ACTA PÆDIATRICA
NURTURING THE CHILD

Acta Pædiatrica ISSN 0803-5253

REGULAR ARTICLE

Five-year outpatient programme that provided children with continuous behavioural obesity treatment enjoyed high success rate

Pernilla Danielsson (pernilla.danielsson@ki.se)[1], Anna Bohlin[2], Ana Bendito[2], Annie Svensson[2], Sven Klaesson[2]

1.Department of Clinical Science, Division of Pediatrics, Karolinska Institutet, Intervention and Technology (CLINTEC), Stockholm, Sweden
2.Department of Women's and Children's Health, Södertälje Hospital, Södertälje, Sweden

Keywords
Behavioural treatment, Childhood obesity, Long-term treatment, Outpatient paediatric clinic

Correspondence
Pernilla Danielsson, PhD, RN, Department of Pediatrics, Karolinska Institutet, B62, SE-141 86 Stockholm, Sweden.
Tel: +46 8 58587423 |
Fax: +46 8 58587200 |
Email: pernilla.danielsson@ki.se

Received
12 May 2015; revised 3 September 2015; accepted 5 February 2016.

DOI:10.1111/apa.13360

ABSTRACT

Aim: Results from long-time follow-up of obesity treatment in early childhood are lacking. We investigate long-term continuous behavioural childhood obesity treatment and factors of importance for treatment effect.

Method: A five-year longitudinal retrospective controlled study of children aged five to 13 years in obesity treatment, divided into three groups depending on age at start of treatment. Outcome is presented as change in degree of obesity, body mass index standard deviation score (BMI SDS), change in weight status and decrease of ≥0.5 BMI SDS units, in relation to a age-matched obese comparison group.

Results: In total, 220 children (46% females) were included. After five years of treatment, the decrease in BMI SDS was significant in all age groups with the largest effect in age group 4-6 years. Compared to the comparison group (n = 369), the decline in BMI SDS was greater (p = 0.001). After five years of treatment, 48% of the patients were cured from their obesity and 72% reached a decline of 0.5 BMI SDS units. Age at start of treatment was the only factor affecting treatment efficacy.

Conclusion: The ability to reach a significant weight loss in a paediatric outpatient clinic is promising through a long-term behavioural obesity treatment.

BACKGROUND

Today, childhood obesity is a major public health problem which has reached epidemic proportions (1,2). Recent statistics show that the prevalence of childhood obesity has stabilised in several developed countries, but is still at historically high levels (2). In Sweden, the prevalence seems to have levelled off at 2–5% obesity 15–24% overweight, the different numbers depending on variations in age, living areas and the socioeconomic status of the families in different studies (3,4). The obese child suffers from a complex pattern of metabolic disorders, low quality of life and poor social integration (1). Metabolic disorders can already be seen in childhood and persist later in life (5,6).

Thus, there is an urgent need for effective childhood obesity treatment. More effort has been made to find well-functioning forms of treatment for children with obesity (7–9). The most common forms of treatment focus on lifestyle interventions involving cognitive and behavioural techniques as well as solution focused and motivational approaches in combination (8) to promote healthy eating habits and physical activity, as well as to reduce time spent in sedentary activities. The forms of behavioural lifestyle interventions vary from group-based, individual- and family-based and combinations of these formats (7). We have previously shown that the outcome of three years of behavioural therapy at a referral obesity centre was good in young children but very poor in adolescents (10,11). The effect of behavioural treatment is especially negligible for severely obese adolescents (10). A recent review by Reinehr concludes that lifestyle interventions are effective in obese children if parents are actively involved, that younger children more easily profit from the intervention, that group settings are more effective, and further, that reduction in sugar-sweetened drinks are the only proven effective diet

Abbreviations

BMI SDS, Body mass index standard deviation score; BVCF, Baseline value carried forward; EPD, Extrapolated data; FAS, Full analysis population; LOCF, Last observation carried forward; MI, Motivational interwieving.

Key Notes

- Results from long-time follow-up of obesity treatment in early childhood are lacking.
- In this longitudinal controlled study, we investigated the effect of behavioural treatment in children aged five to 13 years in an outpatient paediatric clinic.
- After five years of treatment, almost half of the patients were cured from their obesity and age at start of treatment was the only factor affecting the treatment efficacy.

advice (12). Childhood obesity is so common that effective treatment is required in primary childhood healthcare settings. However, long-term results from treatment in such settings are scarce. The majority of published inventions ranged from 12 weeks up to one year and with different follow-up times thereafter (7,12). We have previously shown that the association between one-year and three-year treatment results is poor (11).

In Stockholm, the County Council has created an action plan against childhood obesity based on treatment activities at three different healthcare levels. The action plan is based on stepwise increased activity at more specialised health-care levels. The first level, where the parents and children are supposed to get information and advice, is primary health care in child care centres and schools. The second level is where treatment should be initiated by community-based general paediatricians, and the third level is specialised obesity treatment at paediatric hospitals.

This is a longitudinal retrospective follow-up of a large cohort of children in an outpatient paediatric clinic in Södertälje who are, in other words, at the second level of obesity treatment. The treatment is continuous multidisciplinary behavioural-based lifestyle intervention over five years. Thus, this treatment includes individual, child and parent, and group activities, child and parent separated. The aims of this study were to examine the effect of long-term continuous structured behavioural childhood obesity treatment at a primary healthcare centre, compared to a comparison group from the national registry, and to identify factors of importance for the effect and dropout rate.

