

Original Article

Breakfast consumption among Malaysian primary and secondary school children and relationship with body weight status – Findings from the MyBreakfast Study

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Background and Objectives: This study aimed to determine the relationship between breakfast consumption and body weight status among primary and secondary school children in Malaysia. **Methods and Study Design:** This nationwide cross-sectional study involved 5,332 primary school children aged 6 to 12 years and 3,000 secondary school children aged 13 to 17 years. Height and weight were measured and BMI-for-age was determined. Socio-demographic backgrounds, breakfast habits and physical activity levels were assessed using questionnaires. Breakfast frequency was defined as follows: breakfast skippers (ate breakfast 0-2 days/week), irregular breakfast eaters (ate breakfast 3-4 days/week) and regular breakfast eaters (ate breakfast ≥ 5 days/week). **Results:** The overall prevalence of breakfast skippers and irregular breakfast eaters was 11.7% and 12.7% respectively. Breakfast skipping was related to age, sex, ethnicity, income and physical activity level. Among primary school boys and secondary school girls, the proportion of overweight/obesity was higher among breakfast skippers (boys: 43.9%, girls: 30.5%) than regular breakfast eaters (boys: 31.2%, girls: 22.7%). Among primary school children, only boys who skipped breakfast had a higher mean BMI-for-age z-score than regular breakfast eaters. Among secondary school boys and girls, BMI-for-age z-score was higher among breakfast skippers than regular breakfast eaters. Compared to regular breakfast eaters, primary school boys who skipped breakfast were 1.71 times (95% CI=1.26-2.32, $p=0.001$) more likely to be overweight/obese, while the risk was lower in primary school girls (OR=1.36, 95% CI=1.02-1.81, $p=0.039$) and secondary school girls (OR=1.38, 95% CI=1.01-1.90, $p=0.044$). **Conclusion:** Regular breakfast consumption was associated with a healthier body weight status and is a dietary behaviour which should be encouraged.

Key Words: breakfast consumption, physical activity, body weight status, children, Malaysia

INTRODUCTION

Childhood obesity is a major public health issue in both developed and developing countries across the world. Between 1980 to 2013, it has been estimated that the prevalence of overweight and obesity in boys and girls has increased by about 60% in developing countries (in-

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creasing from 8.1% to 12.9% in boys and from 8.4% to 13.4% in girls) and by about 30% in developed countries (increasing from 16.9% to 23.8% in boys and from 16.2% and to 22.6% in girls).¹ The most recent estimates of overweight and obesity among Malaysian children and adolescents are more reflective of rates in developed countries. A nationwide survey conducted between 2010 and 2011 found that 9.8% and 11.8% of children aged 6 months to 12 years old were overweight and obese respectively,² while the 2012 Malaysia School-Based Nutrition Survey (MSNS) reported that 14.6% and 12.3% of children aged 10-17 years were overweight or obese respectively.³

It is well established that overweight children are more likely to become overweight adults which in turn increases their risk of non-communicable diseases later in life.⁴ Therefore it is critical that modifiable dietary, lifestyle and environmental factors contributing to obesity in Malaysian children are identified. One such potential modifiable risk factor which has been investigated in other populations is the consumption of the breakfast meal. Several cross sectional studies across the world have reported an inverse relationship in both children and adolescents between breakfast skipping and BMI,^{5,6} waist circumference,^{5,7,8} fat mass⁹⁻¹¹ and prevalence of overweight or obesity^{7,8} in both children and adolescents. A small number of longitudinal studies in children and young adults tend to support the cross-sectional data¹²⁻¹⁴ but strong evidence for a casual role of breakfast skipping in obesity is currently lacking.¹⁵ In Asia-Pacific populations, the association between breakfast consumption and body-weight has been explored in a recent meta-analysis of nineteen cross sectional studies in the region involving over 90,000 participants.¹⁶ The pooled odds ratio of overweight or obesity was 1.75 (CI 1.57-1.95) for the lowest versus the highest category of breakfast consumption.¹⁶ However significant between-study heterogeneity was noted. Few studies have examined this relationship specifically among Malaysian children and at the national level. In a small study of 236 adolescents aged 12 to 19 years in the north eastern region of Malaysia, a significantly lower body weight, BMI, BMI z-scores, waist circumference, body fat mass and percent body fat was observed among children who ate breakfast at least 5 days per week compared to those eating breakfast less than 5 days per week.¹⁷ Two large national surveys in 2008 and 2012 indicate that breakfast skipping is very prevalent among Malaysian children and adolescents respectively.^{3,18} Of the children aged 6 to 12 years, 32% reported skipping breakfast at least once per week,¹⁸ while as many as 72% of the adolescents (10-17 years) skipped at least once per week.³ Furthermore among the adolescents, 16.4% reported skipping daily and 24% skipped 4-6 times per week.³ Lack of time was found to be the most common reason for skipping breakfast in a study conducted in eight Asian countries, namely Japan, Korea, Thailand, Malaysia, Singapore, Hong Kong, Philippines and Indonesia.¹⁹ Similarly, lack of time was cited as the main reason for the shift in traditional breakfasts, including rice, wheat and rice noodles, soup and egg, to western style breakfasts such as breads and cereals, which are more convenient.¹⁹

In light of the national data indicating a high prevalence of both obesity and breakfast skipping in Malaysian children, there is a need to investigate this relationship further. Therefore, the aim of the present study was to determine the frequency of breakfast consumption and its association with body weight status among a large cross sectional nationwide sample of Malaysian children and adolescents aged 6 to 17 years, namely the MyBreakfast Study.

