Association Between Ready-to-Eat Cereal Consumption and Anthropometric Status Among Primary School Children in Kuala Lumpur, Malaysia

Koo HC, Suriyani MY & Ruzita AT*

School of Healthcare Sciences, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia

ABSTRACT

Introduction: The consumption of ready-to-eat cereals (RTECs) has been associated with lower anthropometric status as well as a lower risk of childhood obesity. This relationship has not been investigated among school children in Malaysia. This study aimed to determine the association between consumption of RTECs and anthropometric status among primary school children in Kuala Lumpur. **Method:** In this cross-sectional study, a total of 208 school children aged 10 and 11 years were recruited from Kuala Lumpur, Malaysia. Information on socio-demographics, RTECs consumption and anthropometric measurements (height, weight and waist circumference) were obtained. **Results:** The overall median body mass index (BMI) and waist circumference (WC) were 17.95(IqR 6.45) kg/m^2 and 57.35 (IqR 13.00) cm, respectively. The majority of the children (73%) consumed RTECs. The prevalence of obesity was 23.1%, with more boys (31%) than girls (17.4%) being obese. Meanwhile, 16.8% of the children were overweight. BMI (U=3335.50, z=-2.278, p=0.023) and WC (U=3273.50, z=-2.440, p=0.015) of those who consumed RTECs were significantly lower than those who did not consume RTECs. Meanwhile, children who did not consume RTECs were significantly more likely to develop abdominal adiposity than those who consumed RTECS, χ^2(2, N=208) =7.61, p=0.022. **Conclusion:** Children who consumed RTECs have significantly lower BMI and WC, as well as a lower chance of developing abdominal adiposity. Consumption of RTECs indicates an overall healthy lifestyle with an excellent nutritional profile to promote healthy body weight in children and decreased risk of childhood obesity.

Key words: Anthropometric status, childhood obesity, ready-to-eat cereals, school children

INTRODUCTION

The prevalence of childhood obesity has been increasing over the decades from 4% in the 1960s to about 19.6% in 2007-2008 (National Centre for Health Statistics, 2010). The prevalence remains high despite the latest data indicating that this upward trend has reached a plateau. Different cut-off points using various criteria to define overweight and obesity have made comparisons between countries more difficult. Data from the 2009-2010 National Health and Nutrition Examination Survey (NHANES, 2011) indicate that about 32% of

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* Correspondence: Ruzita AT; Email: *rzt@medic.ukm.my*

children and adolescents aged 2 to 19 years are overweight with a body mass index (BMI) between the ≥85th percentile and <95th percentile or obese with BMI ≥95th percentile of the BMI-for-age growth chart (NHANES, 2011). Besides being one of the most challenging public health problems in developed countries, childhood obesity also presents a growing concern in developing countries. In Malaysia, the National Health & Morbidity Survey III (2008), which is based on the United States Center for Disease Control (CDC) weight-for-age growth reference 2000, estimated overweight prevalence among children aged 7-13 years at 5.4% (NHMS III, 2008). In five years, prevalence of childhood obesity had increased to 6.1% (NHMS IV, 2011). On the other hand, overweight prevalence among primary school-age children in Peninsular of Malaysia (based on the WHO 2007 reference) was reported at 20.7% in 2002, but increased to 26.5% in 2008 (Ismail et al., 2009). At the end of 2009, the problem of obesity in Malaysia continued to increase with a 6.6% increase among children aged 7 and 13.9% for the children aged 10 years old (Priya, 2010).

Diet is one of the lifestyle factors that contributes to adverse health conditions. Escalating prevalence of childhood obesity necessitates the identification of modifiable dietary factors in order to improve health status. Previous research supports the notion that ready-to-eat cereals (RTECs) improves children's overall nutritional well-being and lowers their risk of becoming overweight and obese (Frantzen et al., 2013). RTEC is one of the most popular breakfast choices and the leading source of whole grain in the diet of American children. Sixty one percent of Malaysian children reported consuming RTECs with milk as their breakfast (Sharifah Intan Zainun, Shamarina & Kandiah, 2013). Most RTECs are good sources of complex carbohydrates, low in fat and are fortified with vitamins and minerals (Cotton et al., 2004).