SUBJECTS AND METHODS

The multidisciplinary treatment team for obese children is a part of the outpatient paediatric clinic at Södertälje Hospital. Children between five and 13 years of age were enrolled in the programme and were offered continuous behavioural treatment consisting of lifestyle changing support in the clinic until they turned 18 years old. The goal of the treatment was to achieve lasting lifestyle changes that will allow the children to lose weight or grow out of obesity. The model offered both individual meetings child and parent or family together and group activities for parents and children separately. At start of treatment, parents were encouraged to participate in a parental group programme once a week for seven weeks, 90 minutes each time where the aim was to give parents awareness regarding their role in their child's weight development and help parents support lifestyle changes for their child regarding physical activity and diet. During the programme, parents got education about obesity, food choices, the importance of limiting candy, snacks and sugary drinks, the importance of sleep time, how to increase physical activity and decrease screen time for the child and how to support lifestyle changes by being a role model and giving positive reinforcement. The programme included structured discussion among the parents where they got to exchange experiences and is led by a dietician and a nurse with proven knowledge of childhood obesity treatment.

Parallel with the parental group children participated in a weight school, an educational and activity group with a strong emphasis on giving the children positive experiences from physical activity. The education given to the children followed the same themes as the parental group but was given in an age-appropriate way with children divided in two age groups. Parental group and weight school group were offered twice a year. If the parents and, or, child could not participate at the beginning of treatment, they were welcome to join later. A psychologist has consulted the team and participated in the design of the groups. After the group sessions, all families continued with individual treatment. The model included visits to a medical doctor (normally 1–2 times/year), visits to a nurse (1–8 times/year), and for those who needed, visits to a dietician and/or physiotherapist. When visiting the nurse, the child's height and weight is measured and the nurse had a dialogue with the child and one or both parents around the child's weight-development visit time 30–60 minutes. The nurses had education in motivational interviewing (MI) techniques and, or empowerment training. The goal within the treatment team was to offer an empowering attitude during visits, seeking motivation for and giving advice about lifestyle changes to both child and parents. Parents and, or the child were encouraged to control the child's weight at home once a week between visits. The treatment was individualised, and therefore, the frequency of visits varied. During the treatment time, all children had the opportunity to participate in different groups of weekly physical activity within the programme. These groups consisted of four–15 children, and the activities were selected to avoid competitive elements. The activities were, for example, water aerobic, dance, circuit training and spinning. All medical treatment was free of charge, except a minor (aprox 20 EUR/term) fee for the physical activity groups. All obese patients treated at the outpatient clinic at Södertälje hospital were registered in the National Health Care Register for Childhood Obesity, BORIS.

This is a retrospective controlled longitudinal study of patients aged four to 13 years, referred to and treated at the outpatient clinic at Södertälje Hospital, Sweden, between January 2002 and October 2007 (n = 220). A total 95% of the children were classified as obese and 5% overweight according to the criteria suggested by Cole et al. (13). Only children with obesity and severe overweight children with high risk for obesity development or comorbidities are accepted for treatment. All children accepted for treatment during this time period were included in the study (no exclusion criteria were actualised). At the time for evaluation, all children had had the opportunity for a five-year treatment period. Follow-up was terminated after five years of treatment or at the time of loss to follow-up, whichever came first. Patients lost to follow-up were included with an intention-to-treat approach. All data were extracted from the National Health Care Register for Childhood Obesity (BORIS), supervised by the National Board of Health and

Welfare in Sweden. The database includes data from the first visit to the Södertälje outpatient paediatric clinic and comprises background and demographic characteristics such as gender, pubertal status, birthweight, age at onset of obesity, parental weight status, socioeconomic status (parental occupation), immigration status, family living, psychological disorder, diagnosed by physicians according to the guidelines in Sweden and confirmed by the psychologists at the clinic, and weight status (BMI SDS, and ISO BMI) (13,14). Weight and length were assessed in the clinic according to standard procedures on the same equipment. Puberty status according to Tanner was assessed by a paediatrician. All families have accepted to be registered in BORIS, and the study was approved by the Stockholm Regional Ethical Review Board (2007/462-31/2).

The degree of obesity was classified using the BMI standard deviation score (14). BMI SDS was calculated in the database using weight, height, age and gender. The patients were divided into three age groups at start of treatment. The age brackets were 4–6, 7–10 and 11–13 years. Age at onset of obesity was derived from growth charts as the age at which the BMI exceeded ISO BMI 30, in other words, where the BMI trajectory was to be an adult with BMI of 30 (13).

Parental BMI data in the registry was based on self-reported weight and height from the parents at the first clinical visit. The parents were classified with regard to normal weight, overweight and obesity according to the international standards: normal weight (BMI = 18–24.9 kg/m^2), overweight (BMI = 25–29.9 kg/m^2) or obese (BMI $\geq$ 30 kg/m^2). Socioeconomic status was defined in terms of parental occupation/education. This was coded based on official Swedish socioeconomic categories and the Swedish Standard Classification of Occupations provided into three categories: at least one parent with an academic degree, at least one parent with a post-upper secondary school education and others (unemployed, early retired, long-term sick-listed, students, housewives). The treatment effects are described in three different methods: (i) a decrease in the standard deviation scores of BMI (14), (ii) children changing weight status from obesity to overweight or normal weight according to Cole et al. (13) and (iii) a clinically significant weight loss specified as a degree of weight loss reaching a loss of $\geq$0.5 BMI SDS units (15–17).

Patients who missed follow-up visits and those who refused to show up at visits after additional contacts were classified under three main causes of loss to follow-up. Patient's/parents' decision to stop treatment, treatment goals achieved or external causes (e.g. patient moved, patient turned age 18).

Comparison group

To be able to evaluate, the treatment effects in a matched comparison group were identified in the National Health Care Register for Childhood Obesity (BORIS). The comparison group was matched on date and age at start of treatment, further inclusion criteria were treatment in the same healthcare level.

Statistics

The primary statistical analysis in this study was performed using the ANCOVA with regard to the change in BMI SDS at follow-up years 1, 2, 3, 4 and 5; this included BMI SDS at the first visit as a covariate in the model, age at start of treatment, gender, age at onset of obesity, birthweight, psychological disorder, parental weight status, socioeconomic status, family immigration and parents living apart as fixed factors in the model.

