

Factors associated with obesity in primary-school children in Singapore

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An upward trend in obesity has been observed in Singapore school children over the 15 years prior to the study. A case-control study of 400 children (mean age 10 years) and their parents was conducted to determine some of the factors likely to be associated with obesity in primary-school children. It included dietary practices and intake, activity patterns, family history and social factors. It was found that obese children were more likely to consume foods that were deep-fried or sweet and were more likely to have at least one obese parent and sibling. A variety of intervention measures were taken to reduce the prevalence and severity of obesity in school children following the study.

Introduction

Obesity is an important medical condition afflicting our school children. An upward trend had been observed in school children over the 15 years prior to the study. For boys, the prevalence of obesity has increased from 9% in 1984 to 14.5% in 1989 and for girls, it has risen from 8% to 10.4% over the same period¹.

This is a matter of concern as obesity predisposes children to a multitude of chronic disorders later on in life. Most studies, retrospective and prospective, had indicated that obese children were at increased risk of becoming obese adults^{2,6}. This was especially so with a later age of onset of obesity, increased severity of obesity and a family history of obesity. Excessive overweight in puberty was associated with higher than expected morbidity and mortality in adult life³. In the United States, pediatric hypertension was found to be associated with obesity in children⁷. Local studies of obese school children showed that 11% had elevated blood cholesterol levels (>200 mg/dl), 32% had elevated blood triglycerides (>100 mg/dl), and 30% had a LDL:HDL ratio of >3. The very obese (relative weight-for-height >160%) were also found to have poorer lung function (expiratory flow rates and maximum voluntary ventilation) and significantly poorer self-esteem compared to the less obese⁶.

Recognizing the importance of this problem, the National Committee on the Prevention and Control of Obesity was established to study the factors contributing to obesity in Singapore, and to formulate an action plan to deal with the problem. This committee comprised representatives from the Ministry of Health, Ministry of Defence, Ministry of Education, College of Physical Education, Singapore Sports Council, Singapore Dietitians' Association and the Department of Community, Occupational and Family Medicine. One of the recommendations of the committee was to conduct a study to determine the factors associated with obesity in our school children¹. This study was therefore carried out on the dietary and activity patterns of primary-

school children in order to provide useful information for planning and implementing intervention programmes to prevent and control obesity in school children.

Methods

A case-control study was used to achieve the above objective. Ten primary schools with reasonably large enrolment were selected by the Ministry of Education to ensure that all geographical zones were adequately covered.

All children in primary four (mean age 10 years) were first screened based on height and weight measurements taken by a team of experienced nurses using equipment that was calibrated daily. Height was measured to the nearest 0.5 cm without shoes and with the occiput, scapulae, buttocks and heels touching the wall, eyes looking straight (Frankfurt plane parallel to the floor) and a set square resting on the vertex. The measuring tape was fixed to the wall and calibrated against the known height of one of the observers. Weight was taken using bathroom scales with readings to a maximum of 120 kg and increments of 0.5 kg. Calibration was done with known weights.

The weight-for-height standards from the School Health Service, Ministry of Health⁸ were utilized to classify the children as obese ($\geq 120\%$ median weight-for-height) or of normal weight ($\geq 90\%$ and $\leq 110\%$ median weight-for-height).

A total of 200 obese children were selected randomly as cases using the computer statistical programme, Epistat. Another 200 children with normal weight were then selected as controls, matching for race and sex.

Interviews of the 400 children and their parents were carried out by a team of nutritionists, dietitians and nurses

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trained in interview techniques eliciting history of dietary and exercise patterns. Interview of the children took place in the respective schools while the parents were given a choice of either being interviewed in person or over the telephone. Almost all parents opted for the telephone interview.

All completed questionnaires were scrutinized and edited by the supervisors for completeness, reliability and consistency. Whenever necessary, responses were verified and errors and omissions rectified.

Statistical analysis was performed using the statistical package, Statistical Analysis System (SAS 6.02). The chi-square test was used to test the null hypothesis that there was no difference in the factors being studied between the cases and the controls. The difference was statistically significant when the *P* value was less than or equal to 0.05.

Factors studied

Dietary practices

Data on the frequency of intake, preparation and source of meals and snacks were collected using a questionnaire. The children were also required to recall a typical diet over a 24-hour period. The energy requirements of the children are shown in Table 1.

