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Relationship Between Dietary Pattern and Body Mass Index Among Primary School Children

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ABSTRACT

Currently, childhood obesity has been growing at an alarming rate and it is a common nutritional problem among children in developed countries as well as in developing countries. It has become one of the most serious public health challenges of the 21st century. This study attempts to determine the relationship between dietary pattern and Body Mass Index among primary school children. This is a cross-sectional study involving 204 students aged seven to ten years old from Sekolah Kebangsaan Abdul Samat, Kapar, Selangor. Anthropometric data including height and weight were obtained. Data was obtained by interview using of questionnaire. The prevalence of children being overweight (28.9%) and obesity (12.7%) was high. The finding revealed that types of diet were significantly associated with body mass index. Breakfast consumption and number of meals per day did not show any association with the children's BMI. In conclusion, body mass index of school children in this study showed to have association with types of diet intakes but showed no association with number of meals per day and breakfast consumption.

Key words: Childhood obesity, dietary pattern, body mass index, primary school children

INTRODUCTION

WHO defines overweight and obesity as abnormal or excessive fat accumulation that may impair health. Although obesity can be determined by a number of methods, but body mass index (BMI) is the most commonly used measurement for many obesity researchers and health professionals (Afridi and Khan, 2004). Based on the WHO growth reference standard BMI-for-age z-scores for children aged 5 to 19 years old boys and girls, the children are considered overweight if the BMI-for-age is between +1SD and +2SD and obese if the BMI-for-age is more than +2SD. The cut-off point for normal BMI-for-age is in between -2SD to +1SD.

Increasing prevalence of obesity among children is reported in Asian countries, including Singapore, Malaysia, Korea, Indonesia and Thailand (Chadarat *et al.*, 2006). Tee *et al.* (2002) did a study on 5,995 children aged 7 to 10 years in primary schools in Kuala Lumpur and reported a prevalence of overweight of 9.7% among boys and 7.1% among girls.

Higher levels of body mass index during childhood can predict overweight later in life (Deckelbaum and Williams, 2001) and increased risk of getting hypertension, dislipidemia, insulin resistance and hyperinsulinemia (Kocoglu *et al.*, 2003). Obesity in childhood also predicts future low self-esteem (Tiggemann, 2005), inflammation (Daniels *et al.*, 2005) and increased asthma severity (El-Helaly *et al.*, 2009). Ramzan *et al.* (2009) in their study discovered that hyperechogenic

liver was found in obese children while Khositseth *et al.* (2009) indicated that left ventricular mass and abnormal left ventricular geometry was increased in obese children and lead to cardiovascular risk. It is found that obesity is highly related with oxidative stress which gives adverse effects on their health and school performance (Al-Menabbawy *et al.*, 2006).

Global rise in childhood overweight and obesity are attributable to some factors including high intake of energy-dense foods that contain elevated fat and sugars but low in vitamins, minerals and other healthy micronutrients, as well as inactive physical activity (Shehu *et al.*, 2010). Changes in particular eating patterns may explain the elevated adiposity among children for instance increasing number of meals eaten away from home, food accessibility, portion sizes, snacking and meal-skipping (Nicklas *et al.*, 2001).

This study was conducted to determine the relationship between dietary pattern and body mass index among children in a selected primary school in Selangor.

MATERIALS AND METHODS

Study design: This is a cross sectional study that was carried out among primary school children in Sekolah Kebangsaan Abdul Samat, Kapar, Selangor.

Study subjects: Two hundred and four students aged seven to ten years old (94 males and 110 females) who were randomly selected took part in this study. Thirty students from Year Four were randomly selected for 24 h diet recall.

Anthropometric measurement: The anthropometric measurements taken were body weight and height. Weights were measured by using SECA weight scale while heights were measured by using stadiometer. Weights and heights were measured two times to get the average reading.

Dietary questionnaire: The subjects were given a set of questionnaire which consists of part A and part B. Part A consisted of questions on sociodemographic questions. Part B consisted of the questions on dietary pattern. This includes number of meals per day and the frequency of food intake according to mealtimes that are breakfast, morning tea lunch, afternoon tea, dinner and supper. There were given food choices for each mealtime based on commonly eating foods in Malaysia. The types of foods for each mealtime were constructed based on "Validity of physical activity and food consumption questionnaire for children aged seven to ten years old" by Barros *et al.* (2007) and then adopted to the Malaysian context.