PARTICIPANTS AND METHODS

Study design and participants

The MyBreakfast Study was a cross-sectional study involving primary and secondary school children aged 6 to 17 years in Malaysia. Participants were selected using a multistage sampling method based on geographical location and ethnic groups distribution. The sample size was calculated based on the total population of children aged 6 to 17 years in Malaysia derived from the Population and Housing Census 2010.²⁰ This represents a population size of 3,414,906 children aged 6-12 years and 2,521,688 children aged 13-17 years. From census data, the percentage of children required to represent each of the five regions, including Northern, Southern, East Coast, Central region and East Malaysia were first determined. The proportions of children in the urban and rural areas of each state of the regions were then calculated and the proportion of the main ethnic groups, namely Malay, Chinese, Indian and Sabah/Sarawak natives in the urban and rural areas of each of the regions were determined. A standardized ratio of 1:1 for gender was used to determine the number of boys and girls required for each ethnicity in the urban and rural area and equal numbers of children aged 6-17 years were invited to participate. Further details of the sampling procedure have been provided in an earlier publication from this research project.²¹ Inclusion criteria were Malaysian school children and adolescents aged 6 to 17 years old, without any diagnosed physical disabilities or learning difficulties and the children must be present in school on the day of assessment.

Fifty-six urban and 28 rural primary and secondary schools were randomly selected based on the list of public primary and secondary school register in each of the states as of 31st of January 2011.²² For each school, 2 to 3 classes of Primary 1 to Primary 5, and Secondary 1, 2 and 4 were randomly selected. Primary 6 and Secondary 3 and 5 were not selected in the study because permission was not granted for children who were candidates of the 3 national level examinations. A total of 13,694 children were invited to participate in the study and 9,369 children agreed to participate, thus the response rate was calculated at 68.4%. Of the 9,369 participants who agreed to take part, 1,037 had incomplete anthropometric data or did not complete the questionnaires and were removed from the analyses resulting in a final sample size of 8,322. The percentage of incomplete data was 3.5% among the primary school children and 12.8% among the secondary school children.

Ethical approval was obtained from Universiti Kebangsaan Malaysia Research Ethics Committee (UKMREC) (UKM 1.5.3.5/244/NN-116-2013) and was conducted in accordance with the Declaration of Helsinki. Permission

to conduct the study was obtained from the Ministry of Education Malaysia and State Department of Education of all the states involved. A study information sheet was sent to parents together with a standard consent form provided by UKMREC. For primary school children, a written consent was obtained from parents, while for secondary school children written consents were obtained from both parents and children. A verbal explanation about the study was also given to the children prior to the study.

Data collection procedure

Data collection was conducted from April to October 2013. Firstly, a study information sheet, consent form and a questionnaire on socio-demographic background were sent to parents. Parents were given one week to return the consent form as well as the socio-demographic questionnaire if they agreed to participate. Anthropometric measurements of the children were conducted in school. Questionnaires on breakfast habits and physical activity were self-administered with assistance to children aged 10 years and above in their classroom. For children aged 6 to 9 years, the questionnaires were answered by their parents and collected at school the following day. A brief instruction about the questionnaire was sent to the parents through short messaging system (SMS). Parents were encouraged to contact the researcher if they need any assistance on the questionnaire. The completeness of the questionnaire was checked once collected. For children aged 10 years and above, the incomplete parts were interviewed and completed on the spot. For children aged 6 to 9 years, all incomplete questionnaires were returned to their parents with a note on the part where they had missed along with an SMS to inform about the missing part. The questionnaires were then re-collected on the next schooling day. There were two versions of the questionnaires, one was in Bahasa Malaysia and the other was in Mandarin. For children in the national type schools, questionnaires in Bahasa Malaysia were administered, and Mandarin questionnaires were given upon request. For children in the Chinese vernacular schools, Mandarin questionnaires were administered, and questionnaires in Bahasa Malaysia were given upon request.

Socio-demographic background

Data on socio-demographic background including the child's date of birth, sex, ethnicity, parents' education level and monthly household income were obtained from parents through a self-administered questionnaire.

Anthropometric measurements

Height and weight of the children were measured in schools by trained nutritionist using standard procedures. Children were asked to empty their pocket and take off their shoes for the measurements. Height was measured using SECA stadiometer (SECA 217, Germany) to the nearest 0.1 cm, while weight was measured using SECA digital weighing scale (SECA Clara 803, Germany) to the nearest 0.1 kg. All measurements were taken twice and for each measurement, the mean value was used in the analyses. Body mass index (BMI) was calculated by using the formula $BMI = \text{weight (kg)}/\text{height}^2 \text{ (m)}$. Z-scores for BMI-for-age were determined using WHO An-

throPlus Version 1.0.3 software²³ and categorized using WHO Growth Reference 2007.²⁴ The cut-off points for thinness and severe thinness were -2SD and -3SD respectively, while the cut-off points for overweight and obesity were +1SD and +2SD respectively.²⁴

Physical activity

Physical activity was assessed using the Physical Activity Questionnaire for Children (PAQ-C) and Physical Activity Questionnaire for Older Children (PAQ-A).^{25,26} For children aged 6 to 9 years, the PAQ-C was completed by parents while for children aged 10 years and above, the PAQ-C (10-13 years) and PAQ-A (14-17 years) were self-administered at school during the data collection. The questionnaires were translated into Bahasa Malaysia and the type of physical activity was adapted to suit the Malaysian context, for example, ice hockey, cross-country skiing and ice skating were removed, and activities such as table tennis and martial arts were added. The PAQ-C and PAQ-A are self-administered seven-day recall questionnaires designed to assess moderate to vigorous physical activity (MVPA) in school-aged children during school hours and in their spare time. Physical activity was defined as sports and activities that make the child sweat, make their legs feel tired, or make them breathe hard. The PAQ-C consists of 9 items and PAQ-A consists of 8 items scored on a 5-point scale which were averaged to give an overall physical activity score ranging from one to five, with higher scores indicating higher levels of physical activity. Physical activity level was categorized as low, moderate and high by dividing the mean scores into tertiles. A score of 1.00–2.33 was categorized as low, 2.34–3.66 as moderate and 3.67–5.00 as high physical activity level.

