Original Research

Physical activity and sleep on the risk of overweight among Grade 5 students in Gampaha Medical Officer of Health area, Sri Lanka

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Abstract

Background: Overweight in childhood is an emerging health problem in developing countries. The increasing trend in overweight is associated with three important factors; dietary habits, physical activity and socio-economic changes.

Objective: To determine the risk factors for overweight among Grade 5 students in schools of Gampaha Medical Officer of Health area.

Methods: A case control study was carried out. Cases were defined as Grade 5 students who were overweight, which was identified based on the age and sex specific body mass index (BMI) centile charts recommended by the International Obesity Task Force. Controls were those who were not overweight selected from the same class of cases. A pre-tested self-administered questionnaire was administered to the parent or guardian of the children to assess the physical activities, dietary pattern and socio-demographic characteristics of children. Multiple logistic regression analysis was applied. Risk factors for overweight were assessed using adjusted odds ratio (aOR) with 95% confidence interval (CI).

Results: Less physical activity during free times at home (OR=1.86; 95% CI=1.01, 3.42), less physical activity during weekends (OR=2.06; 95% CI=1.18, 3.61), less overall physical activity (OR=1.77; 95% CI=1.08, 2.9) and sleeping more than 8 hours per day (OR=0.46; 95% CI=0.29, 0.74) showed statistically significant associations with overweight in bivariate analysis. Of them, after adjusting for confounders, engaging in less physical activities during the weekend was a risk factor (aOR=2.17; 95% CI=1.22, 3.86) for overweight. Sleeping more than 8 hours per day was a protective factor (aOR=0.46; 95% CI=0.29, 0.74) for overweight. Other characteristics of physical activities, socio-demographic factors, high-fibre diet and fatty food did not show any significant association with overweight.

Conclusions: Less physical activity especially during weekends showed a two-fold risk for overweight while sleeping more than 8 hours per day showed a similar protective effect for overweight among Grade 5 school children.

Key words: overweight, physical activity, risk, schooling, sleeping

Introduction

Childhood overweight and obesity are becoming an increasingly important public health problem both in developed and developing countries, contributing towards a double burden along with the long-standing issue of under nutrition.

Overweight is the consequence of an energy imbalance in the body. Obesity develops when energy intake exceeds the energy expenditure over a considerable period of time. There are many complex and diverse factors that give rise to this positive energy balance. In relation to one's lifestyle, increased intake of fat and energy density of the diet, and reduction in the level of physical activity are found to be the major contributory factors for overweight (1).

Childhood overweight and obesity are associated with many adverse effects and health risks including physical and psychosocial problems in a child. Further, such children are at increased risk of developing cardio-vascular diseases, certain cancers, hyper-insulinaemia, impaired glucose tolerance, increased blood lipids and raised blood pressure during adolescence and adult life (2).

Several studies have identified some important risk factors for childhood overweight and obesity. Socio-demographic factors such as age, sex, residence, family income, and parental education and employment status have shown both positive and negative associations with overweight in different studies (3-7). With regards to diet, high intake of energy dense and micronutrient poor food and beverages (e.g. fast food, processed snacks, sugar-sweetened drinks) consumed by children is shown to be associated with overweight (8-9). In addition, lack of sports and recreational activities, television viewing and increased use of computer have shown positive relationships in overweight children (5-6, 8, 10). Also in a few studies, poor sleep has been identified as a risk factor for childhood overweight (9, 11-13).

In the recent past, various changes in the social, economic and physical environment have taken place in Sri Lanka. With such changes, the lifestyle of adults as well as of children has undergone drastic changes. For example, the eating habits of children have been heavily influenced by lack of time of mothers in preparing meals at home, the increased availability of fast food outlets, and easy access to cheap yet unhealthy food items. The amount of physical activity has been influenced by the competition among children for higher grades at school, compelling them to attend extra classes using the time otherwise spent on physical activities. Television viewing, playing computer games and the increased use of private transport have contributed towards a sedentary lifestyle among children, all of which seem to have worsened the prevalence of overweight in children in Sri Lanka.