The types of foods by Barros *et al.* (2007) were all the same for each mealtime from breakfast to supper, but for this study, the types of food were modified due to Malaysian context. The types of food listed in the questionnaire were commonly eaten by Malaysian children as well as the foods sold at the canteen of Sekolah Kebangsaan Abdul Samat. All of the foods were presented in pictures similar to Barros *et al.* (2007) in order to make it easier to the students to understand and attracted their attention. The participants had to answer either yes or no to the foods shown during each mealtime and if they took the food, they should fill the column given for frequency of food intake in a week. Before data collection, the questionnaires were pilot study tested and found to be suitable for children in that school.

Statistical analysis: All the data were entered in to Statistical Package for Social Science (SPSS) version 16.0. To answer the main objective of this study, that is the relationship between dietary

patterns with Body Mass Index status among the selected sample, chi-square test was used. The continuous data was tested for normality by using Kolmogorov-Smirnov statistics.

RESULTS

Table 1 shows the distribution of children according to age and ethnic group by sex. 92.6% of the participants were Malay, 5.9% were Indian, while 1.0% is from other ethnic group and just 0.5% were Chinese. Table 2 shows the distribution of subjects by their BMI-for-age classification. 50% of the students have normal BMI for their age, 28.9% were classified as overweight and 12.7% were obese.

For dietary pattern, 41.2% of the subjects reported to have three meals per day while the least was the participants who had six meals per day (2.5%).

For chi-square analysis, underweight respondents were excluded, thus the total subjects were 187. Table 3 shows the cross tabulation between breakfast consumption and BMI status of the children. The breakfast consumption had been categorized into skipping breakfast even for one day and the children who take breakfast every day. The BMI status were divided into two categories either normal BMI or overweight and obese. 55.1% of the children reported to skip breakfast and

Table 1: Subjects' characteristics

Characteristics	Male		Female		Total	
	No.	%	No.	%	No.	%
Age						
Year 1 (7 years old)	22	44.0	28	56.0	50	24.5
Year 2 (8 years old)	24	48.0	26	52.0	50	24.5
Year 3 (9 years old)	26	46.4	30	53.6	56	27.5
Year 4 (10 years old)	22	45.8	26	54.2	48	23.5
Total	94	46.1	110	53.9	204	
Ethnicity						
Malay	89	47.1	100	52.9	189	92.6
Indian	4	33.3	8	66.6	12	5.9
Chinese	1	100	0	0.0	1	0.5
Others	0	0.0	2	100.0	2	0.5

Table 2: Subjects' classification of BMI-for-age

Class of BMI	Male		Female		Total	
	No.	%	No.	%	No.	%
Thin	9	52.9	8	47.1	17	8.3
Normal	46	45.1	56	54.9	102	50.0
Overweight	23	39.0	36	61.0	59	28.9
Obese	16	61.5	10	38.5	26	12.7

Table 3: Relationship between breakfast consumption with BMI status

Breakfast consumption	Normal BMI for age		Overweight and obese for age		χ^2 statistics (df)	p-value
	No.	%	No.	%		
Skipping breakfast	52	27.8	51	27.3	1.524 (1)	0.217 ^b
Taking breakfast everyday	50	26.7	34	18.2		

p-value^b = p-value>0.05, breakfast consumption are not significantly associated with BMI status

Table 4: Relationship between BMI classification and types of diet

Types of diet	Normal BMI for age		Overweight and obese for age		χ^2 statistics(df)	p-value
	No.	%	No.	%		
Healthy diet	58	31.0	36	19.3	3.905 (1)	0.048 ^a
Unhealthy diet	44	23.5	49	26.2		

p-value^a = p-value<0.05, types of diet are significantly associated with BMI classification

Table 5: Types of food

Healthy foods	Unhealthy foods
Cereals + milk	Frankfurters, balls, nuggets
Bread	Burger
Biscuits	Rice cooked in coconut milk
Kuih-muih	Fried noodles
Milk	Roti canai
Malted drinks	Fish crackers
White rice	Sweet drinks
Noodles in soup/ tom yam	Carbonated drinks
Chicken soup/ tom yam/ boiled	Banana fritters
Fish/ shellfish in soup/ tom yam/ boiled	Fried rice
Beef in soup/ tom yam/ boiled	Fried chicken
Boiled egg	Chicken curry / cooked in coconut milk
Vegetables	Fried fish/ shellfish
Fruits	Fish/shellfish curry/ cooked in coconut milk
	Fried beef
	Beef curry/ cooked in coconut milk
	Fried egg
	Egg in curry
	Fast foods
	Sweets
	Ice-cream
	Cakes
	Chocolate
	Snacks
	Instant noodles

among the children who skipped breakfast, 27.3% students were overweight and obese but however the p-value was not statistically significant.