Breakfast habits questionnaire

In this study, breakfast was defined as the first eating occasion after an overnight sleep until 10 am during weekdays or until 11 am during weekends, which was similar to the definition of breakfast used in other studies.²⁷⁻³⁰ The definition of breakfast was included on the first page of the questionnaire and was also read by the trained fieldworkers. The breakfast habits questionnaire includes questions on breakfast frequency, location and types of foods and beverages usually consumed at breakfast. Breakfast frequency was assessed through an open-ended question on 'how many times do you usually take breakfast in a week?'. The responses ranged from 0 to 7 days a week. Breakfast frequency was then categorized into three groups, namely breakfast skippers (ate breakfast 0-2 days/week), irregular breakfast eaters (ate breakfast 3-4 days/week) and regular breakfast eaters (ate breakfast 5-7 days/week). Similar categories of breakfast consumption were used by So et al. (2011) in their study on Hong Kong Chinese children.¹¹

Statistical analysis

Data were analyzed using SPSS software version 19 (IBM Corp., USA). All univariate analyses were conducted using descriptive statistics. The relationship between categorical variables and breakfast consumption groups were examined using chi-square tests, while the rela-

Table 1. Demographic characteristics, body weight status and physical activity levels of the study participants

Characteristics		Total	Primary school	Secondary school
		(<i>n</i> =8322)	(<i>n</i> =5322)	(<i>n</i> =3000)
		<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Age groups (years)	6–9	2990 (35.9)	2990 (56.2)	-
	10–12	2332 (28.0)	2332 (43.8)	-
	13–15	2367 (28.4)	-	2367 (78.9)
	16–17	633 (7.6)	-	633 (21.1)
Sex	Boys	3848 (46.2)	2401 (45.1)	1446 (48.2)
	Girls	4474 (53.8)	2920 (54.9)	1554 (51.8)
Area	Urban	5678 (68.2)	3588 (67.4)	2090 (69.7)
	Rural	2644 (31.8)	1734 (32.6)	910 (30.3)
Ethnicity	Malay	5079 (61.0)	3403 (63.9)	1676 (55.9)
	Chinese	1561 (18.8)	905 (17.0)	656 (21.9)
	Indian	671 (8.1)	386 (7.3)	285 (9.5)
	Sabah/Sarawak native	953 (11.5)	582 (10.9)	371 (12.4)
	Others	58 (0.7)	46 (0.9)	12 (0.4)
Father's education level [†]	Primary education and below	586 (7.6)	352 (7.0)	234 (8.6)
	Secondary education	4483 (57.9)	2861 (56.8)	1622 (59.9)
	Tertiary education	2672 (34.5)	1821 (36.2)	851 (31.4)
Income group [‡]	Low (<RM1500/mth)	2811 (35.2)	1696 (32.8)	1115 (39.7)
	Middle (RM1500-7500/mth)	4382 (54.9)	2943 (56.9)	1439 (51.2)
	High (>RM7500/mth)	793 (9.9)	537 (10.4)	256 (9.1)
Body weight status [§]	Severely thin and thin	539 (6.5)	366 (6.9)	173 (5.8)
	Normal	5419 (65.1)	3453 (64.9)	1966 (65.5)
	Overweight	1164 (14.0)	800 (13.2)	464 (15.5)
	Obese	1200 (14.4)	803 (15.1)	397 (13.2)
Physical activity level [¶]	Low	2903 (34.9)	1501 (28.2)	1402 (46.7)
	Moderate	4757 (57.2)	3327 (62.5)	1430 (47.7)
	High	662 (8.0)	494 (9.3)	168 (5.6)

[†]Father's education level (Total, *n*=7741; Primary school, *n*=5034; Secondary school, *n*=2707).

[‡]Income group (Total, *n*=7986; Primary school, *n*=5176; Secondary school, *n*=2810)

[§]Based on BMI-for-age z-score: Severely thin and thin (z-score<-2SD); Normal (-2SD≤z-score≤+1SD); Overweight (+1SD<z-score≤+2SD) and obese (z-score >+2SD).

[¶]Based on tertile scores of the Physical Activity Questionnaire for Children (PAQ-C) and Physical Activity Questionnaire for Older Children (PAQ-A): Low (1.00-2.33); Moderate (2.34-3.66); High (3.67-5.00).

relationship between continuous variables and breakfast consumption groups were examined using analysis of covariates (ANCOVA) controlling for potential confounders including sex, ethnicity, father's education level, income and physical activity. Bonferroni post hoc test was used to examine multicomparisons between groups. Binary logistic regression was performed using the hierarchical method to determine the likelihood of being overweight/obese by breakfast consumption habits, where variables were entered sequentially with potential confounders entered in the first block and breakfast consumption groups in the second block. The results are presented by odds ratios and 95% confidence intervals. Significance level was determined at $p < 0.05$.