RTECs play a role in cutting down body fat, providing a consistent calorie intake, regulating eating habits and improving selection of more healthy food choices, which may all help in achieving or stabilising a lower body mass index (BMI) (Zemel, 2005). RTECs have been found to be inversely associated with BMI in child and adolescent populations (Albertson et al., 2009). Previous studies have demonstrated that those who consumed RTEC at breakfast had a statistically significant lower BMI and waist circumference (WC) compared to breakfast skippers (Brandy et al., 2009). Numerous studies from the West have proven that RTECs will help children improve their nutrient intake and maintain a healthy weight. However, information on the association between consumption of RTECs and anthropometric status among school children in Kuala Lumpur, Malaysia is limited. Thus, this present study was carried out to investigate the relationship between consumption of ready-to-eat cereals and anthropometric status among primary school children in Kuala Lumpur. We hypothesised that increased consumption of RTECs would lower the BMI and WC of school children.

METHODS

A cross-sectional study with a purposive sampling method was conducted among school children from six randomly selected primary schools located in Keramat, Pudu and Sentul Zone, Kuala Lumpur. Kuala Lumpur is the federal capital and the fastest growing region in Malaysia. Inclusion criteria were Malaysian primary school children of both sexes, aged 10 to 11 years with the ability to read, write and understand Malay. School children with mental or physical disabilities and those unable to read were excluded from the study. This study was approved by the Ministry of Education, Malaysia, Kuala Lumpur Federal Territory Education Department and the Ethics Committee of

Universiti Kebangsaan Malaysia. Parental written informed consent was obtained for all children prior to participation. Verbal consent was obtained from the children too before the study began in order to enable us to administer the questionnaires and acquire anthropometric measurements.

Sample size calculation indicated that 181 school children were required based on a desired confidence level of 95%, a relative precision of 5%, a predicted prevalence of 50% and a non-response rate of 20% (Krejcie & Morgan, 1970). A total of 208 school children were recruited into the study. Data collection was conducted by a trained investigator under the guidance of a lecturer. The children were assured that all the information collected would be kept strictly confidential.

The questionnaire was adapted with permission from Nutritional Status and Dietary Habits of Primary School Children in Peninsular Malaysia year 2001-2002 study (Ismail *et al.*, 2009). The self- administered questionnaire, written in the Malay language, consisted of two components: namely (i) the socio-demographics and (ii) consumption of RTECs. Information included was sex, ethnicity, parents'education level, household income, preferred canteen food, daily pocket money, breakfast habits, food choices for breakfast, frequency of breakfast intake, reasons for skipping breakfast, preference type of RTECs and consumption history of RTECs. The results and discussion on breakfast habit, food choices for breakfast, frequency of breakfast intake, reasons for skipping breakfast and preference type of RTECs will be published elsewhere (in press).

The body weight of each child was measured twice using a calibrated TANITA digital scale Model 300GS (TANITA, Cranlea & Co. Birmingham, England) and recorded to the nearest 0.1kg. The child was weighed barefoot with minimal clothing and in a pre-prandial state. The height of the child was measured twice using a portable stadiometer (Leicester, UK)

attached to a smooth wall and recorded to the nearest 0.1cm. Average value of the two readings was reported. BMI classification of children was based on the World Health Organisation (WHO) guideline (WHO, 2007). WC of children was measured using Lufkin W606PM at the site of 0.1 cm above the iliac crest when the child was at minimal respiration (NHANES III, 1996). WC percentile classification of children was based on a previous study (Poh *et al.*, 2011).

All statistical analyses were performed using the Statistic Package for IBM SPSS Version 20.0. The Kolmogorov Smirnov test was used to examine the normality distribution of each variable. Skewed data was presented as median and interquartile range. Mann Whitney test and Pearson's chi square test were applied to determine the relationship between anthropometric measurements and the consumption of RTECs. A two sided p value of < 0.05 was considered statistically significant.

RESULTS

A total of 208 school children aged 10 and 11 years were included in this study and their socio-demographic data are described in Table 1. In terms of gender breakdown, 58% were girls and 41.8% boys. The majority of the school children were Malays (92.8%), followed by Indians (4.8%) and other ethnic groups (2.4%). More than half of their parents had completed at most secondary education (mother: 58.3%; father 61.0%) and belonged to the middle to upper income household group (66.3%), based on the classification by the Malaysian Economic Planning Unit (2010).

The anthropometric measurements, body weight and WC status of the school children are shown in Table 2. The overall median BMI was 17.95 (IqR 6.45) kg/m2, ranging from 11.40 kg/m2 to 39.20 kg/ m2. More than half of the children had normal body weight status (55.3%), with more girls (61.1%) than boys (47.1%).