Table 4 shows that 50.3% were taking healthy diet which was slightly higher compared to the students who took unhealthy diet (49.7%). From the Table 4 we can see that types of food intakes was related to BMI (p = 0.048) where the p-value is lower than 0.05. Table 5 shows the types of diet which were organized into two types of diet that are healthy diet and unhealthy diet. The types of diet were categorized by using scoring. The foods were identified either as healthy or unhealthy due to the nutrients contents, ingredients and methods of cooking and preparations. For unhealthy foods, they were minus scored as -1 and -2, where for unhealthy foods taken in one to two frequencies in a week were scored -1 while they were scored -2 if taken three to seven times in a week. While for healthy foods, they were scored 1 if taken one to two times in a week and 2 score if taken three to seven times in a week. Then the scores were added up and the median, maximum and minimum scores were identified to determine the cut-off point. The median scores was -14.00, the minimum was -51.00 and 19.00 for maximum. The cut-off for the types of diet are -51.00 to-

Table 6: Relationship between number of meals per day and BMI status

Number of meals day ⁻¹	Normal BMI for age		Overweight and obesity for age		χ^2 statistics (df)	p-value
	No.	%	No.	%		
Two times	20.9	39	12.3	23	7.161 (5)	0.209 ^b
Three times	20.9	39	20.3	38		
Four times	4.8	9	6.4	12		
Five times	3.2	6	3.7	7		
Six times	2.1	4	0.0	0		
Seven times and more	2.7	5	2.7	5		

^bp-value>0.05, number of meals day⁻¹ is not significantly associated with BMI status

14.00 is identified as unhealthy diet and the range between -13.90 to 19.00 is identified as healthy foods. The cut-off point was decided due to the minimum, maximum and median scores where the score in between minimum to median was decided as unhealthy diet and from median to maximum score was defined as healthy diet. Higher proportion (26.2%) of students who were taking unhealthy diet were obese and overweight were higher when compared to the students that took healthy. It indicates that the children who were taking unhealthy diet belonged to overweight and obese category.

Table 6 explains the relationship between meal frequencies with BMI status. It was reported that the highest percentage was having meals three times per day that was 41.2% and followed by eating twice per day, by percentage of 33.2%. Three times number of meals per day shows the highest prevalence of overweight and obesity (20.3%) while for six mealtimes; there were no overweight and obese. For the relationship between number of meals per day and BMI status in children, the finding did not show a significant association.

DISCUSSION

In this study, the overall percentage of overweight and obese students was high and alarming. Tee *et al.* (2002) conducted a study on 5,995 children aged 7 to 10 years in all primary schools in Kuala Lumpur and reported a prevalence of overweight of 9.7% among boys and 7.1% among girls. Koletzko *et al.* (2002) in their review reported that the prevalence of overweight and obesity among children kept on increasing. The finding from this study is in agreement with their reported.

Breakfast is the meal that is taken in the morning after waking up from bed and before getting to school. Breakfast is very important to take as skipping breakfast will lead to hunger and those who skip breakfast tend to eat more at lunch. Breakfast consumption is considered to be an important predictor to overweight and obesity in children.

However, in this study, there was no association between breakfast consumption and BMI among the primary school children. This finding is similar to the study done by Berkey *et al.* (2003) where breakfast skipping behavior did not cause excess weight gain in children and overweight children who skipped breakfast lost weight and reduced BMI over the follow up years. On the other hand, a cross sectional study conducted by Ming *et al.* (2006) in Kuala Lumpur which found that breakfast skipping was significantly associated with body mass index. They are among overweight students compare to those who took breakfast every day. Several cross-sectional studies done by Nicklas *et al.* (2000), Summerbell *et al.* (1996), Pastore *et al.* (1996), Wolfe *et al.* (1994) and Gibson and O'Sullivan, 1995) reported that frequency of eating breakfast was positively associated with

prevalence of excessive weight gain where heavier children took breakfast less often compared to leaner children.

Present finding was failed to show a significant association between breakfast skipping and excessive weight gain because of the lack of power (187 children) and this small number of subjects and thus reduced the power of study. Another reason could be because of the answers given by some of the children may not be reliable. The children in Year 1 may not be able to remember all the foods they eat and may not be able to answer the questions correctly. Berkey *et al.* (2003) stated that a longitudinal study conducted over a long period of time should be beneficial to find the correlation between breakfast intake and weight status rather than cross-sectional study since longer period will give the better effect and it could give stronger proof towards the findings. The finding is different may be due to the different range of ages of the subjects includes the different definition of breakfast skipping.

Many papers and reviews claimed that higher intake of unhealthy diet which is composed of especially high calorie, fat and sugar content will contribute to consumption of excess calorie thus lead to increase body weight and higher BMI.