RESULTS

Table 1 shows the demographic characteristics, body weight status and physical activity levels of the participants. A total of 5,322 primary school children aged 6 to 12 years ($M=9.12$, $SD=1.66$) and 3000 secondary school children aged 13 to 17 years ($M=14.18$, $SD=1.16$) participated in the study. The proportions of boys (46.2%) and girls (53.8%) in this study were similar and the majority of the children were from urban areas (68.2%). The percentage of Malay, Chinese, Indian and Sabah/Sarawak natives children was 61.0%, 18.8%, 8.1% and 11.5% respectively. Most of the fathers of these children (57.9%)

attained secondary education and more than 50% of the children came from middle income families (RM1500-7500/month). Among 6-12 year olds, the prevalence of overweight and obesity was 13.2% and 15.1% respectively, whereas among the adolescents, the prevalence of overweight and obesity were 15.5% and 13.2% respectively. Approximately one third of the primary school children and half of the secondary school children were classified as having a low physical activity level.

The proportions of the children who were classified as breakfast skippers (ate breakfast 0–2 days/week), irregular breakfast eaters (ate breakfast 3–4 days/week) and regular breakfast eaters (ate breakfast 5–7 days/week) by socio-demographic factors are outlined in Table 2. The proportions of breakfast skippers and irregular breakfast eaters were significantly higher among secondary school children (15.9% and 16.0% respectively) than primary school children (9.3% and 10.8% respectively) ($p < 0.001$). Breakfast skipping and irregular breakfast consumption were more prevalent among girls, Malays and Sabah/Sarawak natives, children of lower educated fathers and children from low income families ($p < 0.001$). There was no significant difference in the percentage of breakfast skippers between the urban and rural areas of the study ($p=0.551$).

Table 3 outlines body weight status and physical activity levels according to breakfast consumption frequency in

Table 2. Frequency of breakfast consumption according to socio-demographic background

No. of days of breakfast consumption	Total	Breakfast skippers 0-2 days	Irregular breakfast eaters 3-4 days	Regular breakfast eaters 5-7 days	<i>p</i> -value [§]
	<i>n</i>	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
Total sample	8322	972 (11.7)	1053 (12.7)	6297 (75.7)	
Age group					<0.001
Primary school (6–12 y)	5322	495 (9.3)	574 (10.8)	4253 (79.9)	
Secondary school (13–17 y)	3000	477 (15.9)	479 (16.0)	2044 (68.1)	
Sex					<0.001
Boys	3848	394 (10.2)	450 (11.7)	3004 (78.1)	
Girls	4474	578 (12.9)	603 (13.5)	3293 (73.6)	
Ethnicity					<0.001
Malay	5079	663 (13.1)	725 (14.3)	3691 (72.7)	
Chinese	1561	122 (7.8)	104 (6.7)	1335 (85.5)	
Indian	671	74 (11.0)	59 (8.8)	538 (80.2)	
Sabah/Sarawak native	953	110 (11.5)	162 (17.0)	681 (71.5)	
Others	58	3 (5.2)	3 (5.2)	52 (89.7)	
Area					0.551
Urban	5678	660 (11.6)	704 (12.4)	4314 (76.0)	
Rural	2644	312 (11.8)	349 (13.2)	1983 (75.0)	
Father's education level [†]					<0.001
Primary and below	586	76 (13.0)	80 (13.7)	430 (73.4)	
Secondary	4483	566 (12.6)	604 (13.5)	3313 (73.9)	
Tertiary	2672	245 (9.2)	267 (10.0)	2160 (80.8)	
Income group [‡]					<0.001
Low	2811	387 (13.8)	407 (14.5)	2017 (71.8)	
Middle	4382	474 (10.8)	512 (11.7)	3396 (77.5)	
High	793	73 (9.2)	67 (8.4)	653 (82.3)	

[†]No formal education and primary education were grouped as primary and below.

[‡]Monthly household income of <RM1500/mth was grouped as low, RM1500-7500/mth were grouped middle and >RM7500/mth were grouped high income group.

[§]*p*-values are based on chi-square tests between frequency of breakfast consumption groups and characteristics of the children. *p*<0.05 was considered statistically significant.

primary and secondary school children by sex. Overall, among primary school children the proportion of overweight and obesity was higher among breakfast skippers (34.7%) and irregular breakfast eaters (30.8%) compared to regular breakfast eaters (27.1%) (*p*=0.004). Analysis by sex however shows that this relation was only significant for boys (*p*=0.001) and not for girls (*p*=0.457). The overall proportion of children with moderate or high physical activity levels was higher in those eating breakfast regularly compared to less frequent eaters (*p*=0.001). When split by gender this relationship was only significant for girls (*p*=0.006). A similar relationship between proportion of overweight and obesity children and frequency of breakfast consumption was observed for secondary school children (*p*=0.023). However in contrast to primary school children, analysis by sex revealed that the relationship was only significant for girls. More notably among the secondary school children, the overall proportion of children with low physical activity was significantly higher among breakfast skippers (57.9%) (*p*<0.001) compared to regular breakfast eaters (43.7%) which appeared to be driven more by the female adolescents (*p*=0.002) than males (*p*=0.068).

Figure 1a shows the distribution of mean *z*-scores for the BMI-for-age by sex and breakfast consumption group among the primary school children, while Figure 1b shows the distribution among secondary school children. After data adjustment for age, sex, ethnicity, father's education level, monthly household income and physical activity, primary school boys who skipped breakfast

were found to have a significantly higher mean BMI-for-age *z*-score (*M*=0.5, *SD*=1.8) compared to regular breakfast eaters (*M*=0.1, *SD*=1.6) (*p*<0.001). Primary school boys who consumed breakfast irregularly were also found to have a significantly higher BMI-for-age *z*-score (*M*=0.2, *SD*=1.6) than those who consumed breakfast regularly (*M*=0.1, *SD*=1.6) (*p*<0.001). However there was no significant difference observed between boys who skipped breakfast and boys who consumed breakfast irregularly, and there was also no significant difference in BMI-for-age *z*-score among primary school girls in all three categories (*p*>0.05). Among secondary school children, BMI-for-age *z*-score was significantly higher among breakfast skippers for both boys (*M*=0.5, *SD*=1.5, *p*=0.043) and girls (*M*=0.3, *SD*=1.4, *p*<0.001) than those who consumed breakfast regularly (boys, *M*=0.2, *SD*=1.6; girls, *M*=-0.004, *SD*=1.3). BMI-for-age *z*-score was also significantly higher among girls who consumed breakfast irregularly (*M*=0.2, *SD*=1.3) than those who consumed breakfast regularly (*M*=-0.004, *SD*=1.3) (*p*<0.001), but there was no significant difference in the BMI-for-age *z*-score between irregular and regular breakfast eaters among the secondary school boys (*p*>0.05).

