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ORIGINAL ARTICLE

Identification and follow-up of obesity in ten-year-old school children

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Abstract

Objective. Growth surveillance of children in school health services is a routine in Sweden. We describe the effect at follow-up of an overt identification of obesity in school children. *Methods*. Follow-up data were collected in two populations of ten-year-old children with obesity. Children in the study group belonged to a cohort born in 1990. Here the presence of obesity had been identified at the routine growth screening, and intervention activities against obesity had been actively offered. Controls belonged to a cohort born in 1989. *Results*. Of the 176 children with obesity, 91 were in the study group (41 girls) and 85 (44 girls) in the control group. No differences were found between the groups in age, gender or body mass index at baseline. At follow-up, after one to two years, children in the study group had a modest but significantly more pronounced decrease in the relative body mass index, compared with controls. The mean difference between the populations in body mass index standard deviation score (z-score) after adjustment for baseline body mass index and follow-up time was -0.14 (95% confidence interval: -0.25 to -0.02; $P=0.027$). Socioeconomic status, gender, follow-up time and group were independent predictors for change in body mass index z-score. *Conclusions*. To identify children with obesity in a routine school health survey may be a crucial initial step in the management of childhood obesity.

Key words: *Body mass index, child, gender, identification, intervention, prevention, obesity, school health services, screening, socioeconomic status, Sweden*

Introduction

The prevalence of obesity in children has increased rapidly during the past 20 years. Obesity has been denoted as a worldwide epidemic (1), and poses a major risk for serious health consequences and reduces the overall quality of life in children (2,3). The magnitude of the problem with childhood obesity calls for a population-level approach to significantly affect the prevalence of obesity (4,5). Identification of children with obesity has been suggested as an effective targeted preventive measure to be applied at every well-child examination (4,6). Body mass index (BMI) is a reasonable measure to use in the screening for children with obesity (7). The aim of the present study was to describe the effect of an overt identification of obesity in ten-year-old children at the routine health visits in school.

Methods

A regional unit for the school health service in the city of Göteborg in Sweden supports the specialised health nurses and consulting physicians who provide school health services at schools. The program for regional repeated health examinations, health education, health dialogue, and growth monitoring are based on national guidelines for school health services (8).

The present study was performed in the school health services in the city of Göteborg during the years 2001 to 2003. Measurements of weight, height and, BMI were acquired at follow-up visits and retrospectively in two groups of children who were obese at ten years of age. The two groups were recruited separately from two cohorts of children born in 1990 and 1989, described below as the study group and the control group, respectively.

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The BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2). The BMI was also transformed to the BMI Standard Deviation Score (BMI SDS) to obtain a standardization of the BMI-measurements for age and gender in relation to a reference population (9).

To define obesity in children at ten years of age, the nurses used BMI ≥ 25 kg/m^2, irrespective of gender. This was a simplified modification of the published age and gender specific BMI cut-off values to define obesity in children (10), where the cut-offs defining obesity in 9.75 to 11.25 year-old children range from 24.0–25.4 kg/m^2.

Study group

In regular school health visits during the years 2000 to 2001, in the cohort of ten-year-old school children born in 1990, 116 of 4731 (2.4%) children were identified as obese. These children participated in a prevalence study (11) and were actively offered intervention and follow-up by the school health services. The intervention consisted of regular visits with the nurse, individual advice of sound nutrition and exercise, also in writing, and mobilisation of the whole family to support the change of habits in everyday life. For those who wished, the school health services also referred children to the paediatric outpatient clinics for medical care against obesity.

The school nurses managed to trace data in 96 of the initial 116 children with obesity. At follow-up, five of the most severely obese children dropped out: one boy did not want to measure his weight (BMI 30.1 kg/m^2 at ten years of age); one boy did not attend the follow-up at all (BMI 37.1 kg/m^2 at ten years of age); two girls had moved to schools outside Göteborg (BMI 30.0 and 26.5 kg/m^2 at ten years of age); and for one girl (BMI 33.2 kg/m^2 at ten years of age), the headmaster and school nurse declined to participate in the study at the follow-up.

