C (79.8%) were given allowance around IDR 5,000-10,000. ANOVA test indicated significant difference ($p<0.05$) for allowance variable between all groups, followed with post hoc Tukey test which showed no significant difference ($p>0.005$) for the variable (Table 1).

Family characteristics: The education level of parents ranged from high school graduate to university graduate. Most of their fathers were college graduates, i.e., group A (85.7%), group B (89.3%) and group C (91.7%); while for mothers were 82.1% for group A, 75% for group B and 78.6% for Group C, were mostly college graduates. ANOVA test showed no significant difference ($p>0.05$) for mother and father education level variable between all groups (Table 2). Group A (57.1%), B (53.6%) and C (60.7%) belonged to small family category, with the average number of family members were mostly 3-4 people, or small-family category. ANOVA test result indicated no significant difference ($p>0.05$) for family member variable (Table 2).

Heredity or genetic factors: Genetic factor can be assessed from the parent nutritional status using BMI. Most of student' father nutritional status belonged to obese 1 category, i.e., group A (50%), B (57.1%) and C (67.9%). Similarly, most of mother nutritional status belonged to obese 1, i.e., group A (50%), B (60.7%) and C (53.6%). ANOVA test indicated no significant difference ($p>0.05$) for father and mother nutritional status by BMI between all treatment groups (Table 2).

Table 1: Distribution of student by individual characteristic

	------ A ------		------ B ------		------ C ------	
Variable	n	%	n	%	n	%
Sex						
Male	16	57.1	19	67.9	20	71.4
Female	12	42.9	9	32.1	8	28.6
Total	28	100	28	100	28	100
P[a]	---------- 1.000 ----------					
Age						
10	2	7.1	0	0	0	0
11	13	46.4	10	35.7	12	42.9
12	12	42.9	12	42.9	15	53.6
13	1	3.6	6	21.4	1	3.6
Total	28	100	28	100	28	100
Average±SD	11.4±0.7		11.9±0.8		11.6±0.6	
P[b]	---------- 0.064 ----------					
Allowance						
<5,000	2	7.1	0	0	2	7.1
5,000-10,000	26	92.9	17	60.7	24	85.7
11,000-15,000	0	0	7	25.0	2	7.1
>15,000	0	0	4	14.3	0	0
Total	28	100	28	100	28	100
Average±SD	6625±2327.9		11678.6±4784.6		8285.7±3016.7	
P[b]	---------- 0.000 ----------					

A:Nutritional education and physical activity
B: Nutritional education and food fiber source
C: Nutritional education, physical activity and food fibre source
P[a]: Result of Kruskall Walis of significant (<0.05)
P[b]: ANOVA analysis with significant (<0.05)

Student nutritional knowledge: During nutritional knowledge baseline intervention, the three groups showed no significant difference in average value, i.e., approximately 67, where most of students in group A (46.4%), B (57.1%) and C (50%) have nutritional knowledge in moderate level. ANOVA test results indicated no significant difference ($p>0.005$) for average nutritional knowledge between all groups during baseline intervention. During end line intervention, generally student nutritional knowledge increased to approximately 80 where most of students in group A (57.1%), B (46.4%) and C (67.9%) were categorized to have high knowledge level (Table 3).

Physical activity: Most of students in group A (96.4%), B (82.1%) and C (96.4%) were of low physical activity level during physical activity baseline intervention while ANOVA test result indicated no significant difference ($p>0.005$) for the variable between all treatment groups. Researches conducted in developed countries revealed the relation between low physical activities with obesity where individuals with low physical activity have risk of weight gain up to 5 kg (Table 4).

During end line intervention, student physical activity increased in group A and group B up to 1.8 averagely.