Overweight and obesity were grouped as overweight/obese in the logistic regression analysis. After adjusting for socio-demographic background which included age, sex, ethnicity, father's education level and monthly household income, and physical activity, the overall risk among primary and secondary school children combined of being overweight or obese was 1.47

Table 3. Body weight status and physical activity level of the primary and secondary school children by sex and breakfast consumption habits

No. of days of breakfast consumption [†]	Boys (N=3848)			p value [§]	Girls (N=4474)			p value [§]	Total (N=8322)			p value [§]
	0-2 days n (%)	3-4 days n (%)	5-7 days n (%)		0-2 days n (%)	3-4 days n (%)	5-7 days n (%)		0-2 days n (%)	3-4 days n (%)	5-7 days n (%)	
Primary school	218 (9.1)	235 (9.8)	1949 (81.1)	0.001	277 (9.5)	339 (11.6)	2304 (78.9)	0.457	495 (9.3)	574 (10.8)	4253 (79.9)	0.004
Body weight status [†]												
Severely thin/thin	14 (6.4)	11 (4.7)	155 (86.1)		18 (6.5)	24 (7.1)	144 (6.3)		32 (6.5)	35 (6.1)	299 (7.0)	
Normal	110 (50.5)	134 (57.0)	1186 (60.9)		181 (65.3)	228 (67.3)	1614 (70.1)		291 (58.8)	362 (63.1)	2800 (65.8)	
Overweight/obese	94 (43.9)	90 (38.3)	608 (31.2)	0.356	78 (28.2)	87 (25.7)	546 (23.7)	0.006	172 (34.7)	177 (30.8)	1154 (27.1)	0.001
Physical activity level [‡]												
Low	55 (25.2)	57 (24.3)	422 (21.7)		108 (39.0)	129 (38.1)	730 (31.7)		163 (32.9)	186 (32.4)	1152 (27.1)	
Moderate/high	163 (74.8)	178 (75.7)	1527 (78.3)		169 (61.0)	210 (61.9)	1574 (68.3)		332 (67.1)	388 (67.6)	3101 (72.9)	
Secondary school	176 (12.2)	215 (14.8)	1055 (73.0)	0.205	301 (19.4)	264 (17.0)	989 (63.6)	0.049	477 (15.9)	479 (16.0)	2044 (68.1)	0.023
Body weight status [†]												
Severely thin/thin	7 (4.0)	12 (5.6)	75 (7.1)		14 (4.7)	11 (4.2)	54 (5.5)		21 (4.4)	23 (4.8)	129 (6.3)	
Normal	101 (57.4)	130 (60.5)	652 (61.8)		195 (64.8)	178 (67.4)	710 (71.8)		296 (62.1)	308 (64.3)	1362 (66.6)	
Overweight/obese	68 (38.6)	73 (33.9)	328 (31.1)	0.068	92 (30.5)	75 (28.4)	225 (22.7)	0.002	160 (33.5)	148 (30.9)	553 (27.1)	<0.001
Physical activity level [‡]												
Low	71 (40.3)	73 (34.0)	333 (31.6)		205 (68.1)	160 (60.6)	560 (56.6)		276 (57.9)	233 (48.6)	893 (43.7)	
Moderate/high	105 (59.7)	142 (66.0)	722 (68.4)		96 (31.9)	104 (39.4)	429 (43.4)		201 (42.1)	246 (51.4)	1151 (56.3)	

[†]Based on BMI-for-age z-score: Severely thin and thin (z-score<-2SD); Normal (-2SD≤z-score≤+1SD); Overweight and obese (z-score>+1SD).

[‡]Based on tertile scores of the Physical Activity Questionnaire for Children (PAQ-C) and Physical Activity Questionnaire for Older Children (PAQ-A): Low (1.00-2.33); Moderate and high (2.34-5.00).

[§]p-values are based on chi-square tests of body weight status and physical activity level by breakfast consumption habits. P<0.05 was considered statistically significant.

[¶]0-2 days (Breakfast skippers); 3-4 days (Irregular breakfast eaters); 5-7 days (Regular breakfast eaters).