This study found that types of food intakes was related to BMI ($p = 0.048$). Nicklas *et al.* (2003) also found that dietary pattern of sweetened beverages such as carbonated soft drinks, fruit flavor drinks, tea and coffee, sweets, poultry and intake of unhealthful foods was positively associated with occurrence of overweight and obesity in children. This was because, unhealthy diet was composed of foods with high calorie, high fat, high added sugar, processed food, high additives and was prepared in unhealthy food preparations for example fried foods and cooked in coconut milk. Gillis and Bar-Or (2003) in their study on obesity discovered that obese children and adolescents took more servings of meat and alternative, grain products, sugar-sweetened beverages, potato chips and foods away from home which contribute to elevated energy, fat and sugar intake when compared to children who were having normal BMI. Young and Nestle (2002) found that excess caloric consumption has been associated with high-fat foods, increased portion size and foods with high sucrose and fructose content.

Carbonated soft drinks were also included in the unhealthy eating and the consumption of carbonated beverages was being increased among children. Excess consumption of sweetened carbonated beverages was claimed to be the main contributing factor to greater calorie counts (Ludwig *et al.*, 2001) because carbonated soft drinks contain high added sugar and the high sugar content will contribute to excess total energy thus lead to increased body weight. Malik *et al.* (2006) in their review supported that most of the cross-sectional studies, especially the big ones, found a positive relationship between the intake of sugar-sweetened beverages and body weight. Fast foods consumption also had become epidemic among children where they took fast foods frequently that included burger, fried chicken, fries, pizza and other foods that were high in saturated fats, oils and sugar which lead to excess weight gain. Gonzalez-Suarez *et al.* (2009) stated that rising occurrence of childhood obesity is linked with increase availability and affordability of fast foods. Moreover, if they were eating out at fast food restaurants, they tend to take carbonated beverages which are high in sugar content since the fast food restaurant offered more carbonated soft drinks. Bowman *et al.* (2004) indicated that children and adolescents, who ate fast foods, compared with those who did not tend to have intake of more saturated fat, more total carbohydrate and additional sugar, fewer dietary fiber and more energy density.

The subjects in the present were having two session of school during morning and evening thus they were having morning tea and evening tea at their school cafeteria frequently. The school

cafeteria sold and served foods that were high in fat for example rice cooked in coconut milk, fried noodles, fish crackers, banana fritters, burger and sweet drinks. When eating away from home, either restaurant, or school cafeteria, they tend to take high fat, high calorie, energy-dense and sugary foods and beverages. The cafeteria usually reused the oil for several times and caused to increased saturated fat content in which the oil had been oxidized due to frequent usage. The oil supposed to be used for two times only. Eating away-from-home is recognized as a significant determinant of increased dietary intake and greater risk for obesity in which foods consumed outside from home are generally less healthful and larger in portion size (Ayala *et al.*, 2008). This was supported by Guthrie *et al.* (2002) found that away-from-home foods contained more calorie, elevated levels of total fat especially saturated fat, less amount of fiber, calcium and iron as well as higher content of sodium than foods cooked at home.

This study did not show any relationship between number of meals per day and the occurrence of overweight and obesity. This finding is supported by three recent studies done by Fabry *et al.* (1966) among 226 children and Nicklas *et al.* (2003) with 1562 students and Nicklas *et al.* (2004) with 1584 students. This was happened due to lack of sample power. It was similar to this study where the sample was only 187 students. It could also be due to unreliable answers from the young children who may not be able to remember the number of meals per day they take.

However, these findings were contradict to the cross-sectional study done among 4370 children by Toschke *et al.* (2005) who found that the number of meals per day significantly associated with body weight where the result showed that the prevalence of overweight and obesity decreased by increasing number of meals per day.

Our finding was opposite to the discovery of Toschke *et al.* (2005) due to lack of power compared to Toschke in their study used the large sample size. Different results might also be explained by differences in the age of children, description of meals, definition of overweight and obesity.

CONCLUSION

Types of food intake was showed to have a significant association with overweight and obesity status of selected primary school children but breakfast consumption and number of meals per day failed to have significant association. Further study should be done in future to clear the relationship between foods intake, number of meals per day and breakfast consumption with BMI status in children. As prevalence of obesity is increasing throughout the world, it has been suggested to prevent childhood obesity from early in life where obesity in children will lead to many medical complications and may predict obesity in later life. The children should watch out their diet and shift from unhealthy diet which is high in calorie, fat and sugar content to healthy diet. They must choose foods which are prepared in a healthy way and minimize consumption of fast foods and carbonated soft drinks. The intake of vegetable and fruits should be increase and they are advised to avoid skipping meals especially breakfast. Additionally, they must avoid sedentary lifestyle and increase physical activity. Parents, family, canteen caretakers, school's administration and the children themselves must play their own role in preventing and treating childhood obesity.

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