Discriminate analysis of completers and noncompleters

Logistic regression was used to perform an exploratory investigation of possible predictors for subjects lost to follow-up, including age at start of treatment, gender, age at onset of obesity, birthweight, psychological disorder, parental weight status, socioeconomic status, family immigration, parents living apart and treatment modality as independent variables in the model. The odds ratio for lost to follow-up (compared to completion) was evaluated using each factor.

Comparisons between the Södertälje cohort and comparison group were performed by calculating Fisher's exact test.

Analyses were performed using Statistica 10.0 (Statsoft Inc. Tulsa, OK, United States of America). All tests used were two-sided, and statistically significant results were set at $p < 5\%$ or 95% confident limits. All analyses are to be regarded as exploratory. No correction for multiple testing was carried out.

Two analysis populations were defined: first, the complete cases population, which included all patients who were completely assessed for BMI SDS from the first visit throughout the five-year follow-up visits, and, second, the full analysis population (FAS), which included all patients who had a first visit. In the FAS population, missing data for patients lost to follow-up were replaced using the last observation carried forward method (LOCF), the baseline value carried forward (BVCF) and extrapolated data (EPD); in other words, missing data in between yearly visits were replaced with the mean of the visit before and the visit after. If there were no visits after, the data were replaced with the last observation carried forward method.

RESULT

Study population

A total of 220 patients (46% female) met the inclusion criteria for this study and had their first visit to the Södertälje outpatient clinic between January 2002 and October 2007. The numbers of children in the three age groups were 33 (age 4–6 years), 85 (age 7–10) and 102 (age 11–13). The mean BMI SDS at start of treatment (first visit) was greatest in the youngest age group. In the youngest age group, all children were classified as obese, corresponding numbers in the other age groups were 96% (age group 7–10 years) and 92% in the oldest age group (11–13 years). The prevalence of acanthosis nigricans was 21%. Additionally, 11 children classified as overweight were also included.

Comparison group: As a comparison group, in total 369 obese children (45% girls, mean age 9.3 years, range 4.3–13.9 years, mean BMI SDS 3.3 SD 0.6) were identified from 20 different outpatient clinics (corresponding to the same healthcare level). The children were divided into the same three age groups, and the numbers and mean BMI SDS were in age group 4–6 year, 80, BMI SDS 3.6 (SD 0.7), 7–10 years, 139, BMI SDS 3.4 (SD 0.7) and 11–13 years, 150, BMI SDS 3.0 (SD 0.4). The prevalence of acanthosis nigricans was 23%. In the Södertälje cohort, psychological disorders were diagnosed in 17% of the children, for example ADHD, and autism spectrum disorders. The prevalence of overweight and obesity among the parents was 79% in the fathers and 65% in the mothers. Two normal weighted parents occurred for 14 (6%) children of the 220. The proportion of children with parents in socioeconomic status three was 32%, 35% of the children had parents living apart and 43% had two parents born in Sweden. No difference in parental weight status, socioeconomic status, family living, or immigration was found between age groups (Table 1).

The results for the primary outcome analysis in the complete cases population showed a decrease in mean BMI SDS over five years. The change in BMI SDS was significantly greater ($p = 0.01$) in the age group 4–6 years followed by 7–10 years, and the smallest change in the 11–13 year group presented in Figure 1. This was detected in all analysis populations (Table 2). The greatest effects were detected during the first year for all groups, with a continued slower decline during years two, three, four and five (Fig. 1).

Compared to the comparison group the Södertälje cohort had a greater decline in BMI SDS for complete cases population ($p < 0.001$) and full analysis population (LOCF) ($p < 0.001$). This was also seen when comparing each separate age group (Fig. 1 and Table 2) (p less than 0.05).

Overall, in the complete cases population in the Södertälje cohort, the proportion of subjects who made a recovery from obese to overweight was 39%, and from obese to normal weight 9% (Fig. 2). No differences between age groups could be statistically demonstrated. Similar results were observed for the full analysis population, where the recovery to overweight was 34% and to normal weight 6%, respectively.

In the comparison group, the proportion of recovery to overweight was 21%, and normal weight 4%, which was statistically significant lower than that in the Södertälje cohort ($p = 0.002$).

Eleven children were overweight at start of treatment; they had significant ($p < 0.001$) better treatment response compared to the children who started as obese ($n = 209$). The largest difference was seen in the age group 11–13 years; in age group 6–9 years, all children were obese at start of treatment. In age group 7–10 years, three children were overweight at start of treatment; one stopped treatment early during year two, one developed obesity during year five and one was still overweight years one through five. In age group 11–13 years, eight children were overweight at start of treatment; five children were overweight during all five years, two children developed obesity and one changed several times between normal and overweight.

In the analysis of the complete cases population, the proportions of children who fulfilled a clinical relevant change of ≥0.5 BMI SDS, were 83% in age group 4–6 years, 80% in age group 7–10 years; and showed statistically significant greater effect than children 11–13 years ($p = 0.03$), where 56% of the children reached a clinically relevant effect after five years. Similar results were observed in the full analysis population age group 4–6 years with 72%, 7–10 years with 67% and 11–13 years with 40%. In the full analysis population (LOCF), 56% of Södertälje cohort reached a clinical relevant effect of ≥0.5 BMI SDS, whereas the corresponding number in the comparison group was 43% ($p < 0.001$).

In the Södertälje cohort, age at start of treatment was the only studied factor that could affect the treatment efficacy. There were no other differences in treatment response or opportunity to benefit from treatment. These results were irrespective of gender, age at onset of obesity, birthweight, psychological disorder, parental weight status, socioeconomic status, immigration and family living.

