Dietary intake, physical activity and energy expenditure of Malaysian adolescents

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ABSTRACT

Introduction: Paediatric obesity is a public health concern worldwide as it can track into adulthood and increase the risk of adult morbidity and mortality. While the aetiology of obesity is multi-factorial, the roles of diet and physical activity are controversial. Thus, the purpose of this study was to report on the differences in energy intake, diet composition, time spent doing physical activity and energy expenditure among underweight (UW), normal weight (NW) and at-risk of overweight (OW) Malaysian adolescents (317 females and 301 males) aged 11-15 years.

Methods: This was a cross-sectional study with 6,555 adolescents measured for weights and heights for body mass index (BMI) categorisation. A total of 618 subjects were randomly selected from each BMI category according to gender. The subjects' dietary intake and physical activity were assessed using self-reported three-day food and activity records, respectively. Dietary intake components included total energy and macronutrient intakes. Energy expenditure was calculated as a sum of energy expended for basal metabolic rate and physical activity. Time spent (in minutes) in low, medium and high intensity activities was also calculated.

Results: The OW adolescents had the highest crude energy intake and energy expenditure. However, after adjusting for body weight, the OW subjects had the lowest energy intake and energy expenditure (p-value is less than 0.001). The study groups did not differ significantly in time spent for low, medium and high intensity activities. Macronutrient intakes differed significantly only among the girls where the OW group had the highest intakes compared to UW and NW groups (p-value is less than 0.05). All study groups had greater than 30 percent and less than 55 percent of energy intake from fat and carbohydrate, respectively.

Conclusion: The data suggested that a combination of low energy expenditure adjusted for body weight and high dietary fat intake may be associated with overweight and obesity among adolescents. To prevent overweight and obesity among children and adolescents, strategies that address eating behaviours and physical activity are required. Various segments of the society must be involved in efforts to promote healthful dietary intakes and active lifestyle in children and adolescents.

Keywords: adolescents, dietary intake, energy expenditure, energy intake, obesity, physical activity

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INTRODUCTION

Paediatric obesity has become an increasing clinical and public health concern in both developed and developing nations. Children of all ages are fatter now than they were before[1-3]. In many countries, rapid economic development has brought about changes in the populations' dietary intakes and lifestyle. Consequently, these changes contribute significantly to the increasing prevalence of obesity and diet-related chronic diseases, both in the adult and paediatric populations[4]. Malaysia is no exception in that the shift towards a Westernised dietary pattern and sedentary lifestyle has been implicated in the increasing rate of obesity and nutrition-related non-communicable diseases among its population[5].

In Malaysia, the National Health and Morbidity Survey 2 (1996) reported that the prevalence of being overweight and obese among adults is 20.7% and 5.8%, respectively[6]. The prevalence of overweight adults (body mass index [BMI] >25.0) in Malaysia appears to be higher than the levels

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reported in other Asian countries, such as Thailand, China and Japan[7]. However, this health problem is not restricted only to the Malaysian adults. Among the adolescents, the prevalence of overweight and obesity from independent studies ranges from 5% to 26%, depending on the methods used to define overweight and obesity, age, ethnicity, gender and locality[8-11].

Reilly et al[12] showed that obesity in children and adolescents is associated with both short-term and long-term consequences, although the latter may be of a greater health concern. Short-term consequences of obesity in children include low self-esteem, behavioural problems, clinical conditions such as asthma, systemic inflammation and type 1 diabetes mellitus, and cardiovascular risk factors. Long-term consequences of obesity in childhood and adolescence may include adverse social and economic outcomes (e.g. income, educational achievement) and increased cardiovascular risks and premature mortality in adulthood.

The aetiology of obesity involves a complex interaction of various factors, such as genetics, physical activity, diet, social, environment and health. The roles of diet and physical activity in body weight gain and body fat accumulation among adolescents have remained equivocal. While several studies have reported on the positive associations between adiposity in children and adolescents and energy intake, consumptions of high fat foods and high sugar beverages and physical inactivity[13-16], others have found no relationship[17-19]. The relationship between physical fitness and adiposity has also been researched in line with the idea that overweight children had reduced physical fitness due to increased physical inactivity[20-22].

Presently, published research on the relationship between adiposity with diet and physical activity among Malaysian adolescents is limited. Hence, the purpose of this study was to report on the energy and macronutrient intakes, and energy expenditure, among male and female adolescents according to the various BMI levels, namely underweight (UW), normal weight (NW) and at risk of overweight (OW).