Table 1. Socio-demographics and characteristics of the children (n=208)

Variables	n (%)
Age	
10 years old	98 (47.1)
11 years old	110 (52.9)
Gender	
Male	87 (41.8)
Female	121 (58.2)
Ethnicity	
Malay	193 (92.8)
Indian	10 (4.8)
Others	5 (2.4)
Monthly family income	
> RM 5600	71 (34.1)
RM 2000 - 5600	67 (32.2)
< RM 2000	70 (33.7)
Education level of mother	
Graduate	30 (14.4)
Certificate/ diploma	40 (19.2)
Secondary school	121 (58.3)
Primary school	13 (6.2)
Not attended formal education	4 (1.9)
Education level of father	
Graduate	30 (14.4)
Certificate/ diploma	43 (20.7)
Secondary school	127 (61.0)
Primary school	6 (2.9)
Not attended formal education	2 (1.0)

Table 2. Anthropometric measurements, body weight and waist circumference status of the school children (n=208)

	Total (n=208), median (IqR)	Male (n=87), median (IqR)	Female (n=121), median (IqR)
Anthropometric			
Weight (kg)	34.00 (15.80)	35.00 (17.00)	33.00 (14.45)
Height (cm)	137.20 (12.63)	137.10 (11.30)	137.50 (14.00)
Body mass index (kg/m2)	17.95 (6.45)	18.20 (7.30)	17.70 (6.05)
Waist circumference (cm)	57.35 (13.00)	58.00 (16.90)	57.00 (12.30)
	Total (n=208), n (%)	Male (n=87), n (%)	Female (n=121), n (%)
Body mass index status			
Underweight	10 (4.8)	4 (4.6)	6 (5.0)
Normal	115 (55.3)	41 (47.1)	74 (61.1)
Overweight	35 (16.8)	15 (17.3)	20 (16.5)
Obesity	48 (23.1)	27 (31.0)	21 (17.4)
Waist circumference status			
< 25 percentile	69 (33.2)	28 (32.2)	41 (33.9)
25 – 90 percentile	110 (52.9)	46 (52.9)	64 (52.9)
> 90 percentile	29 (13.9)	13 (14.9)	16 (13.2)

This was followed by the prevalence of obesity (23.1%) with more boys (31%) than girls (17.4%) being obese. Sixteen percent of the children were overweight and only small proportions of the children were underweight (4.8%). Meanwhile, the overall median WC was 57.35 (IqR 13.00) cm. It was noted that majority of the children had normal WC (52.9%), while 33.2% had WC value below the 25th percentile. A minority of them had abdominal obesity. Neither body weight nor WC status was significantly different between boys and girls.