In total, 50% of families chose to attend the parental education and weight school; 2/3 of them attended at least four of seven sessions. Families with children in age group 7–10 years at start of treatment showed a trend ($p = 0.06$) towards choosing parental education and weight school to a greater extent than parents with children in the other age groups. We were not able to find any other family characteristics that affect which treatment package families chose.

We were not able to detect any differences between treatment effect in the different treatment tracks ($p = 0.8$). There were no statistically differences in treatment response between those who attended groups or not ($p = 0.44$) or if they attended the physical activity groups ($p = 0.14$) in the LOCF population.

The mean number of visits for the whole group during year one was 5.1 and was decreasing during the treatment period to 4.7 for year two, 4.2 for year three, 4.0 for year four and 2.9 for year five; no statistical differences between age groups were found (data not shown). In age group 4–6 years, 11/33 met the dietician sometime during the five-year treatment period, with the corresponding number for age group 7–10 years 46/85 and 54/102 for age group 11–13 years.

In the youngest age group 4-6 years, 45% were lost to follow-up in the Södertälje cohort after 5 years compared to 55% in the comparison group. Conforming values for age groups 7-10 and 11–13 years were 40% (67%) and 60% (82%), respectively (Table 3). The main reason for loss to follow-up was patient's/parents' decision to stop treatment, amounting to 30% in age group 4–6 years, 24% in age group 7–10 years and 43% in the oldest age group, 11–13 years.

In the Södertälje cohort, age was significantly related to the risk of drop out ($p = 0.002$). Patients in age group 4–6 and 7–10 had lower odds of being lost to follow-up

Table 1 Descriptive statistics of subject characteristics, that is mean and standard deviation for continuous variables and frequency for categorical variables

	4–6 year n = 33	7–10 year n = 85	11–13 year n = 102	Total n = 220
Mean age (SD)	6.1 (0.5)	8.3 (0.8)	11.5 (0.9)	9.5 (2.2)
Female (%)	61%	53%	36%	46%
Tanner score				
1	5 (15%)	17 (20%)	25 (25%)	47 (21%)
2		2 (2%)	14 (14%)	16 (7%)
3		1 (1%)	8 (8%)	9 (4%)
4			5 (5%)	5 (2%)
5			4 (4%)	4 (2%)
Missing	28 (85%)	65 (76%)	46 (45%)	139 (63%)
Birthweight, g (min-max)	3776 (2910-4825)	3326 (3140-4600)	3451 (3000-4998)	3,459 (3000-4998)
Non-reported	8 (24%)	29 (34%)	39 (38%)	76 (35%)
Mean weight, kg (min-max)	36.9 (27.1-44.4)	47.7 (32.2-67.0)	67.8 (46.0-109.5)	55.4 (27.1-109.5)
BMI (SD)	23.9 (2.3)	25.6 (2.6)	28.4 (2.6)	26.6 (3.1)
BMI SDS (SD)	3.7 (0.6)	3.4 (0.6)	3.0 (0.3)	3.2 (0.6)
ISO BMI				
Overweight ≥25		3 (4%)	8 (8%)	11 (5%)
Obesity ≥30	33 (100%)	82 (96%)	94 (92%)	209 (95%)
Psychological disorder				
Yes	7 (21%)	19 (22%)	16 (16%)	42 (19%)
No	26 (79%)	66 (78%)	86 (84%)	178 (81%)
Age at onset (iso BMI>30) of obesity				
Before 4 years	12 (36%)	17 (20%)	13 (13%)	42 (19%)
4–5.9 years	13 (39%)	36 (42%)	23 (23%)	72 (33%)
6 years and older		12 (14%)	41 (40%)	53 (24%)
Missing	8 (24%)	20 (24%)	25 (25%)	53 (24%)
BMI father				
<25	3 (10%)	15 (18%)	18 (18%)	36 (16%)
≥25	14 (42%)	39 (46%)	40 (39%)	93 (42%)
≥30	14 (42%)	28 (33%)	39 (38%)	81 (37%)
Not reported	2 (6%)	3 (4%)	5 (5%)	10 (5%)
BMI mother				
<25	7 (21%)	26 (31%)	38 (37%)	71 (32%)
≥25	12 (36%)	29 (34%)	26 (25%)	67 (30%)
≥30	12 (36%)	28 (33%)	38 (37%)	78 (35%)
Not reported	2 (6%)	2 (2%)		4 (4%)
Immigration status, both parents born in Sweden				
Yes	12 (36%)	38 (45%)	45 (44%)	95 (43%)
No	12 (36%)	37 (44%)	44 (43%)	93 (42%)
Not reported	9 (27%)	10 (12%)	13 (13%)	32 (15%)
Family living				
Parents living together	22 (67%)	54 (64%)	56 (55%)	132 (60%)
Parents living apart	10 (30%)	27 (32%)	40 (39%)	77 (35%)
Non-reported	1 (3%)	4 (5%)	6 (6%)	11 (5%)
Socioeconomic status				
Academic degree	5 (15%)	8 (9%)	12 (12%)	25 (11%)
Upper secondary education	9 (27%)	23 (27%)	39 (38%)	71 (32%)
Others	9 (27%)	31 (36%)	30 (29%)	70 (32%)
Not reported	10 (30%)	23 (27%)	21 (21%)	54 (25%)

BMI SDS = Body mass index standard deviation score. Socioeconomic status was divided into the following categories:(i) at least one parent with an academic degree, (ii) at least one parent with post-upper secondary education and (iii) others (unemployed, early retired, long-term sick-listed, students, mothers on maternity leave).

compared to age 11–14, with OR 0.56 (CI 0.25–1.24) and OR 0.45 (CI 0.25–0.81), respectively. We were not able to find any other family characteristics influencing the risk of being lost to follow-up. Further, we could detect a difference among treatment models in lost to follow-up ($p = 0.002$). Lowest observed risk for lost to follow-up was for those patients with the combination of individual visits, parental education, the child in weight school and weekly