METHODS

This cross-sectional study was conducted as part of a multi-centre research project on "The study of the relationship between dietary habits, physical activity and nutritional status with body image among adolescents" with financial support from the Intensification of Research in Priority Areas (IRPA) grant of the Malaysian Ministry of Science, Technology and Environment. For this study, multi-stage random sampling was utilised in the selection of 14 secondary schools. Other inclusion criteria for the schools were: co-educational, multiracial in composition, non-religious and non-residential.

All Secondary 1 and 2 male and female students (n=6,555) in the age range of 11-15 years old were included in the screening process where they were measured for their weight and height. BMI was calculated for each respondent for the purpose of categorisation into underweight, overweight and normal weight groups. These respondents were then randomly sampled to obtain a total of 2,050 respondents for the assessment of body image. From this sample, another sub-sample of 618 respondents (317 female and 301 male adolescents) was randomly selected to complete additional measurements such as three-day food and physical activity records. The study protocol and ethics were approved by the Malaysian Ministry of Education. Permissions to conduct the study were also obtained from the state education departments and participating schools. The respondents were informed of the study and their participation was voluntary. Those who participated were required to sign consent forms prior to the inception of the study.

The weight and height of the respondents were measured with a TANITA digital scale and a SECA body metre to the nearest 0.1 kg and 0.1 cm, respectively. Two measurements were taken for both weight and height, and the average of the two values were used in the analyses. For measurement accuracy, the respondents were asked to remove their shoes and empty their pockets, and the instruments were calibrated daily. BMI was calculated based on the weight and height measurements and the categorisation of BMI levels were done according to the age and gender-specific BMI for adolescents[23]. Thus, the BMI categories of UW, NW and OW corresponded to <5th percentile, 5th - 85th percentile and ≥85th percentile, respectively.

For dietary intake, a self-administered three-day food record (consecutive two weekdays and a weekend) were obtained from the respondents. Respondents were asked to record their consumption of all foods and beverages, including snacks, and to provide detailed descriptions of the foods and beverages, which included brand names and methods of food preparation. Food portions were estimated by the respondents using standard household measuring cups and spoons, matchbox (for meat, fish and bean curd), ruler (for fruit slices) and counts (for eggs, biscuits, bread slices and fruits). Prior to that, the researchers explained the food record form and the food-measuring tools, and demonstrated the use of these instruments to the respondents. All dietary records were checked by researchers for accuracy and completeness. Further clarifications were sought from the respondents in cases where the food records were incomplete or filled incorrectly. Calculation of energy and macronutrient intakes was done for each day, and the average of the three days' calculation was taken in the final statistical analyses.

The respondents were also asked to record their physical activities simultaneously with their food records. This three-day activity record method has been shown to be suitable for the estimation of energy expenditure in children[24] and had been previously used among Malaysian adolescents[25]. The activities including the body postures (sitting, standing, walking and squatting) were recorded every five minutes. There were a total of 42 recorded activities and based on their characteristics and the circumstances of their performance, these activities were then grouped into nine categories according to energy cost or physical activity ratio (PAR) as recommended by Torun[26]. Thus, light, moderate and high intensity activities were defined as activities with PAR of 1-1.9, 2-2.9 and >3.0, respectively. The sum of the duration (in minutes) of activities in each category was calculated and included in the energy expenditure calculation[27]. The calculation for the adolescents' basal metabolic rate (BMR) in kcal/day, was based on a validated gender-specific BMR equation for Malaysian adolescents[25]. Energy expended for physical activity was calculated as the difference between total energy expenditure and energy expended for BMR. The reported values for energy expenditure and physical activity were calculated based on the average values of the three days of activity record.

The dietary intakes of the respondents were analysed using Nutri-Cal Professional Version 1.01 which had the Malaysian food database[28]. In cases where the foods or ingredients consumed were not available in the database, other food databases such as "Singapore Food Facts"[29] and "Thai Food Composition Tables"[30] were also utilised to assist the dietary intake analysis. Dietary quality was reported for macronutrient intakes (carbohydrate, fat and protein) as mean intakes in grammes and percentages of energy.