Table 2: Distribution of student by family characteristic data

	A		B		C	
Education	n	%	n	%	n	%
Father						
Elementary graduate	0	0	0	0	0	0
Junior high graduate	0	0	0	0	0	0
Senior high graduate	4	14.3	3	10.7	0	0
University graduate	24	85.7	25	89.3	28	100
Total	28	100	28	100	28	100
Average±SD	15.6±1.8		15.1±1.7		15.7±1.0	
P[b]	0.348					
Mother						
Elementary graduate	0	0	0	0	0	0
Junior high graduate	0	0	0	0	0	0
Senior high graduate	5	17.9	7	25.0	6	21.4
University graduate	23	82.1	21	75	22	78.6
Total	28	100	28	100	28	100
Average±SD	14.9±1.9		14.2±1.7		14.8±2.8	
P[b]	0.443					
Family						
Medium (5-6)	11	39.3	13	46.4	10	35.7
Large (>6)	1	3.6	0	0	1	3.6
Total	28	100	28	100	28	100
Average±SD	4.5±1.0		4.5±0.8		4.3±1.1	
P[b]	0.618					
Nutritional status (BMI)						
Father						
Underweight (<18.5)	0	0.0	0	0.0	0	0.0
Normal (18.5-24.9)	10	35.7	6	21.4	5	17.9
Overweight (25-29.9)	4	14.3	6	21.4	4	14.3
Obese 1 (30-34.9)	14	50.0	16	57.1	19	67.9
Obese 2 (35-39.9)	0	0.0	0	0.0	0	0.0
Obese 3 (>40)	0	0.0	0	0.0	0	0
Total	28	100	28	100	28	100
Average±SD	30.9±3.5		30.7±3.1		30.8±2.8	
P[b]	0.526					
Mother						
Underweight (<18.5)	0	0.0	0	0.0	0	0.0
Normal (18.5-24.9)	4	14.3	3	10.7	5	17.9
Overweight (25-29.9)	10	35.7	8	28.6	7	25.0
Obese 1 (30-34.9)	14	50.0	17	60.7	15	53.6
Obese 2 (35-39.9)	0	0.0	0	0.0	1	3.6
Obese 3 (>40)	0	0.0	0	0.0	0	0.0
Total	28	100	28	100	28	100
Average±SD	29.8±3.5		30.4±2.6		30.9±3.6	
P[b]	0.484					

A: Nutritional education and physical activity
B: Nutrition education and food fibre source
C: Nutritional education, physical activity and food fibre source
P[b]: ANOVA analysis with significant (<0.05)

Most of physical activity level in group A and group C, i.e., 71.4 and 75%, respectively, was categorized into moderate; while 10.7 and 7.1% into high category. On the other hand, group B, which was only given nutritional education and fibre food source interventions, showed no increase in physical activity, i.e., most of the students of the group 92.9% belonged to low category (Table 4).

Fiber intake: Most of the students in group A (85.7%), B (85.7%) and C (75%) during baseline intervention consumed fibre <10 g/day and belonged to low category with average distribution 6-7 gr/day. During end line intervention, fibre intake increased in all groups, with the highest increase was showed by group B and C (approximately 6 g/day). Most of students from group B (60%) and C (71.4%) consumed fibre $\geq$10 g/day while in group A (60.7%), the fibre consumption was <10 g/day (Table 5).

Student nutritional status: Overall, students' average BMI/U z-score during baseline intervention in both group A and C was 2.7, while in group B was 2.8 and all the scores belonged to obese category. ANOVA test results indicated no significant difference (p>0.05) for student

Table 3: Distribution of student by nutritional education and treatment group

	A				B				C			
	Baseline		Endline		Baseline		Endline		Baseline		Endline	
Category	n	%	n	%	n	%	n	%	n	%	n	%
Low (<60)	8	28.6	0	0.0	8	28.6	1	3.6	6	21.4	1	3.6
Modrate (60-80)	13	46.4	12	42.9	16	57.1	14	50.0	14	50.0	8	28.6
High (>80)	7	25.0	16	57.1	4	14.3	13	46.4	8	28.6	19	67.9
Total	28	100	28	100	28	100	28	100	28	100	28	100
Average±SD	67±15.6	67±15.6	79.6±8.8	79.6±8.8	66.6±10.0	66.6±10.0	76.1±9.5	76.1±9.5	66.6±11.3	66.6±11.3	79.6±9.9	79.6±9.9
P^a	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P^b Basline	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
P^b Endline	0.266	0.266	0.266	0.266	0.266	0.266	0.266	0.266	0.266	0.266	0.266	0.266
P^b Δ	0.341	0.341	0.341	0.341	0.341	0.341	0.341	0.341	0.341	0.341	0.341	0.341

A:Nutritional education and physical activity
B: Nutritional education and food fibre sources
C: Nutritional educaton, physical activity and food fibre source
P^a: Paired sample t-test analysis with significant (<0.05)
P^b: ANOVA analysis with significant (<0.05)

Table 4: Distribution of student by physical activity and treatment group

	A				B				C			
	Baseline		Endline		Baseline		Endline		Baseline		Endline	
Physical activity	n	%	n	%	n	%	n	%	n	%	n	%
Light	27	96.4	5	17.9	23	82.1	26	92.9	27	96.4	5	96.4
Moderate	1	3.6	20	71.4	5	17.9	2	7.1	1	3.6	21	3.6
Heavy	0	0	3	10.7	0	0	0	0	0	0	2	0
Total	28	100	28	100	28	100	28	100	28	100	28	100
P^a	0.000	0.000	0.000	0.000	0.605	0.605	0.605	0.605	0.000	0.000	0.000	0.000
P^b Basline	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169
P^b Endline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P^b Δ	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