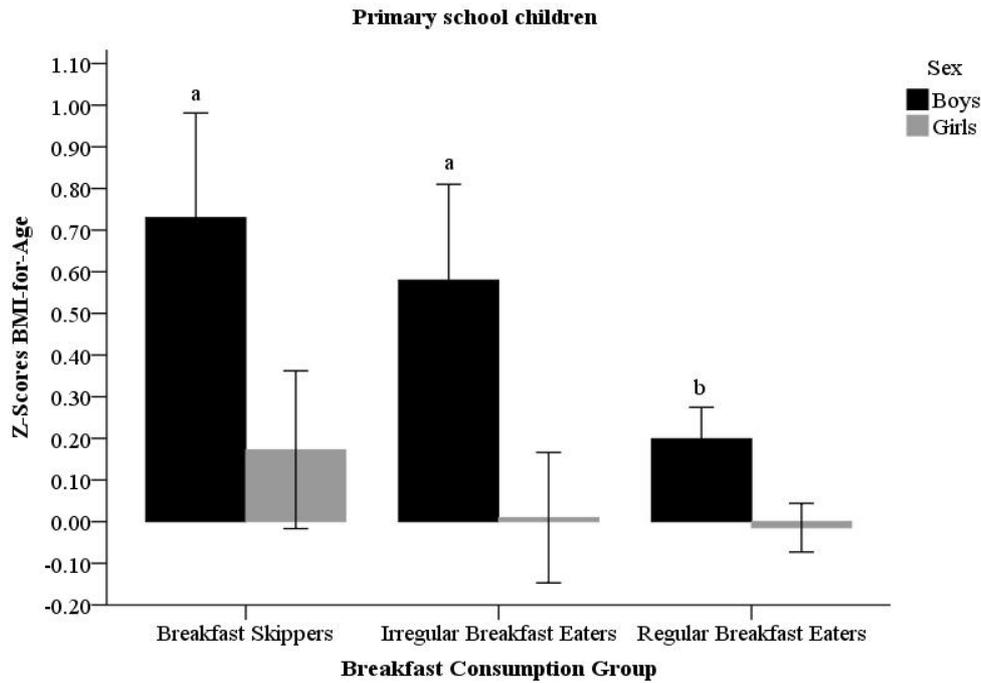


Figure 1a. BMI-for-age z-scores by sex and breakfast consumption group among the primary school children. ^{a,b} Different alphabets denote significant difference, $p < 0.05$ was considered statistically significant. For boys the p -value was < 0.001 and for girls, $p = 0.088$. Data were adjusted for age (years), ethnicity, father’s education level, monthly household income and physical activity scores using ANCOVA comparing mean z-scores for BMI-for-age among breakfast consumption groups by sex.

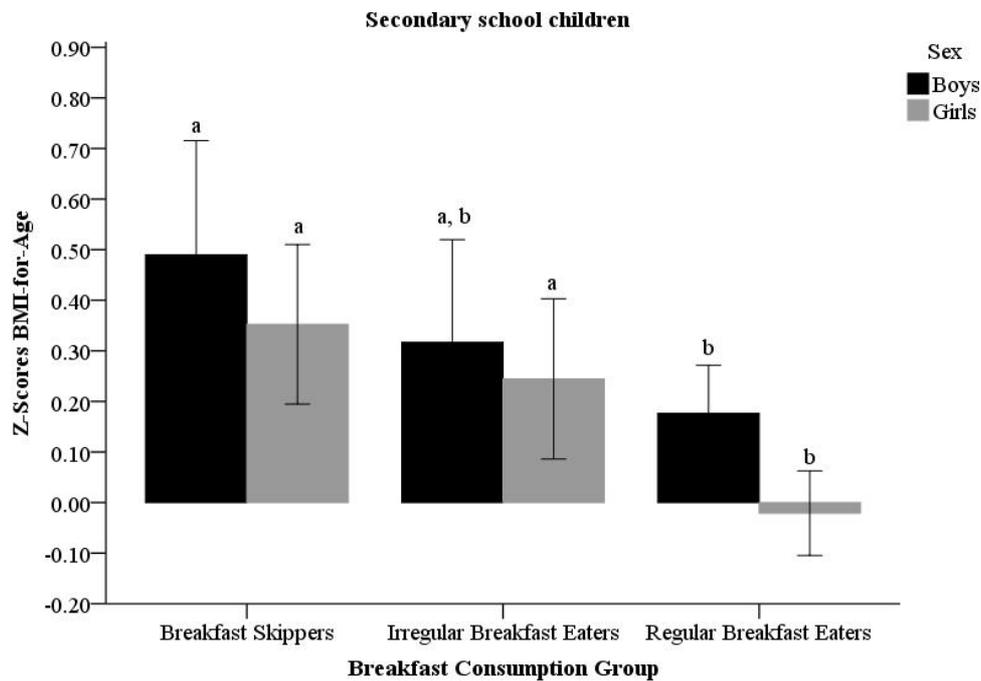


Figure 1b. BMI-for-age z-scores by sex and breakfast consumption group among the secondary school children. ^{a,b} Different alphabets denote significant difference, $p < 0.05$ was considered statistically significant. For boys, the p -value was 0.043 and for girls, $p < 0.001$. Data were adjusted for age (years), ethnicity, father’s education level, monthly household income and physical activity scores using ANCOVA comparing mean z-scores for BMI-for-age among breakfast consumption groups by sex.

(95%CI=1.26-1.71, $p < 0.001$) times higher among breakfast skippers and 1.23 times (95% CI=1.05-1.43, $p = 0.009$) higher among irregular breakfast eaters compared to regular breakfast eaters. When the total sample was stratified by sex and school age level, compared to regular breakfast eaters, primary school boys who skipped breakfast were 1.71 times (95% CI=1.26-2.32, $p = 0.001$) more like-

ly to be overweight or obese, while the risk was lower in girls (OR=1.36, 95% CI=1.02-1.81, $p = 0.039$). Among secondary school children, girls who skipped breakfast were 1.38 times (95% CI=1.01-1.9, $p = 0.044$) more likely to be overweight or obese than girls who consumed breakfast regularly. However, the likelihood of being overweight or obese was not significant among boys

Table 4. Unadjusted and adjusted odds ratios (OR) and 95% confidence intervals (CIs) on the likelihood of being overweight/obese[†] among the children by breakfast consumption habits