Control group

In the cohort of 4495 12-year-old children born in 1989, 88 (1.9%) children were detected as obese when they were 10 years old. Here the regular school health visits had been performed using old routines. In other words, children had not been identified as obese at the screening, nor had they actively been offered intervention and follow-up by the school health services. At the follow-up of weight and height in the control group, retrospectively, data corresponding to those of the study group were collected for comparison. Three of the 88 children dropped out at follow-up: two girls did not want to measure weight (BMI 28.3 kg/m^2 and 25.6 kg/m^2 at ten years of age), and one girl had left to live outside the country (BMI 25.6 kg/m^2 at ten years of age).

Interventions to counteract obesity in children

At follow-up, a record of the data of intervention activity over the observation time was collected in both groups of children with obesity. In essence, the interventions provided by the school health services to children in the study group meant promotion of a healthy lifestyle targeted at both children and parents. Most of them also had information in writing, advice about nutritious eating habits, scheduled meals and daily physical activity, and regularly assessments of weight and height. For those having had a referral to medical care, additional interventions were provided at the medical ward by a team of professionals, such as paediatricians, dieticians, physiotherapists and occasionally also psychologists. Compared with the study group, the intervention in the control group was limited. Most of the children had isolated health visits at the nurse's office including weight monitoring and general advice in line with national guidelines, such as an example of a balanced diet chart. The intervention activities to counteract obesity in the two groups of children were classified as: 1) referral to medical care, 2) intervention without referral, or 3) no intervention.

The socioeconomic status in school districts

The City of Göteborg, with about 500 000 inhabitants, can be considered representative of urban areas in Sweden demonstrating a large range in socioeconomic status (SES) in its 21 city districts. Low SES is found in the northeastern suburban areas and high SES in the west and south regions of the city, close to the coast. In a previous study, an index of the local SES of all 21 city districts was derived from four parameters: The average income of men aged 25–49; the participation rate in the latest general election; the number of single parents with children <16 years of age; and the number of blue collar workers (12). As the regional unit of school health service in Göteborg uses this index to characterize schools into high, intermediate or low SES, we found it helpful to use this method. By using the school addresses, the children were classified according to the SES of the school district into: 1) high SES, 2) intermediate SES, or 3) low SES.

Statistical methods

Data were analysed by software SAS 8.2. To measure the comparison between groups, Mann-Whitney

U-test was used for continuous variables. Fisher's Exact test was used for dichotomous variables and Mantel-Haenszel Chi-2 test for ordered categorical variables. In order to adjust for baseline covariates and follow-up time, analyses of covariance (ANCOVA) were performed. Stepwise linear regression was used to select independent predictors for change in BMI SDS. All significance tests were two-tailed and conducted at 5% level.

Ethical approval

Ethical approval was obtained from the Ethical Committee at the Sahlgrenska University Hospital of Göteborg University (Study group #Ö293-00 and Control group #Ö397-01).

Results

A total of 176 children remained for evaluation at follow-up, 91 children (41 girls) in the study group and 85 children (44 girls) in the control group. At baseline, there were no differences between the groups in the distribution of gender, age, weight, height, BMI, or BMI SDS. The percent of children belonging to school districts of low, intermediate and high socioeconomic status were 46%, 30% and 24% in the study group and 47%, 31% and 22% in the control group (non-significant). The prevalence of obesity was highest in low SES districts both in the study and control groups, 46% and 47%, respectively (Table I).

The mean follow-up time was 1.3 years (standard deviation, SD = 0.42) in the study group and 2.1 years (SD = 0.48) in the control group ($p < 0.001$). At follow-up, age, weight and height were significantly different between the two groups ($p < 0.0001$, $p = 0.003$ and $p = 0.006$, respectively). The BMI and BMI SDS did not differ at follow-up ($p = 0.14$ for both) (Table II).