Table 1 The energy requirements of the children.

	Height (cm)*	Weight (kg)*	Requirements† (kcal/kg/day)
Boys	140	32.2	66.5
Girls	142	33.7	56.7

* Average weight and height measurements, School Health Service standards⁸.

† Requirements based on WHO's recommendations for moderately active children¹¹.

Children who consumed more than 100% of their daily requirements were classified as having high intake; those who consumed between 50% to 100% as having moderate intake; and those with consumption less than 50% as having low intake.

Activity patterns

Energy expenditure was assessed according to the activities done both in and out of school. Based on criteria set by the College of Physical Education, children were classified into very active, active, moderately active or insufficiently active (Table 2).

Table 2. Activity level (kcal per week).

	Boys	Girls
Very active	>600	>612
Active	399-600	410-612
Moderately active	196-398	202-409
Insufficiently active	<195	<201

The children were questioned on the sporting activities they performed both in and out of school. Questions on the amount of time spent on sedentary activities like studying, watching television, playing computer games, reading, were also asked.

Family history

An attempt to assess the contribution of genetic factors towards the development of obesity was made. Self-reported height and weight measurements of both parents were obtained from one of the parents. The body mass index (BMI) was computed based on these. A BMI of ≥ 30 was classified as obese. For families with more than one child, parents were asked if the other children were obese.

Social history

Information on the parents' educational level, occupation and income were obtained either from existing students' record or by direct questioning.

Results

Dietary practices

Frequency of intake, preparation and source of main meals. For the main meals, there was no significant difference between the cases and the controls regarding the frequency of meals, preparation of meals (home-cooked or bought) and source of bought food. For breakfast, lunch and dinner, the proportion of children who ate at home was 80.3%, 83.9% and 95.7% respectively. The two main sources of meals eaten out of home for the children were school tuckshops (40.2%) and hawker centres/coffee shops (54.2%).

Frequency of intake and source of snacks. Snacks were food consumed between the main meals. Most children (65.3% of cases and 75.9% of controls) took snacks two to three times a day. The food items frequently taken as snacks by both the cases and controls were sweetened drinks (cordials, aerated drinks, etc.), beverages (coffee, tea, milk, milo, etc.), biscuits, noodle soup, deep-fried foods and sandwiches. The source of snacks varied between the cases and the controls. More cases obtained their snacks from outside of home as opposed to the controls. This difference was not significant statistically.

Intake of deep-fried food, western fast food, sweetened drinks, sweets and sweet desserts. There was no significant difference in the frequency of intake of western fast food, sweetened drinks, sweets and sweet desserts. A significantly higher proportion of cases had more frequent intake of deep fried food (≥ 6 times a week) compared to the controls.

Table 3. Distribution of cases and controls by mean total energy intake.

	Mean total energy intake (kcal)		RDA (kcal)
	Case	Control	
Boys	2369	2196	2140
Girls	2057	1978	1910

Total daily intake of energy. The mean energy intake for the cases and controls by meals are shown in Table 3. Using the unpaired t-test, no significant difference was detected in the total daily intake of energy between the cases and controls.

There was no significant difference in the proportion of cases and controls in the high intake, moderate intake and low intake groups. More than half of the boys (58.3%) and girls (54.5) fell into the moderate intake groups, consuming between 50–100% of their energy requirements.

Activity patterns

Physical education sessions. Almost all children (95.8%) attended two physical education sessions per week regularly, each session lasting 30–35 minutes.

Activity status. The mean energy expenditure of boys was 2404 kcal for the cases and 2209 kcal for the controls. For girls, the figures were 2078 kcal and 1972 kcal, respectively. No significant difference was detected between the energy expenditure of the cases and controls using the unpaired t-test.

Using the criteria described earlier, 65.9% of girls and 73.3% of boys fell into either the active or very active categories for energy expenditure. No significant difference in energy expenditure was observed between the proportion of cases and controls in all the categories.

Time spent on sedentary activities. More than half the students spent 20–40 hours per week on sedentary activities. The cases were not observed to be more sedentary compared to the controls.

Family history

A strong family history of obesity among the parents and siblings of the cases was obtained. 23.0% of cases had at least one obese parent compared to 12.0% of the controls. Similarly, 26.0% of the cases had at least one obese sibling compared to 15.6% of the controls. These differences were all statistically significant ($P \leq 0.05$).