Treatment of overweight especially in children is costly and achieving targets is difficult. Treatment procedures could easily frustrate children, parents as well as physicians. Therefore, prevention of overweight and obesity plays a bigger role, which in turn requires a broad understanding of the risk factors specific for childhood overweight. Such risk factor identification provides direction in planning future interventions for prevention. In the Sri Lankan context, only a few associated factors for childhood overweight have been identified. These too had been based on cross-sectional studies, with limited value in quantifying the magnitude of the risks involved (3, 8). Therefore, the present study was conducted using an analytical approach to determine the risk factors for overweight among Grade 5 school children in the Gampaha Medical Officer of Health (MOH) area.

Methods

A case control study was conducted among children in Gampaha MOH area. The study population included children studying in Grade 5 classes in government schools belonging to different types of 1AB, 1C, 2 and 3, semi-government schools and international schools. The estimated sample size was 318 with 106 cases and 212 controls, based on an estimated exposure rate of 30%, an estimated odds ratio (OR) of 2 and 1:2 desired case to control ratio (9).

A case was defined as a student studying in Grade 5 in a school of Gampaha MOH area with a body mass index (BMI) value above the cut-off points for overweight i.e. 85th centile based on the age and sex specific BMI centile charts recommended by the International Obesity Task Force (14). A control was defined as a student studying in the same grade in the same school with a BMI value below the cut-off points for overweight, based on the same charts. All students detected as being overweight in a descriptive study were taken as cases. The two students placed on either side of each case in the attendance register and fulfilling the eligibility criteria were selected as controls. If the students were over-weight, the next immediate student was considered for

sampling. A detailed sampling technique is published elsewhere (15).

A structured pre-tested self-administered questionnaire completed by the parent or guardian was used to collect data of students on socio-demographic factors, physical activity and food consumption pattern. Physical activity was assessed with two different sets of questions; day-to day physical activity and activity of last week using the Physical Activity Questionnaire (PAQ) for older children, which has been developed by Crocker et al. and validated in several countries (16). Of the day-to-day activities, using private vehicles as the mode of transport to school, spending half an hour or more on television viewing per day, sleeping more than eight hours per day, and spending more than three hours on tuition classes per day were defined as being 'less active'. With regard to sleeping, both day time and night time sleep duration was taken as a whole. PAQ assessed the activity of last week in a five-point Likert scale on the following nine items: activity based on some given activities; activity at physical education classes in school, during free times at home, at school interval, just after school, on last weekend and in the evening; overall activity according to parent's view; and time engaged in overall activities of the week. Overall physical activity was assessed with the total marks which defined 'less activity' with less than three marks and 'more activity' with three or more marks.

Food consumption pattern consisted of the questions assessing coconut consumption, oil consumption, meal taking pattern, television viewing while taking meals. Along with that, a food frequency questionnaire was used to assess the frequency of consuming tempered foods, fried foods, milk, yoghurts, butter, margarine, cheese, sausages, sugar added drinks, fruits and vegetables in the last seven days. Food frequency questionnaire was used as it is the most widely used and the best method to assess the diet in large scale epidemiological studies (17). The questionnaire was sent through students to parents or care givers of cases and controls with a consent form. They were instructed to handover the completed questionnaire to the class teacher. Those questionnaires were collected two days later with the help of class teachers.

Data were analysed using Statistical Package for Social Science (SPSS) version 13. OR and its 95% confidence intervals (CI) were calculated. Multiple

logistic regression analysis was applied for controlling confounding factors. Variables that showed a significance level less than 0.2 were entered into the model and analysed with backward elimination method.

Results

A total of 150 cases and 300 controls were selected. The non-response rate was 24.7% (n=111). Non-response rate of cases was (n=40, 26.7%) more than that of controls (n=71, 23.7%).

In bivariate analysis, mother being employed showed a significant risk for overweight. All other variables in relation to socio-demographic factors were not statistically significant for overweight (Table 1).

The unadjusted ORs calculated for overall activity (assessed using the PAQ) and day-to-day physical activity are shown in Tables 2 and 3, respectively. Engaged in less physical activity at free times, less physical activity during weekends, less overall physical activities and sleeping more than 8 hours per day showed statistically significant associations with overweight in bivariate analysis. Sleeping during day time was not significantly associated with overweight (OR=0.5; 95% CI=0.24, 1.05; p=0.06).