This present study demonstrated that a large proportion of the study children consumed RTECs (73.6%), with more girls (n=95) than boys (n=58) (Figure 1) consuming the products. Anthropometric measurements, body weight and WC status among two different groups consisting of those who consumed and those who did not consume RTECs are shown in Table 3. The overall median BMI and WC for those who consumed RTECs were 17.20 (IqR 6.40) kg/ m² and 56.00 (IqR 12.20) cm, respectively. Meanwhile, the overall median BMI and WC for those who did not consume RTECs were 18.70 (IqR 5.80) kg/m² and 58.90 (IqR 14.00) cm, respectively. The Mann Whitney test indicated that the BMI (U=3335.50, z=-2.278, p=0.023) and WC (U=3273.50, z=-2.440, p=0.015) of those who consumed RTECs were significantly lower than those who did not consume RTECs. The majority of the children who consumed RTECs had normal weight (58.2%), followed by obese (22.2%), overweight (14.4%) and underweight (5.2%). Meanwhile, 48.4% of the children who consumed RTECs had normal WC, followed by WC values below the 25th percentile (38.6%) while 13.0% had abdominal adiposity. Pearson's chi square test demonstrated that children who did not consume RTECs were significantly more likely to develop abdominal adiposity than those who consumed RTECS, χ^2(2, N=208) =7.61, p=0.022. However, no significant association was shown between RTECs consumption and body weight status.
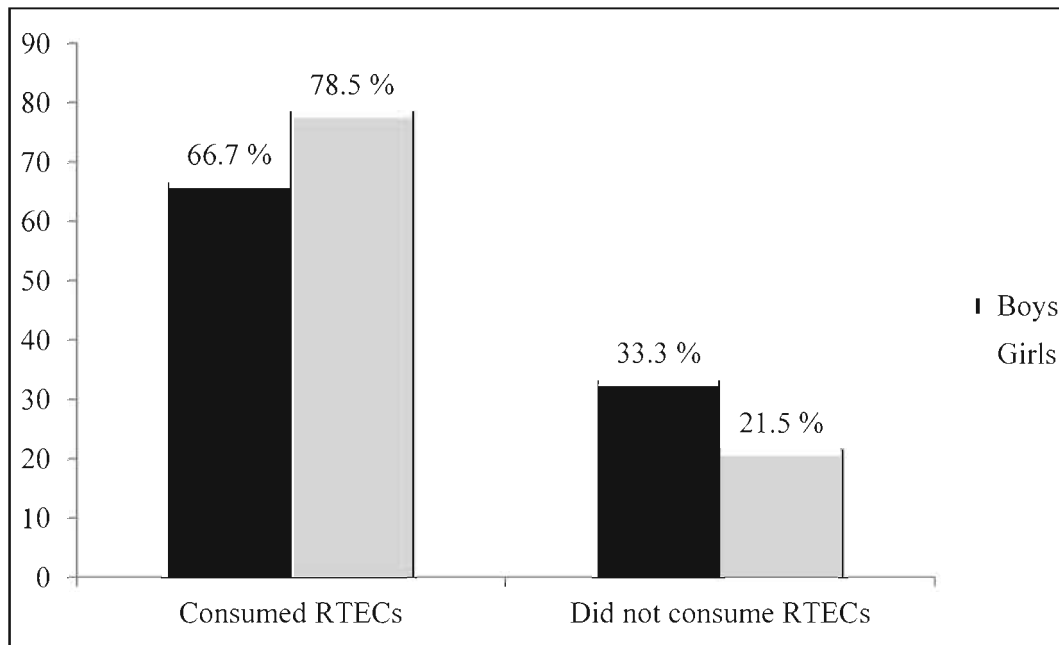

Figure 1. Ready-to-eat cereals consumption (n=208)

Table 3. Anthropometric measurements, body weight and waist circumference status of two different groups: those who consumed RTEC and those who did not

N=208	Consumed RTECs (n=153) median (IqR)	Did not consume RTECs (n=55) median (IqR)	P-value
Anthropometric			
Waist circumference (cm)	56 (12.20)	58.90 (14.00)	0.023[1]
Body mass index (kg/m2)	17.20 (6.40)	18.70 (5.80)	0.015[2]
	Consumed RTECs (n=153) n (%)	Did not consume RTECs (n=55) n (%)	
Body mass index status			0.344
Underweight	8 (5.2)	2 (3.7)	
Normal	89 (58.2)	26 (47.3)	
Overweight	22 (14.4)	13 (23.7)	
Obesity	34 (22.2)	14 (25.3)	
Waist circumference status			0.022[3]
< 25 percentile	59 (38.6)	10 (18.2)	
25 – 90 percentile	74 (48.4)	36 (65.5)	
> 90 percentile	20 (13.0)	9 (16.3)	

Abbreviation: RTECs= ready-to-eat cereals
[1] Mann-Whitney U test: U=3273.50, z=-2.440, p=0.015
[2] Mann-Whitney U test: U=3335.50, z=-2.278, p=0.023
[3] Chi square test: $\chi 2(2, N=208) = 7.61, p=0.022$

DISCUSSION

Socio-economic problems, poor response to healthcare treatment and the multiple complications of childhood obesity justify the need for effective prevention strategies (Geng *et al.*, 2009). This study showed no gender disparity in WC, which is in line with previous findings conducted among Pakistani children (Muhammad Umair Mushtaq *et al.*, 2011). WC has been proven to be a strong predictor of metabolic and cardiovascular disease risk in children (Rodriguez *et al.*, 2011). The overall prevalence of overweight and obesity in this present study (39.9%) was considerably high compared to the results found in the SEANUTS Malaysia study, which was representative of the national population of Malaysian children (21.6%) (Poh *et al.*, 2013). It was also higher compared to previous studies from Sarawak (33.4%) (Lee *et al.*, 2012) and Kelantan (13.1%) (Wan Abdul Manan,

Norazawati & Lee, 2012). This difference may be due to the fact that the majority of the children in this present study were from middle to upper income households, with 32.3% and 34.1% of the parents earning an income of RM2000-RM5600 and > RM5600 per month, respectively. This prevalence of overweight and obesity also exceeded the National Plan of Action for Nutrition of Malaysia II (NPANM II) which set a target of not more than 10% of obese school children from the age group 6 to 12 years by 2015 (MOH, 2005). Hence, a simple yet proper intervention which could be accepted easily by children and based on an adaptation of Malaysian Dietary guidelines is needed to combat the devastating problem of childhood obesity in Kuala Lumpur, which in turn is likely to bring down the risk of other chronic diseases in adulthood.