In Figure 1, the development of mean BMI SDS in the two groups from baseline to follow-up is illustrated.

To assess whether the outcome of BMI and BMI SDS differed between the groups at follow-up, analyses of covariance were used after adjustment for covariates (time to follow-up and BMI at baseline). BMI at follow-up was significantly ($p = 0.041$) higher in the control group (adjusted mean = 28.94 kg/m^2) compared with the study group (adjusted mean = 28.09 kg/m^2). The adjusted mean difference in BMI between the two groups was −0.85 (95% CI −1.66; −0.03). BMI SDS at follow-up was also significantly higher in the control group (adjusted mean = 2.84, $p = 0.027$) compared with the study group (adjusted mean = 2.71) after adjustment for time to follow-up and BMI SDS at baseline. The adjusted mean difference between the groups was −0.14 (95% CI −0.25; −0.02). Exactly the same p-values were obtained when the analyses were repeated with change in BMI and BMI SDS as dependent variable. If the analysis were also adjusted for socioeconomic categories, the adjusted mean difference for BMI SDS between the two groups was −0.12 (95% CI −0.24; −0.01).

The impact of different variables on the mean change in BMI SDS was studied in a regression model. First, group (study group, control group), SES (low, intermediate and high), gender, intervention activity (referral to medical care, intervention without referral, no intervention) were included as independent variables. Only 7% of the variation was explained with SES, higher values predict better outcome $\beta = -0.09$ ($p = 0.0016$), and gender, with boys having better outcome $\beta = -0.10$ ($p = 0.0397$), as significant variables. When duration to follow-up was added to the model, SES ($\beta = -0.09$, $p = 0.0024$), duration (longer time predicts better outcome $\beta = -0.18$, $p = 0.0005$), gender ($\beta = -0.11$, $p = 0.0134$) and group (study group predicts better outcome $\beta = 0.13$, $p = 0.0352$) were significant

Table I. Mean data at baseline of children with obesity by group, gender, total and group difference, and also the prevalence of obesity by socioeconomic districts (p-value and n [%]).

Mean (SD) Baseline	Study group (identified)			Control group			Differences Study group vs. Control group
	Boys n = 50	Girls n = 41	Total n = 91	Boys n = 41	Girls n = 44	Total n = 85	Total n = 176 p-value
Age (y)	10.6	10.5	10.6 (0.4)	10.6	10.5	10.6 (0.4)	0.58
Weight (kg)	62.2	62.4	62.3 (7.7)	61.5	59.5	60.5 (7.6)	0.11
Height (cm)	149.9	149.9	149.9 (6.5)	149.7	148.0	148.8 (6.9)	0.26
BMI (kg/m^2)	27.6	27.7	27.6 (2.2)	27.4	27.1	27.2 (2.0)	0.12
BMI (SDS)	3.26	2.84	3.07 (0.35)	3.23	2.76	2.99 (0.36)	0.14
SES (n (%))							0.82
Low	25 (50%)	17 (42%)	42 (46%)	22 (54%)	18 (41%)	40 (47%)	
Intermediate	13 (26%)	14 (34%)	27 (30%)	12 (29%)	14 (32%)	26 (31%)	
High	12 (24%)	10 (24%)	22 (24%)	7 (17%)	12 (27%)	19 (22%)	

Table II. Mean data at follow-up of children with obesity by group, gender, total and group difference.