Factors in relation to food consumption pattern were not significantly associated with overweight. Though not significant, frequent consumption of fruits (OR=0.61; 95% CI=0.28, 1.35; p=0.35) and frequent consumption of vegetables (OR=0.56; 95% CI=0.17, 1.89; p=0.22) were negatively associated with overweight.

After adjusting for confounding effects, less physical activity during weekends was a significant risk factor for overweight. In contrast, sleeping more than 8 hours per day was a significant protective factor (Table 4).

Discussion

Less physical activity assessed by activities carried out on weekends was a significant risk factor for overweight (p=0.008). Sleeping more than 8 hours per day was a significant protective factor (p=0.001). In addition, mother being employed, less physical activity during free time at home, and less physical activity based on overall activities showed statistically significant associations with overweight in univariate analysis.

Table 1. Unadjusted odds ratios for overweight in relation to socio-demographic factors

Socio-demographic factors	Cases (n=110) No. (%)	Controls (n=229) No. (%)	Odds Ratio (95% CI)	p value
Sex: Female	65 (59.1)	141 (61.6)	0.9 (0.57-1.43)	0.66
Male	45 (40.9)	88 (38.4)	Ref	
Residence: Urban	30 (27.3)	70 (30.6)	0.85 (0.51-1.41)	0.53
Rural	80 (72.7)	159 (69.4)	Ref	
Care giver: Non parental	26 (23.6)	46 (20.1)	0.81 (0.31-2.13)	0.67
Parents	84 (76.4)	183 (79.9)	Ref	
Living: With both parents	103 (93.6)	217 (94.8)	1.23 (0.71-2.12)	0.45
With one or no parent	7 (6.4)	12 (5.2)	Ref	
Father's employment: Employed	101 (91.8)	213 (93.0)	0.84 (0.36-1.97)	0.69
Unemployed	9 (8.2)	16 (7.0)	Ref	
Mother's employment: Employed	49 (44.5)	74 (32.3)	1.68 (1.05-2.68)	**0.03**
Unemployed	61 (55.5)	155 (67.7)	Ref	
Father's education: Up to O/ Level	35 (31.8)	67 (29.3)	0.6 (0.36-1.02)	0.06
Above O/Level	75 (68.2)	162 (70.7)	Ref	
Mother's education: Up to O/ Level	25 (22.7)	75 (32.8)	1.13 (0.69-1.85)	0.63
Above O/Level	85 (77.3)	154 (67.2)	Ref	
Monthly income (Rs.): >=20,000	64 (61.5)	115 (53.2)	1.41 (0.87-2.26)	0.16
< 20,000	40 (38.5)	101 (46.8)	Ref	
Siblings: One or more	87 (79.1)	199 (86.9)	0.57 (0.31-1.04)	0.06
None	23 (20.9)	30 (13.1)	Ref	
Smoking status of father: Yes	17 (15.5)	34 (14.8)	1.05 (0.56-1.97)	0.88
No	93 (84.5)	195 (85.2)	Ref	
Smoking inside home: Yes	12 (10.9)	16 (7.0)	1.63 (0.74-3.58)	0.22
No	98 (89.1)	213 (93.0)	Ref	
School type: Non-governmental	38 (34.5)	73 (31.9)	1.13 (0.70-1.83)	0.62
Others	72 (65.5)	156 (68.1)	Ref	

Table 2. Unadjusted odds ratios for overweight in relation to physical activity assessed by a physical activity questionnaire