As the data were parametric, one-way ANOVA and chi-square analyses were conducted to assess the relationship between the BMI categories according to gender and demographical, socioeconomic and physical measurements. The interaction between ethnicity (Malay, Chinese and Indian) and household income was tested with a two-way ANOVA; however, no interaction effect was observed (F=0.65, p=0.63). Finally, analysis of covariance (ANCOVA) was utilised to determine the mean differences in the outcome variables among UW, NW and OW subjects with statistical control of household income and ethnicity. These covariates were included individually and combined in the ANCOVA; however, the mean scores for all outcome variables from ANCOVA with individual covariate did not differ much from the mean scores when both covariates were included in ANCOVA. All statistical analyses were conducted using Statistical Package for Social Sciences (SPSS) version 11.5 (Chicago, IL, USA).

RESULTS

Based on the screening sample (n=6,555), the proportion of UW, NW and OW male and female adolescents are presented in Table I. The prevalence of UW and OW was higher among male (14.8% and 19.7%) than female (7.9% and 16.7%) adolescents. The mean and range of BMI for male and female adolescents were 19.26 ± 4.16 (10.58-45.71) and 19.72 ± 4.12 (10.51-43.98), respectively. Table II describes the demographical characteristics and anthropometric measurements of the subjects by gender and study group (n=618).

Self-reported energy intake and expenditure and energy balance of the subjects are shown in Table III. The OW girls had significantly higher crude energy intake than the UW and NW groups (p<0.05). Among the boys, the differences in mean crude energy intake were not statistically significant. When body weight was considered, the OW subjects (girls

Table I. Prevalence of underweight, normal weight and overweight male and female adolescents (n=6,555)

Gender	Total n	UW n(%)	NW n(%)	OW n(%)	χ^2	p-value
Male	3,353	498 (14.8)	2,195 (65.5)	660 (19.7)	101.6	< 0.001
Female	3,202	252 (7.9)	2,415 (75.4)	535 (16.7)		
Total	6,555	750 (11.4)	4,610 (70.3)	1,195 (18.3)		

BMI-for-age (WHO, 1995): <5th percentile (underweight: UW); 5th - 85th percentile (normal weight: NW);
≥ 85th percentile (at risk of overweight: OW).

Table II. Characteristics of subjects by gender and body mass index (n=618).

	Girls				Boys			
	UW (n=72)	NW (n=123)	OW (n=122)	p-value	UW (n=82)	NW (n=118)	OW (n=101)	p-value
Age (year)[a]	13.0 (0.7)	13.1 (0.7)	13.2 (0.8)	ns	13.1 (0.8)	13.2 (0.8)	13.1 (0.8)	ns
Height (m)[a]	1.49 (0.1)	1.51 (0.08)	1.54 (0.05)	<0.001	1.50 (0.10)	1.57 (0.09)	1.60 (0.08)	<0.001
Weight (kg)[a]	32.8 (3.5)	42.6 (6.3)	64.2 (10.4)	<0.001	33.5 (5.2)	45.7 (8.3)	65.5 (11.6)	<0.001
BMI (kg/m^2)[a]	14.7 (0.6)	18.7 (1.9)	27.0 (3.5)	<0.001	14.8 (0.8)	18.5 (2.0)	25.5 (3.4)	<0.001
Household income[a] (RM)	1,328 (1,708)	1,082 (1,123)	1,124 (1,254)	<0.05	958 (939)	1,002 (940)	1,193 (877)	<0.01
0-500	19 (26.4)	44 (35.8)	34 (27.9)		28 (34.1)	34 (28.8)	30 (29.7)	
501-1000	31 (43.1)	50 (40.7)	58 (47.5)		35 (42.7)	60 (50.8)	39 (38.6)	
>1000	22 (30.5)	29 (23.5)	30 (24.6)		19 (23.2)	24 (20.4)	32 (31.7)	
Ethnicity[b]				<0.05				<0.05
Malay	43 (59.7)	84 (68.3)	72 (59.0)		51 (62.2)	56 (47.5)	48 (47.5)	
Chinese	24 (33.3)	33 (26.8)	36 (29.5)		16 (19.5)	46 (39.0)	43 (42.6)	
Indian	5 (7.0)	6 (4.9)	14 (11.5)		15 (18.3)	16 (13.5)	10 (9.9)	

UW: underweight; NW: normal weight; OW: at risk of overweight

1 USD = RM 3.8; [a]: Mean (SD); [b]: n (%)

ns: not significant

Table III. Energy intake, energy expenditure and energy expended for basal metabolic rate and physical activity by gender and body mass index (n=618).