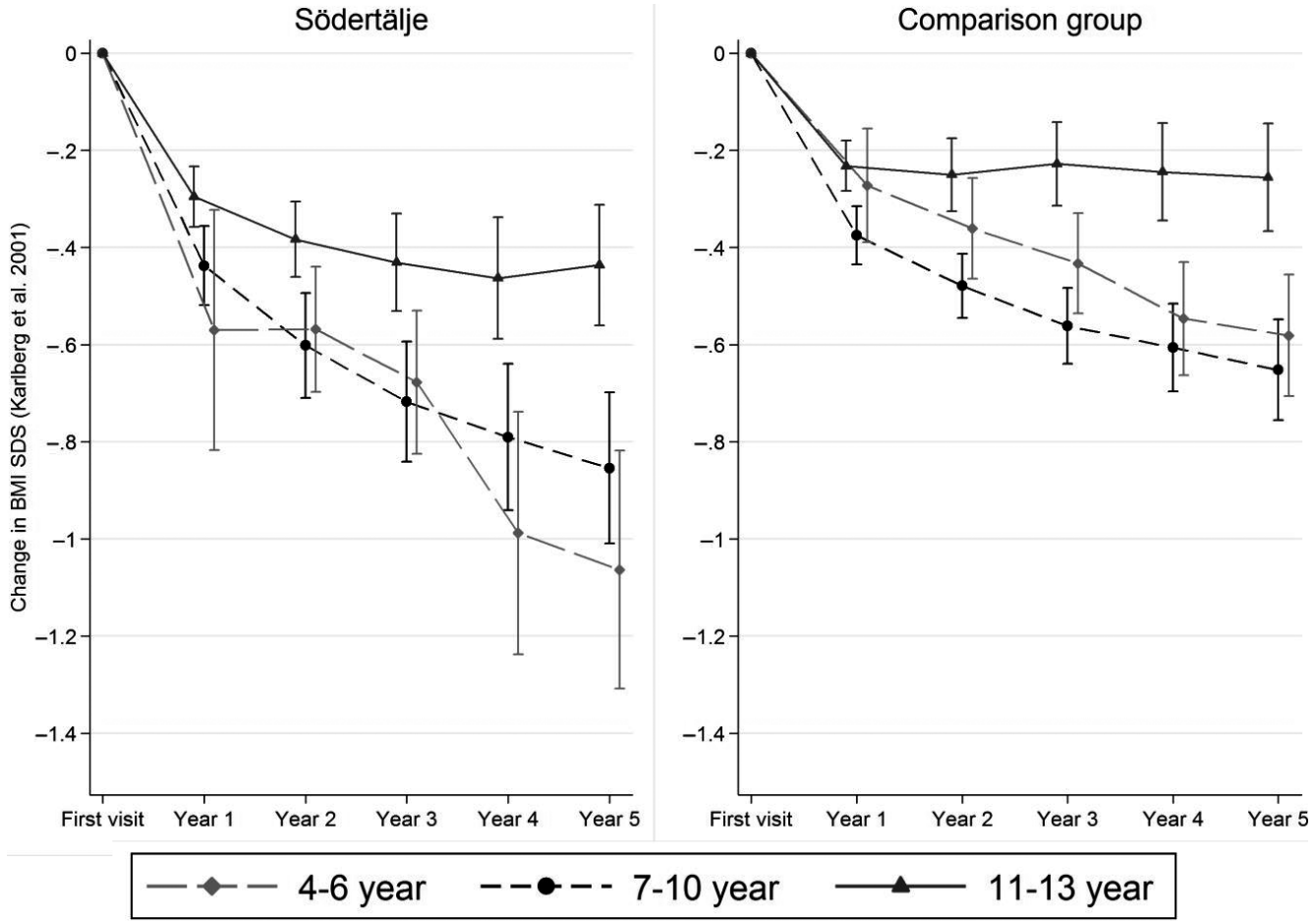

Figure 1 BMI SDS changes during lifestyle changing support from first visit to year five by age group in the Södertälje cohort and comparison group. All patients with complete valid measurement at first visit and year five are presented. The curve pattern in the youngest age group from Södertälje is due to the last observation carried forward (LOCF) analyses. Some of them have missing values between the yearly follow-ups.

physical activity group (reference group). Further, patients with only individual visits had highest odds for being lost to follow-up, with OR 2.16 (CI 1.24–3.74) compared to the reference group.

DISCUSSION

The present study is based on a cohort of patients treated with lifestyle changing support for five consecutive years at a primary healthcare outpatient paediatric clinic. The study sample, the setting and the treatment duration make this study unique. Lifestyle intervention trials are generally on small sample sizes over short duration times (7,12), and it has previously been pointed out that studies performed 'in real life' are scarce (18).

In the present paper, we can see a good effect of the Södertälje model of the treatment in all age groups with the greatest change in the youngest age group. The mean declines in BMI SDS in all age groups are in line with a recent review where a mean reduction in BMI SDS from −0.29–0.63 units after 12 months of intervention were reported (12).

The importance of an early age at start of treatment for acceptable results was the same in this setting as well as in a specialised centre (10,11) and in follow-up studies of short-term treatment (19–22).

Data of the complete cases population in all age groups showed that after five years with lifestyle changing support, 48% of the children changed their weight status from obesity to overweight or normal weight and 72% reached a clinically significant decrease, which is defined as ≥0.5 BMI SDS units. All children that changed their weight status from obese to nonobese reached a clinically significant decrease in BMI SDS except for one individual. Among those who did not change their weight status, another 23% reached a clinically significant decrease of ≥0.5 BMI SDS units. The European study in 129 outpatient paediatric obesity care centres found the success rate (reduction >0.25 BMI SDS units) varies from 7–50% after two years of treatment (19).