Physical activity	Cases (n=110) No. (%)	Controls (n=229) No. (%)	Odds Ratio (95% CI)	p value
Some given activities				
: Less active	103 (93.6)	199 (86.9)	2.2 (0.94-5.22)	0.06
: More active[1]	7 (6.4)	30 (13.1)	Ref	
Activity pattern in physical education classes				
: Less active	59 (53.6)	134 (54.5)	0.82 (0.12-1.3)	0.4
: More active	51 (46.4)	95 (41.5)	Ref	
Activities done at free time in home				
: Less active	94 (85.5%)	174 (76.0)	1.86 (1.01-3.42)	**< 0.01**
: More active	16 (14.5)	55 (24.0)	Ref	
Activities at school interval				
: Less active	43 (39.1)	73 (31.9)	1.37 (0.85-2.2)	0.19
: More active	67 (60.9)	156 (68.1)	Ref	
Activities done just after return home				
: Less active	83 (75.5)	155 (67.7)	1.47 (0.88-2.4)	0.14
: More active	27 (24.5)	74 (32.30	Ref	
Activities done in the evening				
: Less active	75 (68.2)	140 (61.1)	1.36 (0.84-2.2)	0.21
: More active	35 (31.8)	89 (38.9)	Ref	
Activities done at weekends				
: Less active	90 (81.8)	157 (68.6)	2.06 (1.18-3.61)	**0.01**
: More active	20 (18.2)	72 (31.4)	Ref	
Overall activities as parent's view				
: Less active	84 (76.4)	155 (67.7)	1.54 (0.92-2.6)	0.1
: More active	26 (23.6)	74 (32.3)	Ref	
Time engaged in overall activities in the week				
: Less active	76 (69.1)	138 (60.3)	1.47 (0.91-2.4)	0.12
: More active	34 (30.9)	91 (39.7)	Ref	
Overall physical activity				
: Less active	79 (71.8)	35 (59.0)	1.77 (1.08-2.90)	**0.02**
: More active	31 (28.2)	94 (41.0)	Ref	

[1] Some given activities were bicycling, running, dancing, football, badminton, volleyball, cricket and netball. Activity assessed by the number of days engaged in those activities.

Table 3. Unadjusted odds ratios for overweight in relation to day-to-day activities

Day-to-day activities	Cases (n=110) No. (%)	Controls (n=229) No. (%)	Odds Ratio (95% CI)	p value
Mode of transport to school				
: Private vehicle	86 (78.2)	172 (75.1)	1.19 (0.69-2.04)	0.54
: Public transport or walking	24 (21.8)	57 (24.9)	Ref	
Time spent on television				
: >=half an hour per day	89 (80.9)	171 (74.7)	1.44 (0.82-2.52)	0.2
: < half an hour per day	21 (19.1)	58 (25.3)	Ref	
Having a computer at home				
: Yes	37 (33.6)	66 (28.8)	1.25 (0.77-2.04)	0.37
: No	73 (66.4)	163 (71.2)	Ref	
Time spent on computer				
: >=half an hour per day	7 (6.4)	18 (7.9)	0.8 (0.33-1.99)	0.64
: < half an hour per day	102 (93.6)	211 (92.1)	Ref	
Time spent on sleeping				
: >=8hours per day	45 (40.9)	137 (59.8)	0.46 (0.29-0.74)	**0.01**
: < 8 hours per day	65 (59.1)	92 (40.2)	Ref	
Sleeping during day time				
: Yes	10 (9.1)	38 (16.6)	0.50 (0.24-1.05)	0.06
: No	100 (90.9)	191 (83.4)	Ref	
Attending tuition classes				
: Yes	88 (80.0)	184 (80.3)	0.98 (0.55-1.73)	0.94
: No	22 (20.0)	45 (19.7)	Ref	
Time spent in tuition classes				
: >=3 hours per day	52 (47.3)	92 (40.2)	1.34 (0.84-2.11)	0.22
: < 3 hours per day	58 (52.7)	137 (59.8)	Ref	

Table 4. Adjusted odds ratios for overweight

Cases	β	Standard error No. (%)	Odds Ratio (95% CI)	p value
Mother's employment	0.46	0.25	1.58 (0.98-2.57)	0.06
Sleeping more than 8 hours per day	0.77	0.24	0.46 (0.29-0.74)	**0.001**
Less physical activity during weekends	0.77	0.29	2.17 (1.22-3.84)	**0.008**

Less physical activity assessed by activities done during weekends was a risk factor for overweight. Results were consistent with the results of another study done by Veugelers and Fitzgerald, which had shown that more physical activities decrease the risk of overweight (5). However, a statistically significant relationship with physical activity and overweight was not detected by two other Sri Lankan studies (3, 8). The difference of results may be due to the different methods of assessing physical activity or differences in study populations. Many cross sectional data had revealed inverse relationship between BMI and physical activity (18-20). However, such correlations did not demonstrate cause and effect relationship. It was difficult to be certain whether over-weight individuals were less active because of their obesity or whether a low level of activity caused the obesity.