	Girls[b]				Boys[b]			
	UW (n=72)	NW (n=123)	OW (n=122)	p-value	UW (n=82)	NW (n=118)	OW (n=101)	p-value
Energy intake[a]								
Kcal/day	1,916 (73.7)	1,903 (56.5)	2,138 (56.7)	<0.05	2,198 (92.4)	2,133 (77.1)	2,262 (84.1)	ns
Kcal/kg body weight	59 (1.8)	46 (1.4)	34 (1.4)	<0.001	66 (2.4)	49 (2.0)	36 (2.2)	<0.001
Energy expenditure[a]								
Kcal/day	1,581 (24.0)	1,778 (18.4)	2,189 (18.4)	<0.001	1,917 (38.8)	2,195 (32.4)	2,871 (35.3)	<0.001
Kcal/kg body weight	49 (0.5)	42 (0.4)	34 (0.4)	<0.001	58 (0.7)	49 (0.6)	44 (0.6)	<0.001
Basal metabolic rate[a]								
Kcal/day	1,091 (11.9)	1,219 (9.2)	1,500 (9.2)	<0.001	12,02 (18.8)	1,431 (15.7)	1,811 (17.1)	<0.001
Physical activity[a]								
Kcal/day	490 (17.7)	559 (13.6)	689 (13.6)	<0.001	715 (28.7)	763 (23.9)	1,059 (26.1)	<0.001
Energy balance[a]								
Kcal/day	334 (74.6)	125 (57.2)	-51 (57.4)	<0.001	281.7 (94)	-61 (79.1)	-608 (86.3)	<0.001

UW: underweight; NW: normal weight; OW: at risk of overweight

[a] : Analysis of covariance controlling for ethnicity and household income

[b] : Mean (standard error)

ns: not significant

BMR (kcal/day) = $\frac{\text{BMR (kJ/day)}}{\text{4.184 (kJ/kcal)}}$

and boys) had the lowest energy intake compared to the UW and NW subjects (p<0.001). Crude energy expenditure and energy expended for BMR and physical activity were significantly greater for OW boys and girls. However, our data also showed that the total energy expenditure per kilogramme of body weight for boys and girls was lowest among the OW subjects (p<0.001). OW girls and boys had significantly lower energy balance (negative energy balance) than NW and UW subjects (p<0.001).

The mean duration in minutes of low, moderate and high intensity physical activities performed by the UW, NW and OW adolescents is presented in Table IV. There was no significant difference in time

Table IV. Mean duration (minutes) of low, moderate and high intensity physical activity by gender and body mass index (n=618).

Physical activity	Girls[b] (n=317) UW (n=72)	NW (n=123)	OW (n=122)	p-value	Boys[b] (n=301) UW (n=82)	NW (n=118)	OW (n=101)	p-value
Light intensity[a]	1,156 (9.4)	1,147 (7.2)	1,148 (7.2)	ns	1,163 (9.4)	1,180 (7.8)	1,157 (8.6)	ns
Moderate intensity[a]	245 (8.2)	252 (6.3)	251 (6.3)	ns	207 (8.0)	205 (6.7)	218 (7.3)	ns
High intensity[a]	40 (3.7)	41 (2.8)	41 (2.8)	ns	69 (4.8)	55 (4.0)	65 (4.4)	ns

UW: underweight; NW: normal weight; OW: at risk of overweight

[a] : Analysis of covariance controlling for ethnicity and household income

[b]: Mean (standard error)

Light: sleeping, lying down, sitting (resting, reading, writing, playing computer and video games, watching TV, eating), standing still (watching TV, talking, queuing)

Moderate: walking, standing with movements (washing dishes, cleaning, dusting, gardening)

High: cycling, walking up and down the stairs, running, playing sports, exercise

ns: not significant

Table V. Macronutrient intakes by gender and body mass index (n=618).