Mean (SD) Characteristics Follow-up	Study group (identified) Boys n = 50	Girls n = 41	Total n = 91	Control group Boys n = 41	Girls n = 44	Total n = 85	Difference Study group vs Control group Unadjusted n = 176 p-value	Adjusted* n = 176 p-value
Time in study (y)	1.3	1.4	1.3 (0.42)	2.0	2.1	2.1 (0.48)	<0.0001	–
Age (y)	11.9	11.9	11.9 (0.5)	12.6	12.7	12.6 (0.6)	<0.0001	–
Weight (kg)	70.9	70.0	70.5 (9.5)	77.9	72.3	75.0 (10.1)	0.0032	0.0081
Height (cm)	157.9	157.7	157.8 (7.7)	163.2	159.4	161.3 (7.9)	0.0063	0.2304
BMI (kg/m^2)	28.4	28.1	28.2 (2.86)	29.2	28.4	28.8 (2.69)	0.14	0.0410
BMI (SDS)	3.0	2.6	2.81 (0.45)	2.9	2.6	2.73 (0.42)	0.14	0.0275

*Analyses of covariance adjusted for group, baseline values and follow-up time.

independent determinants ($R^2 = 0.14$), while intervention activity was non-significant.

In the two studies, interventions over observation time initiated by the school staff were registered. In Table III, the distribution of children by intervention categories is presented. There was a significant difference of intervention activities between the groups ($p < 0.0001$). Referral to medical care was done in 45% vs. 15% and no intervention was noted in 18% vs. 54% in the study and control group, respectively.

Discussion

An overt identification of children with obesity by screening of growth in the regular school health service may be an important preventive measure. In the present study, children identified as obese had a significantly more pronounced decrease in body mass index compared with the controls. The size of the effect at follow-up was modest, with a difference after adjustment for covariates of -0.85 kg/m^2 for BMI and -0.14 for BMI SDS at the 1 to 2 year follow-up.

However, the limited effect should be considered in relation to the small changes in routine that were done in the intervention, i.e. active identification of obesity. In Sweden, where there is ongoing regular health screening in schools, the costs and the volume of work to change the program to an overt identification of children with obesity is minor. It is quite remarkable that a different way to approach children with obesity can be detected at all in the outcome of BMI at follow-up.

There are several school-based interventions to prevent overweight in childhood. Many studies show limited but significant effects comparable with this study. Reducing children's TV viewing in normal weight students, who were 9 years of age, was found to have a significant effect on BMI at a one-year follow-up, the adjusted difference in BMI between the intervention and control group was -0.45 kg/m^2 (13). An intervention study in 11–12 year-old children ($n = 766$) with counselling on nutrition and physical activity showed significant differences in BMI, 18.0 vs. 18.4 kg/m^2, for intervention and control group at the one-year follow-up (14). Another intervention study with an increase of physical activity and an introduction of a healthier diet resulted in a non-significant difference compared with controls in girls at the two-year follow-up, while a significant effect was present in boys (the change in

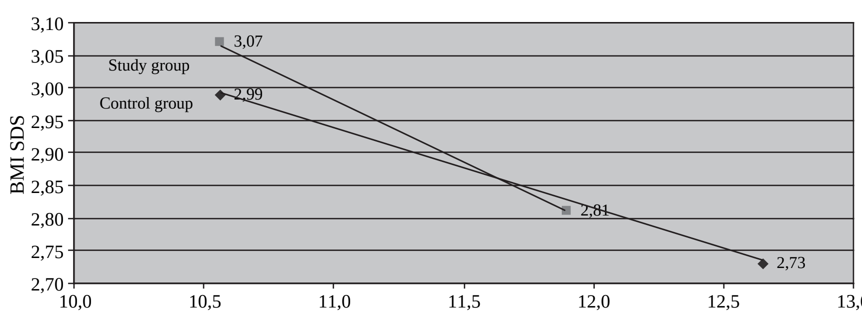

Figure 1. Development of mean BMI SDS from baseline to follow up in the two groups of children with obesity.