Sleeping more than 8 hours per day had decreased the risk of overweight. There was no statistically significant association between sleeping in day time and overweight. The results were consistent with global studies (9, 11). Short sleeping hours was a risk factor for overweight as revealed by Huil et al. in their case control study in Hong Kong with children aged 6 to 7 years (9). By logistic regression analysis, a dose-response effect between sleeping duration and overweight was shown. Nine hours per day was taken as reference there. Odds ratio for 9 to 11 hours was 0.54 (95% CI=0.3, 0.97) and OR for more than 11 hours was 0.31 (95% CI=0.11, 0.87). It has been suggested that this relationship may be the result of hormonal mechanism, such as reduction in growth hormone secretion and increase in serum cortisol concentration. The same association was seen in a study carried out in Korean children (11). A longitudinal study done among New Zealand children showed that those who do not get enough sleep are at increased risk of becoming overweight. The weight gain has been described as a result of increased fat deposition rather than additional accumulation of fat free mass (12). A critical review conducted to detect the association between sleep duration and obesity in community has shown a clear pattern that shorter sleep durations were associated with obesity in paediatric population (13). It is not possible to determine whether overweight causes lack of sleep or whether short sleeping duration results in weight gain. Laboratory research and further epidemiological studies specially randomized controlled trials are needed to better understand this association.

A significant association was detected in the univariate analysis (p=0.03) between mother being employed and child's overweight, which may be due to other confounding factors. A significant association between using fruits or vegetables with overweight was not detected in the present study. High fibre diets such as vegetables and fruits limit energy intake and reduce the weight gain (1). High intake of dietary fibre promotes weight loss (21). One study had shown that there was a negative association with fruit consumption and adolescent's overweight among Grade 8 students (8). A lower fruit-eating frequency was revealed as a risk factor for children's overweight by a study carried out in Korean children (11). Failure to detect a significant association in the present study may be due to the errors in reporting food frequency leading to bias. Ideally, food frequency questionnaire should be complemented with portion size assessment. Dietary records with portion sizes would give more valid information than food frequency questionnaire. Assessment of frequency of food items consumption over one week may not be adequate to assess dietary patterns.

Conclusions and Recommendations

Less physical activity during weekends and overall less physical activity were identified as risk factors for overweight. Sleeping more than eight hours per day was a protective factor for overweight. Though not statistically significant, overweight showed a positive association with fatty food and a negative association with high fibre diet.

Parents, teachers and students should be educated regarding the fact that low physical activity is a risk factor for overweight. School curriculum should be revised giving more weightage to physical activity rather than having just a physical education period. Participating at least one physically active sport can be made compulsory for each and every student. Compulsory physical education classes should be implemented in schools. Adequate sleeping, at least eight hours per day, should be encouraged via parents and teachers. Fatty food consumption should be discouraged while high fibre diet consumption should be encouraged with public health policies. It is necessary to educate parents, teachers and students regarding overweight and its consequences.

Public health implications

The risk of getting overweight when performing less physical activity and having less sleeping hours should be taken into consideration when planning programmes to reduce childhood overweight. More opportunities should be available for children to have plenty of physical activities and adequate sleep in order to live as healthy adults in future. Parents, teachers as well as children have the responsibility to lessen overweight.

Author Declarations

Competing interests: The authors declare that they have no competing interests.

Ethics approval and consent to participate: Ethics clearance was granted by Ethics Review Committee of the Faculty of Medicine, University of Kelaniya. Written authorization was obtained from the Zonal Education Director of the Gampaha educational zone. Informed, written consent was taken from parents of selected students.

Author contributions: UP was the principal investigator of the study. UP and CA were involved in the conception and design, acquisition of data, analysis and interpretation of data. UP was involved in drafting the manuscript. UP and CA revised it critically for important intellectual content, and gave final approval of the version.

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