The matched comparison group from the BORIS registry had a smaller effect of treatment, and they were lost to follow-up to a larger extent than the Södertälje group of patients. However, these registry data do not provide any

Table 2 Mean change in BMI SDS for each year and age group in completers and full analysis populations in the Södertälje cohort and comparison group

	Completers			LOCF		
Södertälje	4–6 year n = 18	7–10 year n = 51	11–13 year n = 41	4-6 year n = 33	7–10 year n = 85	11–13 year n = 102
Year 1 mean (SD)	−0.6 (0.7)	−0.5 (0.4)	−0.3 (0.3)	−0.6 (0.7)	−0.4 (0.4)	−0.3 (0.3)
Year 2 mean (SD)	−0.7 (0.4)	−0.7 (0.5)	−0.4 (0.4)	−0.6 (0.4)	−0.6 (0.5)	−0.4 (0.4)
Year 3 mean (SD)	−0.8 (0.4)	−0.9 (0.6)	−0.5 (0.6)	−0.7 (0.4)	−0.7 (0.6)	−0.4 (0.5)
Year 4 mean (SD)	−1.2 (0.8)	−1.0 (0.7)	−0.7 (0.7)	−1.0 (0.7)	−0.8 (0.7)	−0.5 (0.6)
Year 5 mean (SD)	−1.2 (0.8)	−1.0 (0.8)	−0.6 (0.8)	−1.1 (0.7)	−0.9 (0.7)	−0.4 (0.6)
	BVCF			EPD		
	4–6 year n = 33	7–10 year n = 85	11–13 year n = 102	4–6 year n = 33	7–10 year n = 85	11–13 year n = 102
Year 1 mean (SD)	−0.6 (0.7)	−0.4 (0.4)	−0.3 (0.3)	−0.6 (0.7)	−0.4 (0.4)	−0.3 (0.3)
Year 2 mean (SD)	−0.5 (0.4)	-0.6 (0.5)	−0.3 (0.4)	−0.6 (0.4)	−0.6 (0.5)	−0.4 (0.4)
Year 3 mean (SD)	−0.6 (0.5)	−0.7 (0.6)	−0.3 (0.5)	−0.7 (0.5)	−0.7 (0.6)	−0.4 (0.5)
Year 4 mean (SD)	−0.8 (0.8)	−0.7 (0.8)	−0.3 (0.6)	−1.0 (0.7)	−0.8 (0.7)	−0.5 (0.6)
Year 5 mean (SD)	−0.7 (0.8)	−0.6 (0.8)	−0.3 (0.6)	−1.1 (0.7)	−0.9 (0.7)	−0.4 (0.6)
	Completers			LOCF		
Comparison group	4–6 year n = 34	7–10 year n = 43	11–13 year n = 26	4–6 year n = 80	7–10 year n = 139	11–13 year n = 150
Year 1 mean (SD)	−0.3 (0.4)	−0.4 (0.3)	−0.1 (0.2)	−0.3 (0.5)	−0.4 (0.4)	−0.2 (0.3)
Year 2 mean (SD)	−0.5 (0.5)	−0.5 (0.3)	−0.2 (0.3)	−0.4 (0.5)	−0.5 (0.4)	−0.2 (0.5)
Year 3 mean (SD)	−0.6 (0.5)	−0.7 (0.4)	−0.1 (0.5)	−0.4 (0.5)	−0.6 (0.5)	−0.2 (0.5)
Year 4 mean (SD)	−0.8 (0.6)	−0.7 (0.6)	−0.3 (0.7)	−0.5 (0.5)	−0.6 (0.6)	−0.2 (0.6)
Year 5 mean (SD)	−0.8 (0.6)	−0.8 (0.5)	−0.3 (1.0)	−0.6 (0.6)	−0.7 (0.6)	−0.3 (0.7)

FAS= Full Analysis population; LOCF= Last observation carried forward; BVCF= Baseline value carried forward; EPD= Extrapolated data; BMI SDS = Body mass index standard deviation score.

information about their treatment modalities, for example how trained the staff are or if multidisciplinary team is a part of the treatment. We suggest the success factors in the Södertälje model to be the structured and systematic programme with experienced and trained staff working together in a multidisciplinary team and that the structured programme involved both group sessions and individual visits with the parents and the child separated and together.

In one previous study, the treatment effect was better in boys (23). However, in this study, we could not confirm any differences in treatment effect between boys and girls. In addition, we could not detect any differences by controlling for parental weight status, socioeconomic status, family immigration or if the parents living apart. It remains unclear how family characteristics may influence treatment success. Most of the children with psychological disorder were treated pharmacologically, and we could not detect any problem for them to benefit from the lifestyle changing support. A possible success factor for the children with psychological disorder may be that they were treated for both conditions at the same outpatient clinic.

In the present study, age at start of treatment was the only factor that affected the treatment efficacy and loss to follow-up. It has previously been suggested that treatment in groups was more effective (24), but we were not able to find any weight-related differences in effect of treatment between those who attended group sessions and those who did not. However, the children who only choose to attend individual visits had a larger risk of being lost to follow-up. We were not able to detect any differences between the families who chose different treatment packages, our conclusion is that the families chose to attend the track that suits their ability, possibilities and needs best.