More than 11 million children in the United States are currently participating

in school breakfast programmes which highlight the importance of RTEC consumption in a school setting (Food Research & Action Center, 2011). It may be an indicator of an overall healthy lifestyle. In this study, more than half of the children (73.6%) reported consuming RTECs. However, it was considerably low compared to the previous study conducted among Malaysian children (87%) (Ismail *et al.*, 2009) and American children (90%) (Albertson *et al.*, 2009).

The relationship between consumption of RTECs and anthropometric measurements is complex. This present study showed that BMI of those who consumed RTECs was significantly lower than those who did not consume RTECs. It is in accordance with a study from Texas, which demonstrated that children who had a higher intake of RTECs had lower BMI (Frantzen *et al.*, 2013). Another study which sampled 660 children revealed that a lower BMI was correlated with more days of RTECs consumption (Albertson *et al.*, 2009). This relationship may be due to a healthy eating habit and nutrient profile as RTECs are a source of whole grain and dietary fibre (Albertson *et al.*, 2009). Besides, RTECs are most frequently consumed with milk, which is a good source of dietary calcium. Calcium has been shown to modulate circulating calcitriol (1, 25-dihydroxyvitamin D) levels that in turn regulate intracellular calcium which affects fat metabolism by reducing the levels of lipogenesis in human adipocytes and increasing both fat oxidation and faecal fat excretion (Zemel, 2005). A portion of this additional anti-obesity bioactivity is attributable to the inhibition of angiotensin-converting enzyme activity by dairy foods and the rich concentration of branched-chain amino acids which act synergistically with calcium to attenuate adiposity (Zemel, 2005). Hence, a regular intake of RTEC will benefit from the above mentioned mechanism (Albertson *et al.*, 2003). Moreover, milk proteins,

especially whey proteins, have been shown to be positively correlated with satiety (Dougkas, Reynolds & Givens, 2011). An increase in satiety, reduces an over-eating pattern while lower fat content of the RTECs may help in maintaining a favorable energy balance and ultimately a favorable BMI (Albertson *et al.*, 2009). However, no significant association was shown between consumption of RTECs with the body weight status of the participants in this study. One possible reason for the non significant result was the relatively small sample size (n=208), leading to inadequate power to make reliable body weight status comparisons.

This present study showed that WC of children who did not consume RTECs was significantly greater than those who consumed RTECs. It is in accordance with a previous study which was conducted among African American children (William *et al.*, 2008). A previous study revealed that WC was associated with visceral adipose tissue and is an independent risk factor for insulin resistance, hyperinsulinaemia, dyslipidamia and hypertension (Wajchenberg, 2000). Milk compounds may be involved in body fat distribution too. Visceral adipose tissue has been described as having greater amounts of 11-β-hydroxysteroid dehydrogenase type 1 (Morris & Zernel, 2005), which is over-expressed *in vitro* in those with central adiposity (Masuzaki, Paterson & Shinyama, 2001). High calcium or a high dairy diet will down-regulate 11-β-hydroxysteroid dehydrogenase type 1 expression and decreases the concentration of glucocorticoid, which consequently decreases the size of adipose fat deposits (Morris & Zernel, 2005).

Some limitations of this present study are acknowledged. As this is a cross-sectional study, no causal relationship can be established from the observed association. Furthermore, only WC was used to measure central adiposity in this study; visceral fat was excluded. There are

some sophisticated methods of accurately measuring visceral fat, such as dual-energy X-ray absorptiometric densitometry and MRI. However, such techniques were not feasible due to their complexity, time consuming nature and expenses incurred.

CONCLUSION

Children who consumed RTECs were found to have significantly lower BMI and WC, as well as a lower probability of developing abdominal adiposity. Consuming RTECs leads to an overall healthy lifestyle, as RTECs possess an excellent nutritional profile. RTECs are also a component of an eating pattern that promotes the maintenance of healthy body weight in children. Randomised controlled trials or prospective investigations are needed in the future to develop a RTECs intervention programme to manage overwhelming childhood obesity in Malaysia.

ACKNOWLEDGEMENTS

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