Discussion

From this study, it has been found that the obese children were not consuming more food energy than the controls. Thus overeating did not seem to be a necessary contributing factor towards childhood obesity. This is not surprising, as results of nutritional assessment of the diets of obese children in the past 30 years have refuted this generally held belief⁹. However, the obese children tended to consume more deep-fried foods, sweetened drinks, sweet desserts and candies.

There was evidence that obesity tended to run in the families of the cases. It could be hypothesized from the above that those children who are predisposed would become obese even if their intake is similar to those of children without such history. The likely reason should be that obese people have lower metabolic rates and energy expenditure as shown in some studies¹⁰. Therefore, even though obese individuals

may not eat more than their leaner counterparts, they could still be consuming more than they actually need.

There was no evidence to suggest that the cases spent more time on sedentary activities or were less active compared to the controls. However, the generally long hours spent in sedentary activities might have contributed to the rising trend of obesity among our school children. Those who are metabolically most susceptible to weight gain will be at risk of doing so even if they are not more inactive than their peers.

With this information, some measures were undertaken to enable the children to adopt healthier eating habits and activity patterns. As the school tuckshop was found to be the major supplier of bought food, a pilot school tuckshop project was implemented in six schools. In this project a variety of nutrition education activities were directed at the children and their parents, teachers and principals and the school tuckshop operators. Foods sold in the school tuckshops were assessed and recommendations made to ensure that foods with less oil and sugar were supplied together with more fruit and vegetables. Following the success of this pilot project, guidelines for the provision of healthier food choices in the school tuckshops were drawn up for implementation in all schools in Singapore. A 'Trim and Fit' (TAF) scheme was also initiated for overweight students. The scheme aims to help overweight students maintain a healthy weight through healthy eating and regular exercise. All new students entering school in 1994 will also receive a leaflet educating them on the importance of healthy eating in the school tuckshops.

References

- 1 Report of the National Committee on the Prevention and Control of Obesity in Singapore. Ministry of Health, Singapore, 1991.
- 2 Freedman DS, Shear CL, Burke GL, Srinivasan SR, Webber LS, Harsha DW, Bergenson GS. Persistence of juvenile-onset obesity over eight years. The Bogalusa Heart Study. *Am J Pub Hlth* 1987; 77:588–92.
- 3 Sørensen TIA, Sonne-Holm S. Risk in childhood of development of severe adult obesity: retrospective, population-based case-cohort study. *Am J Epidemiol* 1988; 127:104–13.
- 4 Royal College of Physicians. Obesity. *J Roy Coll Physicns* 1983; 17(1):3–58.
- 5 Braddon FEM, Rodgers B, Wadsworth MEJ, Davies JMC. Onset of obesity in a 36-year birth cohort study. *Br Med J* 1980; 293:299–302.
- 6 Ho TF. Prevalence and significance of childhood obesity in Singapore. Proceedings of the symposium on nutrition and our changing lifestyles, 1989:30–33.
- 7 Gortmaker SL, Dietz WH, Sobol A, Wehler CA. Increasing paediatric obesity in the United States. *Am J Dis Child* 1987; 141:535–540.
- 8 Growth charts of Singapore school children, 1983. School Health Service, Ministry of Health, Singapore.
- 9 Kneebone G. Obesity in children. *J Paediatr Obstets Gynaecol* 1990; (Mar/Apr): 33–36.
- 10 Miller DS, Parsonage S. Resistance to slimming: adaptation or illusion? *Lancet* 1975; 1:773.
- 11 Energy and protein requirements. Report of a Joint FAO/WHO/UNU Expert Consultation. Tech Rep Ser 724. Geneva: WHO, 1985.

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Asia Pacific Journal of Clinical Nutrition 1994; 3: 65-68**新加坡小學兒童與肥胖有關的因素****摘要**

過去 15 年，新加坡學校兒童的肥胖症已有上升的趨勢。作者選用了 400 名兒童（平均年齡 10 歲）和他們的父母為對象，測定某些與小學兒童肥胖症有關的因素。這些因素包括膳食習慣與飲食、活動模式、家庭歷史和社會因素。結果發現肥胖兒童多半進食油炸食物或甜品，同時通常最少有一個肥胖的父母和同胞兄弟或姐妹。該研究以後，作者正採用多種措施去減少學校兒童肥胖症的患病率和嚴重程度。