Poor attendance is a major challenge in obesity treatment. Treatment duration appears to be associated with the degree of lost to follow-up patients, with lower rates in short-term studies (20,22). In the present study, 55% of the children in the youngest age group of 4–6 years remained in treatment after five years of continues treatment. The corresponding number for age groups 7–10 and 11–13 was 60% and 40%, respectively. This retention rate after five years was higher than in a study on clinical practice, where only 8% remained after 24 months of treatment (19). Higher dropout rates have been reported in both lower and higher SES groups (25,26). Patients lost to follow-up have been reported to be more likely to live with one parent and have a higher degree of depressive symptoms and low self-esteem (25). However, the same group has also found that age at start of treatment was the

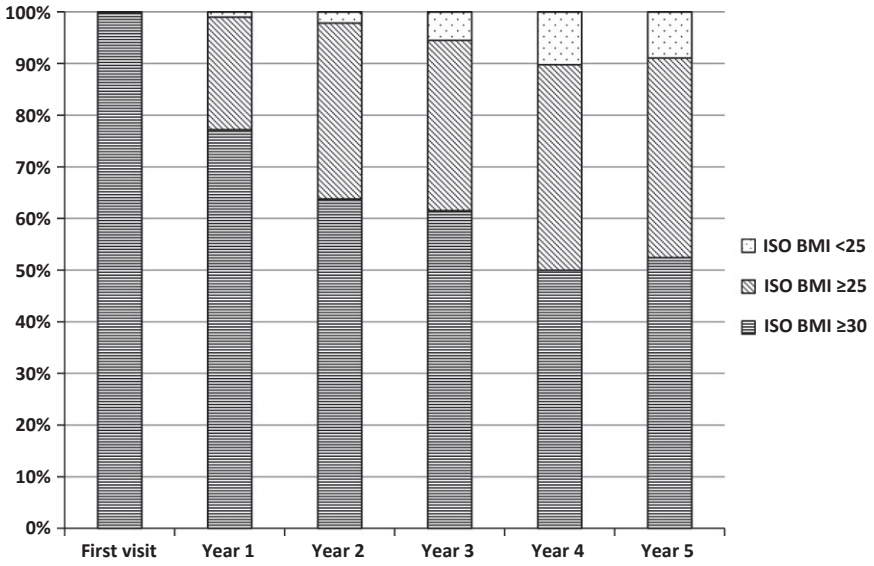

Figure 2 Change from obesity status to overweight or normal weight in the completers population over the five years of lifestyle changing support.

Table 3 Percentage of children lost to follow-up for each age group and year

First visit	4–6 years n = 33	7–10 years n = 85	11–13 years n = 102
Year 1	3%	6%	9%
Year 2	9%	7%	10%
Year 3	6%	6%	16%
Year 4	9%	8%	13%
Year 5	18%	13%	12%
Total lost to follow-up	45%	40%	60%

most important factor for retention in treatment (23,25). Braet et al. found that parents of treatment completers reported a significantly higher degree of motivation, although there were no differences with the motivation of the children (27). This shows the difficulty to find the typical characteristic of the patients lost to follow-up due to that the children are influenced by the parents characteristics, problems and needs. We found only age at start of treatment to correlate with the risk to be lost to follow-up, this despite that we had many family characteristic factors of importance to study. The large numbers of patients lost to follow-up are a huge challenge and an important topic for future research.

We have presented treatment outcome in three different ways, as we consider the different dimensions of weight loss to be poorly covered by the most commonly used change in mean BMI SDS. There is a risk that statistically significant effects are highlighted independently, as well as that the effect size is so small that the clinical effect might be negligible (22,28). The other measure we examine is cure. In other words, how many of the participants who change weight class from the disease of obesity to overweight/normal weight according to Cole (13). But this method can be misleading if used alone, as children with a high degree of obesity may have a successful weight loss without reaching that goal. Therefore, the thresholds used to identify a weight loss associated with a reduction in the risk markers for obesity comorbidity are also required. In three studies, Reinehr et al. have demonstrated a clinically significant decrease in negative health consequences for obese children after one year of behavioural treatment with a reduction of ≥0.5 BMI SDS units (15–17). Later studies have found a decrease in BMI SDS of ≥0.25 units might be enough to reduce clinical risk factors (29), but further studies are required to certify the stability of these findings over time.

Strengths and limitations

The strengths of this study are the duration of the treatment in an ordinary real-life setting, a matched comparison group and the relatively large number of patients. But there are also several limitations; the high dropout rate which may influence the interpretation of the results is an obvious limitation. However, this paper reports data from a clinical practice and reflects the general situation in obesity treatment. The families were not randomised to different treatment modalities. Puberty may affect treatment effect, and it is a limitation that puberty data were lacking. Another limitation of this study is that we cannot identify changes that have contributed to the treatment result, for example changes in diet, physical activity habits, screen time, sleep time and motivation. However, the treatment is individualised and we believe that each one has made the changes that benefited them and their needs. The possible benefits of the physical activity programme could not be evaluated in the present study. The goal was that all children should attend some physical activity as its positive

effect on cardiovascular risk factors in obese children is well established (30); the physical activity groups were especially designed for those who had no other physical activity. The clinical stuff involved had some education in MI and/or empowerment but no counselling to ensure that they used those techniques correctly in their meetings with patients and parents.

CONCLUSION

Behavioural obesity treatment in a single general outpatient paediatric centre can result in clinically and statistically significant weight loss in all age groups. After five years of treatment, 48% of the patients changed their weight status from obesity to either overweight or normal weight. Age at start of treatment was the only independent factor for treatment success.

ACKNOWLEDGEMENTS

This study was funded by the Public Health Services Committee Administration, the Department of Development, Stockholm County Council and the Samariten Foundation. We would like to thank the BORIS steering committee for establishing and maintaining of the registry.

COMPETING INTEREST

The authors declare that they have no conflict of interest to declare.