Breakfast consumption habits	N	Unadjusted			Adjusted [‡]		
		OR	95% CI	p-value [§]	OR	95% CI	p-value [§]
Total sample	7670						
Regular breakfast eaters	5844	1.00			1.00		
Irregular breakfast eaters	945	1.20	1.04–1.38	0.012	1.23	1.05–1.43	0.009
Breakfast skippers	881	1.40	1.21–1.61	<0.001	1.47	1.26–1.71	<0.001
Primary school boys	2248						
Regular breakfast eaters	1834	1.00			1.00		
Irregular breakfast eaters	214	1.37	1.04–1.81	0.028	1.33	0.98–1.81	0.063
Breakfast skippers	200	1.67	1.26–2.22	<0.001	1.71	1.26–2.32	0.001
Primary school girls	2749						
Regular breakfast eaters	2176	1.00			1.00		
Irregular breakfast eaters	315	1.11	0.86–1.44	0.429	1.09	0.82–1.44	0.567
Breakfast skippers	258	1.26	0.96–1.67	0.102	1.36	1.02–1.81	0.039
Secondary school boys	1289						
Regular breakfast eaters	946	1.00			1.00		
Irregular breakfast eaters	183	1.14	0.84–1.56	0.411	1.15	0.82–1.62	0.420
Breakfast skippers	160	1.40	1.00–1.94	0.048	1.31	0.92–1.87	0.135
Secondary school girls	1384						
Regular breakfast eaters	888	1.00			1.00		
Irregular breakfast eaters	233	1.35	0.99–1.83	0.056	1.31	0.94–1.82	0.107
Breakfast skippers	263	1.50	1.12–1.99	0.006	1.38	1.01–1.90	0.044

[†]Based on BMI-for-age z-score: Overweight and obese (z-score>+1SD).

[‡]Data were adjusted for age (year), sex (except for analyses by sex), ethnicity, father's education level, monthly household income and physical activity scores.

[§]p-values are based on binary logistic regression on the association between breakfast consumption habits and the likelihood of being overweight/obese. *p*<0.05 was considered statistically significant.

(*p*=0.135) (Table 4).

DISCUSSION

In this large nationwide survey on breakfast consumption among primary and secondary school children in Malaysia, the overall prevalence of breakfast skipping and irregular breakfast consumption combined (defined as consuming breakfast <5 days/week) was 24.3%, and was highest amongst girls, secondary school children, children of Malay ethnicity and children from families with a higher education and income level. More importantly, breakfast skipping (defined as consuming breakfast <3 days/week) was found to be associated with a higher BMI-for-age z-score and a greater likelihood of being overweight and obese, independent of socio-economic status (SES) and physical activity levels. When the sample was stratified by sex and school level, this association was most evident among primary school boys and secondary school girls.

The prevalence of breakfast skipping among primary school children in this study appears to be similar to that reported by the Universiti Kebangsaan Malaysia (UKM) study in 2008,¹⁸ but the prevalence among secondary school children appears lower than the 2012 MSNS study.³ In these studies, 32% of children and 72% of adolescents reported skipping breakfast at least once per week, while in the current study, 35% of children and 51% of adolescents skipped at least once per week. Similarly, a recent cross-sectional study of 382 school children aged 10–12 years from Kuala Lumpur reported that 78% of the children skipped breakfast at least once per week.³¹ Comparisons of breakfast skipping prevalence between studies should however, be interpreted with caution as

wide differences exist between studies in the applied definitions of breakfast and cut offs used to define breakfast skippers. Nonetheless, similar to the findings of previous national studies^{18,32,33} and elsewhere,^{34,35} the prevalence of breakfast skipping was found to be higher among girls and older children than their counterparts. This could be related to a higher self-awareness among girls and adolescents and greater prevalence of body dissatisfaction, dieting and disordered eating.³⁵ Of note, in the MSNS 2012, 5% of the boys and 6% of girls reported being on a diet which could be a contributory factor to breakfast skipping.³ Our findings that parents' education level and household income group were related with breakfast consumption are also in agreement with others.^{35–37}

The high rates of overweight and obesity observed in the current study among primary (13% overweight and 15% obese) and secondary school children (15% overweight and 13% obese) are similar to rates reported in two earlier nationwide studies^{2,3} indicating little improvement in the obesity epidemic in Malaysia. The positive association we observed between breakfast skipping and bodyweight are consistent with studies from across the world including the United States,⁵ Europe,³⁸ the Middle East^{8,39} and the Asia and Pacific region.^{16,40–42} Our results are also in agreement with an earlier study in Malaysian adolescents from the north eastern region¹⁷ suggesting that this relationship may be applicable to the general population. It is noteworthy however, that when the sample was stratified by sex and school age level, the risk of overweight/obesity was more significant for primary school aged boys than girls, whereas among the secondary school children, the relationship was only evident for girls. A cross-sectional study of children aged 2–

10 years in eight European countries also observed a greater risk of overweight and obesity among boys than girls.⁷ The reasons for our findings are unclear. Among the primary school boys, the prevalence of low physical activity was quite small overall and did not differ significantly across breakfast consumption groups (22-25%). This paper did not report on dietary intakes but it is possible that boys who skipped have a poorer overall diet quality than girls. Among secondary school girls but not boys, those who skipped breakfast were more likely to be overweight or obese and have a higher BMI-for-age z-score compared to regular breakfast eaters. In addition, secondary school girls who skipped breakfast were more likely to report low physical activity levels relative to regular breakfast eaters which could be a contributory factor. Similar findings were obtained in studies among British female adolescents,⁴³ and among Latina and African American female adolescents.⁴⁴ Among girls especially, it is unclear whether breakfast skipping and low physical activity are a cause or a consequence of overweight and obesity. It is often reported that young girls skip breakfast as a means to assist in weight loss or prevent weight gain.^{17,45} Furthermore, it is possible that overweight and obese girls avoid exercise because they are more self-conscious about their bodies. A recent randomised controlled trial has provided some evidence for a causal link between daily breakfast consumption and physical activity thermogenesis in lean adults.⁴⁶ Participants who consumed breakfast daily for 6 weeks exhibited significantly higher physical activity thermogenesis than the breakfast skipping group and this was mainly attributed to greater light intensity physical activity during the morning suggesting that breakfast eaters are more likely to engage in spontaneous physical activity during the morning.