A:Nutritional education and physical activity
B: Nutritional education and food fibre source
C: Nutritional educaton, physical activity and food fibre sources
P^a: Paired sample t-test analysis with significant (<0.05)
P^b: ANOVA analysis with significant (<0.05)

Table 5: Distribution of student by fibre intake level and treatment group

	A				B				C			
	Baseline		Endline		Baseline		Endline		Baseline		Endline	
Intake fiber	n	%	n	%	n	%	n	%	n	%	n	%
Low (<10 g)	24	85.7	17	60.7	24	85.7	12	40	21	75	8	28.6
Adequate (≥10 g)	4	14.3	11	39.3	4	14.3	18	60	7	25	20	71.4
Total	28	100	28	100	28	100	30	100	28	100	28	100
Average±SD	7.4±2.1	7.4±2.1	9.7±2.4	9.7±2.4	6.7±2.6	6.7±2.6	12.5±2.6	12.5±2.6	7.8±3.3	7.8±3.3	13.3±2.5	13.3±2.5
P^a	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P^b Basline	0.274	0.274	0.274	0.274	0.274	0.274	0.274	0.274	0.274	0.274	0.274	0.274
P^b Endline	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
P^b Δ	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

A: Nutritional education and physical activity
B: Nutritional education and food fibre sources
C: Nutritional educaton, physical activity and food fibre sources
P^a: Paired sample t-test analysis with significant (<0.05)
P^b: ANOVA analysis with significant (<0.05)

Table 6: Average of student nutritional status by treatment group

Nutritional status	A	B	C	P[b]
Baseline	2.7±0.2	2.8±0.3	2.7±0.4	0.744
End line	2.4±0.2	2.7±0.4	2.5±0.3	0.009
Δ	-0.21±0.1	-0.08±0.7	-0.36±0.5	0.004
P[a]	0.000	0.216	0.026	

A: Nutritional education and physical activity
B: Nutritional education and food fibre source
C: Nutritional education, physical activity and food fibre source
P[a]: Paired sample t-test analysis with significant (<0.05)
P[b]: ANOVA analysis with significant (<0.05)

BMI/U z-score during baseline intervention between all treatment groups. During end line intervention, student BMI /U z-score in the three groups decreased, i.e., group A up to 0.21, B 0.08 and C 0.36 kg, however they were still categorized as of obese nutritional status (Table 6).

DISCUSSION

According to paired samples t-test, there was a significant difference ($p<0.05$) between the baseline and end line interventions of student nutritional knowledge in each group, i.e., group A, B and C, indicated that nutritional education intervention was capable of improving knowledge score at end line intervention in each treatment group. ANOVA test results indicated no significant difference ($p>0.005$) for average nutritional knowledge between all groups during end line intervention and there was no significant difference ($p>0.005$) for student's average delta nutritional knowledge level between end line and baseline intervention (Table 3). These results are consistent with the findings of Ikada (2010) where the provision of nutritional education intervention using Guidelines for Balanced Nutrition (*Pedomanuntuk Gizi Seimbang*/ PUGS) material on elementary school children increased the percentage of children knowledge from 5% before the intervention to 57% after the intervention (post-test 1).

Another study conducted by Vijiyapushpam *et al*. (2009) revealed that student knowledge increased after intervention was given, i.e., children average knowledge score increased from 28.3 to 29.2. Study by Shi-Chang *et al*. (2004) about the effect of health promotion on food intake indicated that knowledge on food intake guidelines increased from 49.2% before intervention to 68.2% after intervention.

Paired sample t-test showed a significant difference ($p<0.05$) between the baseline and end line interventions of physical activity level in group A and C, indicating that physical activity intervention was capable of improving physical activity score. There was no significant difference ($p>0.05$) between the baseline and end line interventions of physical activity level in group C. ANOVA test results indicated a significant difference ($p<0.05$) between treatment groups during end line intervention on physical activity level, as well as on baseline and end line interventions of delta physical activity level between all treatment groups. Post hoc Tukeyas the following test, however, indicated no significant difference ($p>0.005$) for both variables (Table 4).

Newest examination of the Department of Education's Early Childhood Longitudinal Survey (ECLS-K) found that increase in physical activity up to one hour per week can decrease 0.31 children BMI (around 1.8%). Sigmund *et al*. (2012) also found that school-based exercise intervention is effective to reduce obesity and over weight in children. Similarly, Ventura and Garst (2013) also stated that interventions of nutritional education and physical activity brought about more positive impacts to improve food consumption and to decrease obesity in children.