	Girls[b] (n=317) UW (n=72)	NW (n=123)	OW (n=122)	p value	Boys[b] (n=301) UW (n=82)	NW (n=118)	OW (n=101)	p-value
Total intake (grammes)[a]								
Total carbohydrate	247 (9.8)	252 (7.5)	272 (7.5)	<0.05	281 (1.8)	271 (9.9)	285 (10.7)	ns
Total fat	70 (3.6)	69 (2.7)	81 (37.4)	<0.05	80 (4.0)	81 (3.4)	86 (3.7)	ns
Total protein	72 (3.2)	70 (2.4)	80 (2.5)	<0.05	89 (5.9)	80 (4.9)	86 (5.4)	ns
Percent energy (%)[a]								
From carbohydrate	52 (0.9)	53 (0.7)	52 (7.8)	ns	52 (0.9)	51 (0.8)	51 (0.8)	ns
From fat	33 (0.8)	32 (0.6)	33 (0.6)	ns	32.4 (0.7)	34 (0.6)	34 (0.7)	ns
From protein	15 (0.3)	15 (0.3)	15 (0.3)	ns	16 (0.4)	15 (0.4)	15 (0.4)	ns

UW: underweight; NW: normal weight; OW: at risk of overweight

[a] : Analysis of covariance controlling for ethnicity and household income

[b]: Mean (standard error)

ns: not significant

spent in each physical activity category among the study groups. In general, OW adolescents did not appear to spend more time doing low to moderate activities compared to the UW and NW groups. This, however, could also be due to misreporting of activities, especially among the overweight and obese subjects. Macronutrient intakes (carbohydrate, protein and fat), expressed as intake in grammes and as percentage of energy intake are shown in Table V. When compared to the UW and NW groups, the OW girls had the highest total grammes of macronutrient intake (p<0.05). No significant differences were observed for macronutrient intakes (total grammes and percent of energy) among the UW, NW and OW boys. All groups, however, had more than 30% of energy from fat and relatively lower percentage of energy from carbohydrates (<55%).

DISCUSSION

The high proportion of adolescents at-risk of overweight in this multi-ethnic sample was similar to[9] or higher than other findings among Malaysian adolescents[8-11]. The prevalence of at-risk overweight reported in this present study, however, may not be comparable to those reported in previous studies due to different methods and cut-offs used to define overweight and obesity, age groups, ethnic composition and locality (urban and rural) utilised in each study. Nevertheless, overweight and obesity among children and adolescents is of a concern as the problem may persist into adulthood and increase the risk of adult morbidity and mortality[31-33].

Various studies have shown that overweight or obese children did not consume more energy; they consumed less energy and had higher physical activity than their normal weight peers, yet maintained their adiposity[14,17-18]. However, other researchers have reported that energy intake was positively related to adiposity[13,15-16]. Our findings showed that while crude energy intake did not differ significantly among UW, NW and OW male adolescents, OW female adolescents had significantly higher crude energy intake than the other two groups. A mean difference in the range of 113-173 kcal/day between the NW and OW male and female subjects in this study (with the OW subjects consuming the extra energy), could as well contribute to a weight gain of several pounds per year[34].

We reported that after body weight was considered, the overweight subjects actually had the lowest energy intake compared to the subjects in the other two groups. Our results are similar to those of Gazzaniga and Burns[35] in that the researchers also found that the 9- to 11-year-old obese children had higher crude daily energy intakes but lower energy intake per kg of body weight than did the non-obese children. These findings may actually reflect systematic underreporting among the OW subjects which consequently leads to the difficulty to identify excess energy intake as the main contributor to energy imbalance.

In children, percent of energy from dietary fat is positively related with increasing adiposity[16,19,36]. Percentage of body fat has also been shown to correlate positively with intakes of total, saturated and monounsaturated fatty acids and negatively with carbohydrate intake, even after adjusting for energy intake, resting energy expenditure and physical activity among pre-adolescent children[35]. Similarly, Eck et al[36] have shown that children at high risk of obesity consumed higher percentage of fat energy but lower percentage of carbohydrate energy than children at low risk of obesity. In contrast, Grant et al[38] reported that obese children did not consume significantly more energy from macronutrients than non-obese children.

In the present study, while mean total gramme intake of macronutrients (carbohydrate, fat, protein) was significantly higher ($p<0.05$) in OW than NW and UW girls, no significant differences were observed among the OW, NW and UW boys. Unlike previous studies, we did not find any significant difference in percentage of energy from macronutrients by gender and study groups. The adolescents in this study consumed 32-34%, 51-53% and 14-16% of energy intake from fat, carbohydrates and proteins, respectively. However, The National Coordinating Committee on Food and Nutrition of Malaysia (2005), recommends that carbohydrates should contribute 55-75%, fat 20-30% and proteins 10-15% of total daily energy intake.