Table III. The distribution of children by group and intervention in school health services.

n (%)	Study group (Identified) n = 91	Control group n = 85
Referral to medical care	41 (45%)	13 (15%)
Intervention without referral	34 (37%)	26 (31%)
No intervention	16 (18%)	46 (54%)
Total	91 (100%)	85 (100%)

The distribution of intervention by groups significantly differed ($p < 0.0001$).

BMI was -0.28 kg/m^2 vs. $+0.36$ kg/m^2 for intervention vs. controls) (15). Other studies on normal weight school children showed significant effects on the prevalence of obesity and overweight. The simple message to reduce the intake of carbonated drinks was found to give a significant difference in the prevalence of overweight and obesity (16). Some studies, such as the Planet Health (17) and Dance for Health (18), were interventions found to be effective in girls only. Several school-based studies have been performed where no significant effects of the interventions were seen (19–21).

The study subjects in this study were children with obesity and the effect of interventions may also be compared with treatment studies. Many of these show high dropout rates and no significant effect at follow-up in spite of intense programs (22). One recent study with an intense family-based program in 8–16 year olds gave a significant 12-month difference in BMI of 3.3 kg/m^2 compared with controls (23). This effect might be seen as a possible upper limit of treatment effects. However, the difference in the outcome is great compared with the present study, but so is also the costs and intensity of the program.

The healthcare system in Sweden has performed standardised registrations of weight and height in children for several decades and growth charts for BMI have been used as the Swedish reference since 2000 (24,25). The national guidelines for school health services in Sweden recommend giving priority to childhood overweight (26). To use BMI monitoring of school children and identify obesity using specific cut-offs is hypothesised to do little or no harm and result in awareness among parents leading to changes in lifestyle and also a possibility of a decreasing trend of obesity (27).

A number of limitations were seen in this study designed as a descriptive observational study: the children were not randomized for intervention, the data was collected retrospectively; the groups had different follow-up times; and obesity in the ten-year-old children was defined by using BMI $\geq$25 kg/m^2. However, the latter is a simplified cut-off point of BMI, which was used to facilitate the data collection for the school nurses. If the exact age- and gender specific cut-off values to define child obesity (10) had been used, a larger number of children with BMI between 24 and 25 kg/m^2 would have been included. When designing the study we felt that gains in compliance and cooperation from the nurses would compensate for the drawbacks of a simplified cut-off for the screening. It should be pointed out that the screening work by the nurses was not computerized.

The prevalence of obesity in this study appeared to be highest in low SES districts. This is under the condition that the individual SES is homogenous in schools with different SES levels. Children from low SES districts decreased their adjusted mean BMI and BMI SDS to a lesser degree than the others. The importance of SES has also been observed by others (28) where many factors may contribute, such as low maternal education (29), parental neglect (30) or low physical activity associated with weak parental emotional support and the family's SES (31). The regression model used, to analyze possible determinants of the mean change in BMI SDS, showed significant values in relation to SES, duration to follow-up, gender and group but not to intervention activity. Consequently, when only 14% of the variation in BMI was explained by these factors, it might illustrate the many possible etiologic factors leading to obesity in childhood.

The dropouts might reflect a problem in the care of children with obesity, who often avoid interventions and follow-up contacts (32). The mean BMI at baseline was below 28 kg/m^2 for participants, while in 4 of 5 dropouts it was between 30 and 37 kg/m^2. To understand the reason for this avoidance is most important. It could be based on the co-morbidities of obesity (2), low self-esteem, alienation, behavioral aspects (33), and lack of support from the family (3), parental overweight and also high prevalence of obesity-related health problems in the community (32). Prevention of obesity, if possible, might be the best way to handle this problem.

The present study shows that the mere identification of children with obesity at growth screening in school health services is a simple measure in the prevention and management of childhood obesity. We suggest that further randomised controlled trials should assess the validity of this procedure. Both the possible beneficial effects and the adverse events of screening and identifying children with obesity in school health services must be addressed. There is also a need for qualitative studies to address the efficacy and effectiveness of childhood overweight interventions (34).

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