Baseline intervention of student fibre intake belonged to low level category. This result is in line with the study conducted by Haryanto (2012) who stated that fibre consumption in children aged 7-9 and 10-12 years in Java Island was 5.7 and 6.02 g in average, respectively. Fibre intake increased during end line intervention, indicating consistent result with Struempler *et al*. (2014) who stated that nutritional education intervention emphasizing on fruits and vegetables, as well as fruits and vegetables tasting once a week, can increase fruits and vegetables consumption in children.

Paired sample t-test result indicated a significant difference ($p<0.005$) between baseline and end line interventions in group A, B and C, indicating that food fibre source intervention can increase student fibre intake. Based on ANOVA test, there was no significant difference ($p>0.05$) in fibre intake baseline intervention between groups. However, significant differences ($p<0.05$) between all groups were seen in fibre intake end line intervention, as well as delta end line and baseline intervention (Table 5). High consumption of vegetables, fruits and grains is related to low increase in BMI and abdominal circumference (Newby *et al*., 2003). Similarly, Drapeau *et al*. (2004) stated that vegetable and fruit consumption can reduce abdominal circumference and body weight.

Paired sample t-test result indicated significant difference in student BMI/U z-score between baseline and end line interventions in group A and C, while group B showed no significant difference ($p>0.05$). ANOVA test results indicated that there are significant differences ($p<0.05$) in student BMI/U z-score during end line intervention between all groups. Post hoc Tukey test, however, showed no significant difference ($p>0.005$) in student BMI/U z-score during end line intervention between all treatment groups. Delta BMI/U z-score of end line and baseline interventions showed no significant difference ($p>0.05$) between all treatment groups (Table 6).

Based on ANOVA, nutritional education and physical activity interventions showed significant effect ($p<0.05$) against student delta BMI/U z-score, while food fibre source intervention showed no significant effect ($p>0.05$) in decreasing student delta BMI/U z-score. These results are consistent with the research conducted by Silveira *et al*. (2013) where school-based nutritional education intervention can improve consumption pattern and decrease obesity incidence in children. Sigmund *et al*. (2012) also stated that school-based exercise intervention is effective to reduce obesity and overweight in children. Similarly, according to Ventura and Garst (2013), nutritional education and physical activity interventions brought about more positive impact to improve food consumption and to decrease obesity in children.

Struempler *et al*. (2014) stated that nutritional education intervention emphasized on fruits and vegetables, as well as fruit and vegetables testing once a week can only increase fruits and vegetables consumption in children. In addition according to Epstein *et al*. (2001), the increase in vegetables and fruits interventions can reduce high-fat and sugar intakes. To control weight, the best method is energy intake reduction and diet restriction. Fibres can restrict energy intake because of their low energy density and their ability to in no time bring about satiety effect (WHO, 2000). Increasing fibre intake up to 12 g/day can lead to decrease abdominal circumference up to 0.63 cm in the long term (9 years) and decrease fibre intake up to 3 grams/kcal/day for a year in overweight teenagers is related to increasing abdominal fat up to 21%, compared with non-decreasing fibre intake (Koh-Banerjee *et al*., 2003).

Group C which was given nutritional education, food fibre source and physical education interventions showed the highest decrease in BMI /U z-score. These results are consistent with the results of meta-analysis by Evans *et al*. (2012) who stated that multi-component school-based intervention programme brings about better result than single-component one. Similarly, Singhal *et al*. (2010) stated that multi-component nutritional intervention managed to improve aspects of student nutritional knowledge, nutritional behavior and anthropometric.

Conclusion and suggestion: Based on paired samples t-test, significant differences ($p<0.05$) were seen in nutritional knowledge and fiber intake of all three treatment groups, in physical activity and BMI/U z-score of group with nutritional education and physical activity interventions and group with nutritional education, food fibre source and physical education interventions. ANOVA test results indicated significant changes ($p<0.05$) in physical activity, fibre intake and BMI/U z-score between treatment groups. ANCOVA test results showed nutritional education and physical activity interventions significantly decrease ($p<0.05$) BMI/U z-score in group A (0.21) and group C (0.36). Multi-component intervention is more influential than two-components to decrease BMI/U z-score in obese students.

Nutrition teachers and health workers can carry out nutritional education intervention to improve children nutritional knowledge. Physical activity such as exercising three times a week for 30 min at least is necessary to decrease body weight and improve food consumption pattern in obese children. Food fibre sources are also necessary for children. Similar studies are advised to include information sharing with student's parent, school and related government offices in structural manner.

ACKNOWLEDGEMENTS

I would like to thank Head and staffs of Bogor Department of Education, Headmaster of Bogor SDIT Aliya, Headmaster of Bogor SDIT Insan Kamil and Headmaster of Bogor SDIT Ummul Quro, as well as all teachers and students who actively took part in this study.

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