Other proposed mechanisms to explain the relationship between breakfast frequency and body weight focus around the effects of breakfast consumption on appetite and overall energy intake.⁴⁷ In particular, the consumption of fibre-rich breakfast foods may improve postprandial glycaemic responses, insulin sensitivity and satiety.⁴⁷ A large cross-sectional study of over 4,000 children in the United Kingdom found that children who reported not usually eating breakfast had significantly higher fasting insulin, insulin resistance, HbA1C and glucose concentrations compared to those consuming breakfast daily.¹⁰ Furthermore, children eating high fibre breakfast cereals had lower insulin resistance than those eating other types of breakfasts.¹⁰ Several studies have shown that skipping breakfast is associated with an overall less healthy diet characterised by higher daily intakes of soft drinks and salty snacks^{8,49-50} and lower intakes of fruit, vegetables and dairy.^{8,49,51} The better diet quality observed in more regular breakfast eaters is also often associated with higher daily intakes of important nutrients including fibre, calcium, vitamin A and C, riboflavin, zinc and iron.⁴⁷ Breakfast skipping may therefore potentially contribute to an unhealthy daily dietary pattern leading to overweight and obesity.

The findings of this study support the importance of breakfast consumption among Malaysian children and highlight a need for targeted interventions to encourage

more regular breakfast consumption among all school children. In the MSNS study, a lack of time and appetite were identified as the main reasons for skipping breakfast among adolescents.³ In a cross-sectional study of 382 children aged 10-11 years in Kuala Lumpur, stomach ache and lack of time due to oversleeping were cited as the most common reasons for skipping breakfast.³¹ The traditional Malaysian breakfast usually consists of cooked dishes such as *nasi lemak* (rice cooked in coconut milk) or fried rice/noodles which can be quite satiating. Therefore, lighter and more convenient breakfast foods which take less time to prepare, and yet balanced and nutritious, may encourage more regular breakfast consumption especially among adolescents. Government funded school breakfast programmes exist in many countries worldwide and often are targeted to children from lower socio-economic backgrounds. In the United States, participation in the school breakfast programme has been associated with a lower BMI in children.⁵² In Malaysia, the School Supplementary Feeding Programme (SSFP) was implemented in primary schools to improve health and nutritional status of children, especially those in the rural areas and from low income families.⁵³ The SSFP is usually served during recess, where children in the SSFP will receive their foods while other children will either buy foods from the canteen or eat packed foods that they bring from home. A typical school in Malaysia starts at 7.20 am with morning assembly and about 2 classes before recess. The recess time usually differs according to grade, for example, Primary 1 to Primary 3 children may have their recess at 10 am, while Primary 4 to Primary 6 may have their recess at 11 am, or vice versa. Malaysia could give consideration to implementing school breakfast programmes especially for lower socio-economic children or the existing SSFP should be served earlier before the first class starts, not during recess after the children had gone through about 2 classes.

Nutrition education in schools is another potential way to highlight the importance of the breakfast meal. Although nutrition education is not a formal subject in the school curriculum, it is entirely possible to introduce simple nutrition messages to school children. Educational modules have been developed to impart basic nutrition information to school children, including importance of regular consumption of breakfast through the Healthy Kids Programme of the Nutrition Society of Malaysia.⁵⁴ It is noted that the importance of taking regular breakfast has not been mentioned at all in the Dietary Guidelines for Children and Adolescents.⁵⁵ It is important that this recommendation be emphasised in the next update of these Guidelines so that all health care professionals utilising this publication will pay sufficient attention to highlight this to the public. Furthermore, some guidance should be given on the types of food and beverages and portion size that should be consumed at breakfast.

There are several limitations of the present study which should be acknowledged. Firstly, the breakfast skipping definition was based on an open ended question which relied on children's correct interpretation and ability to recall in answering. While we tried to use a definition consistent with other studies, several different definitions exist in the literature which limits the comparison of our

findings with other studies, waist circumference and body fat percentage, which can be a useful indicator for metabolic risk were not measured in this study. In addition, physical activity was assessed through a self-administered 7-day recall questionnaire which relied on children's ability and reliability to recall rather than an objective measure such as an accelerometer. Lastly, it is recognised that given the cross-sectional nature of the study, the results cannot imply causation.¹⁵ Evidently, more studies with an intervention design are needed in Malaysia and elsewhere to corroborate this relationship. Major strengths of this study include the large sample size covering all regions of Malaysia and major ethnicities. Furthermore, we controlled for several factors likely to influence bodyweight.

Conclusion

This study found a high prevalence of overweight and obesity amongst the full range of school-going children, from primary to secondary school. These findings are in line with similar high rates reported in two earlier nationwide studies. The study also found a high prevalence of breakfast skipping among both primary and secondary school children. More importantly, it was found that breakfast skipping (defined as skipping ≥ 3 days per week) was related to an increased risk of overweight and obesity among primary and secondary school children in Malaysia, independent of socio-economic status and physical activity levels, and that the risk appears greatest among primary school aged boys. Considering that 10% of primary school children and 16% of secondary school children were breakfast skippers, the potential implications to public health could be significant. However, as this study cannot infer a causal relationship between breakfasts skipping and bodyweight, further studies with a longitudinal or intervention design are urgently needed to corroborate these findings.

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