In comparison to the NW and UW adolescents in this study, the OW adolescents expended more energy per day for physical activity and BMR. The higher BMR among the overweight subjects was expected because the increase in body weight will result in an increase in BMR[39]. However, the higher energy expended for physical activity by the OW subjects remained questionable. Several studies have shown that obese children are physically less active than non-obese children, however, due to higher body weight, the energy requirement of the same activity in obese children is much higher than in the non-obese[40-41]. Thus, the obese children expended more energy for physical activity than did non-obese children, yet were not necessarily more active. It is also possible that the OW adolescents had misreported the duration and intensity of physical activities which then caused an overestimation of physical activity- associated energy expenditure[42].

The most significant finding from this study is that when body weight is considered, energy intake and energy expenditure are lowest among the OW subjects. Gazzaniga and Burns[35] have also found that among boys and girls aged 9-11 years, energy intake, total energy expenditure, resting energy expenditure and energy expended for physical activity were substantially higher among obese than non-obese children; however, the total energy expenditure and energy intake per kg body weight were lower. Perhaps, among the overweight and obese individuals, the combination of a genetically-determined low fat oxidation capacity when the diet is high in fat, and a sedentary lifestyle with a low level of energy expended on physical activities (contributing to a low total energy expenditure) may put the individuals at risk of further weight gain[43], independent of energy intake.

It is always important to highlight the limitations of the study that may influence the study findings and warrant caution in the interpretation of the findings. Firstly, the design of the study is cross-sectional, which provided information only on the overweight status and not on the development of the overweight status. The study did not obtain important information related to weight changes i.e. gain, loss or stable. Thus, the data could only report on the behaviours that were associated with the current weight status and not behaviours that contribute to weight gain. For example, excess energy intake and low physical activity may be contributory factors to overweight and obesity in adolescents, but reduced energy intake and high or increased physical activity may be the outcome behaviours of overweight and obese adolescents in their attempts to reduce weight. The present study, however, was not able to determine the direction of these dietary and physical activity variables. Perhaps, future research with a longitudinal study design may overcome these limitations.

Secondly, the use of three-day food and physical activity records among the adolescents depended very much on the initiative, cooperation and honesty of the respondents to record their daily food intakes and activities. The act of recording food intake and physical activity over a period of time can also lead the respondents to simplify the recording processes i.e. reduce the number, types and frequency of foods and snacks eaten or types and duration of activities performed[44]. Consequently, the records may significantly under-report or over-report energy and nutrient intakes and energy expenditure. Thirdly, the physical activity and energy expenditure information obtained were of crude measurements compared to assessments using doubly-labelled water method, indirect calorimetry, heart rate monitoring or motion sensors. In addition, the use of equations to calculate BMR and the assumption that the energy cost for all activities in each category is the same may introduce error in the determination of total energy expenditure.

Finally, the aetiology of overweight and obesity is multi-factorial. At present, the role of individual factors (e.g. dietary intake, genetic and physical activity) and their interactions are still inconclusive. Our study, however, did not consider genetic factors which may influence the roles of diet composition, energy intake and expenditure in the maintenance of overweight and obesity among the adolescents. Despite the limitations in study design and methodology, our findings indicated that the overweight adolescents were not consuming more energy than their non-overweight counterparts, after body weight was adjusted. However, compared to non-overweight adolescents, the overweight adolescents had significantly lower energy expenditure per kilogramme of body weight. Despite no significant difference in total energy contribution from macronutrients, all study groups had higher percentage of energy from fat (>30%) but lower percentage of energy from carbohydrate (<55%). Our data suggested that a combination of a diet high in fat (>30% of total energy intake) and low energy expenditure may contribute to overweight and obesity among the adolescents[36,42].

To promote a healthy lifestyle in children and adolescents, which eventually can prevent overweight and obesity, health promotional strategies that address a broad range of factors, especially environmental factors that relate to eating behaviours and physical activity, may be required. Efforts to promote healthy eating habits and regular physical activities among children and adolescents must engage all segments of the society, such as the government and non-government agencies, health professionals, food industries, media, school authorities and parents, to help create an environment in which the children live and form their behaviours.

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