References

1. Han JC, Lawlor DA, Kimm SYS. Childhood obesity. *Lancet* 2010; 375: 1737–48.
2. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 2014; 384: 766–81.
3. Sjoberg A, Moraeus L, Yngve A, Poortvliet E, Al-Ansari U, Lissner L. Overweight and obesity in a representative sample of schoolchildren - exploring the urban-rural gradient in Sweden. *Obes Rev* 2011; 12: 305–14.
4. Lissner L, Sohlstrom A, Sundblom E, Sjoberg A. Trends in overweight and obesity in Swedish schoolchildren 1999-2005: has the epidemic reached a plateau? *Obes Rev* 2010; 11: 553–9.
5. Singh AS, Mulder C, Twisk JW, van Mechelen W, Chinapaw MJ. Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obes Rev* 2008; 9: 474–88.
6. Biro FM, Wien M. Childhood obesity and adult morbidities. *Am J Clin Nutr* 2010; 91: 1499S–505S.
7. Luttikhuis HO, Baur L, Jansen H, Shrewsbury VA, O'Malley C, Stolk RP, et al. Interventions for treating obesity in children. *Cochrane Database Syst Rev* 2009; CD001872.
8. Whitlock EP, O'Connor EA, Williams SB, Beil TL, Lutz KW. Effectiveness of weight management interventions in children: a targeted systematic review for the USPSTF. *Pediatrics* 2010; 125: E396–418.
9. Ho M, Garnett SP, Baur L, Burrows T, Stewart L, Neve M, et al. Effectiveness of lifestyle interventions in child obesity: systematic review with meta-analysis. *Pediatrics* 2012; 130: E1647–71.
10. Danielsson P, Kowalski J, Ekblom O, Marcus C. Response of severely obese children and adolescents to behavioral treatment. *Arch Pediatr Adolesc Med* 2012; 166: 1103–8.
11. Danielsson P, Svensson V, Kowalski J, Nyberg G, Ekblom O, Marcus C. Importance of age for 3-year continuous behavioral obesity treatment success and dropout rate. *Obes Facts* 2012; 5: 34–44.
12. Reinehr T. Lifestyle intervention in childhood obesity: changes and challenges. *Nat Rev Endocrinol* 2013; 9: 607–14.
13. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *Br Med J* 2000; 320: 1240–3.
14. Karlberg J, Luo ZC, Albertsson-Wikland K. Body mass index reference values (mean and SD) for Swedish children. *Acta Paediatr* 2001; 90: 1427–34.
15. Reinehr T, Andler W. Changes in the atherogenic risk factor profile according to degree of weight loss. *Arch Dis Child* 2004; 89: 419–22.
16. Reinehr T, Kiess W, Kapellen T, Andler W. Insulin sensitivity among obese children and adolescents, according to degree of weight loss. *Pediatrics* 2004; 114: 1569–73.
17. Reinehr T, Kleber M, Toschke AM. Lifestyle intervention in obese children is associated with a decrease of the metabolic syndrome prevalence. *Atherosclerosis* 2009; 207: 174–80.
18. Holm JC, Nowicka P, Farpour-Lambert NJ, O'Malley G, Hassapidou M, Weiss R, et al. The ethics of childhood obesity treatment - from the Childhood Obesity Task Force (COTF) of European Association for the Study of Obesity (EASO). *Obes Facts* 2014; 7: 274–81.
19. Reinehr T, Widhalm K, l'Allemand D, Wiegand S, Wabitsch M, Holl RW. Two-year follow-up in 21,784 overweight children and adolescents with lifestyle intervention. *Obesity (Silver Spring)* 2009; 17: 1196–9.
20. Reinehr T, Kleber M, Lass N, Toschke AM. Body mass index patterns over 5 y in obese children motivated to participate in a 1-y lifestyle intervention: age as a predictor of long-term success. *Am J Clin Nutr* 2010; 91: 1165–71.
21. Sabin MA, Ford A, Hunt L, Jamal R, Crowne EC, Shield JPH. Which factors are associated with a successful outcome in a weight management programme for obese children? *J Eval Clin Pract* 2007; 13: 364–8.
22. Reinehr T, Hoffmeister U, Mann R, Goldapp C, Westenhofer J, Egmond-Froehlich A, et al. Medical care of overweight children under real-life conditions: the German BZgA observation study. *Int J Obes (Lond)* 2009; 33: 418–23.
23. Holm JC, Gamborg M, Bille DS, Gronbaek HN, Ward LC, Faerk J. Chronic care treatment of obese children and adolescents. *Int J Pediatr Obes* 2011; 6: 188–96.
24. Steele RG, Aylward BS, Jensen CD, Cushing CC, Davis AM, Bovaird JA. Comparison of a family-based group intervention for youths with obesity to a brief individual family intervention: a practical clinical trial of positively Fit. *J Pediatr Psychol* 2012; 37: 53–63.
25. Zeller M, Kirk S, Claytor R, Khoury P, Grieme J, Santangelo M, et al. Predictors of attrition from a pediatric weight management program. *J Pediatr* 2004; 144: 466–70.
26. Inelmen EM, Toffanello ED, Enzi G, Gasparini G, Miotto F, Sergi G, et al. Predictors of drop-out in overweight and obese outpatients. *Int J Obes (Lond)* 2005; 29: 122–8.
27. Braet C, Jeannin R, Mels S, Moens E, Van Winckel M. Ending prematurely a weight loss programme: the impact of child and

family characteristics. *Clin Psychol Psychother* 2010; 17: 406–17.
28. Nowicka P, Pietrobelli A, Flodmark CE. Low-intensity family therapy intervention is useful in a clinical setting to treat obese and extremely obese children. *Int J Pediatr Obes* 2007; 2: 211–7.
29. Ford AL, Hunt LP, Cooper A, Shield JPH. What reduction in BMI SDS is required in obese adolescents to improve body composition and cardiometabolic health? *Arch Dis Child* 2010; 95: 256–61.
30. Puder JJ, Marques-Vidal P, Schindler C, Zahner L, Niederer I, Burgi F, et al. Effect of multidimensional lifestyle intervention on fitness and adiposity in predominantly migrant preschool children (Ballabeina): cluster randomised controlled trial. *Br Med J* 2011; 343: d6195.