ORIGINAL ARTICLE

A two year family based behaviour treatment for obese children

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Background: Childhood obesity has become a nutritional problem in China since the 1990s.
Aims: A family based behavioural treatment was developed and tested, to see if its use was feasible in China and to evaluate its impact on obese schoolchildren.
Methods: In a single school in Beijing, 33 obese children were randomly assigned to a treatment group and 35 to a control group. The treatment group participated in a family based behavioural treatment programme for two years. Height and weight were measured every six months for all participants. Blood pressure, cholesterol, and triglyceride levels were measured at baseline and after two years of programme implementation.
Results: Body mass index (BMI, kg/m^2) was significantly reduced in the treatment group (from 26.6 (1.7) to 24.0 (0.9), 95% CI 2.06 to 3.18) but not in the control group (from 26.1 (1.5) to 26.0 (1.6)). Total cholesterol decreased 5.5% and triglycerides 9.7% in the treatment group. There was a significant correlation between change in BMI and change in triglycerides. There were no significant changes in plasma lipids in the controls. Blood pressure values also decreased significantly in the treatment, but not the control group.
Conclusions: A family based behavioural intervention was feasible to use in treating obesity in schoolchildren in Beijing, China. After two years of implementation, it successfully decreased the degree of obesity, reduced levels of blood pressure, and decreased serum lipids in treatment; there were no significant changes among control children.

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Obesity has become a global epidemic and a major public health problem in recent years.[1] Behaviour modification is a cornerstone of all weight control programmes for obese children. Several studies have shown the superior effectiveness of comprehensive behaviour modification programmes.[2] Parents' food preferences, the quantities and variety of foods in the home, and eating behaviour influence children's body weight. Studies also show that family involvement is needed in the treatment and can be beneficial throughout life.[3]

China is a developing country which is being lifted from poverty ever since the reform and opening of the 1980s. Lifestyle changes have been substantial, especially in large cities, linked to the rapid economic development. A wide variety of foods are becoming more and more available, accessible, and affordable.

Obesity has also become an increasingly important health problem among children during the past decade.[4] In Chinese tradition, parents like to show their love to children with food. Overfeeding and overeating may be one factor underlying the rapid increase in obesity in China.[5] An effective intervention is needed to deal with this chronic nutritional disorder, but treatment approaches for childhood obesity have rarely been studied in China.

Behavioural treatments have been the most widely studied approaches to childhood obesity and have generally had success.[6 7] Among them, family based behavioural treatment outcomes have had particularly beneficial effects on dietary practices.[8] In urban Chinese one-child families, children receive intense attention from the parents and grandparents. Thus a family based approach must be employed. The purpose of the present study was to find out if such an approach was feasible in China and to evaluate its impact on obese children.

METHODS

Subjects

The study was conducted in one middle school in Beijing, China. This school had a similar curriculum, including physical education, as most other middle schools in Beijing. Written information about the project was sent to all the obese children in Grades 7–9 (106 in total) and their parents. Informed consent was obtained from 75 families, including verbal consent from the obese children before the initial assessment. The children were then divided randomly to treatment (36 children) and control (39 children) groups at baseline. Seven children did not complete the two year programme because of family moves (three in the treatment and three in the control group). This programme was approved and funded by the Ministry of Health in China. Childhood obesity in China is defined as weight-for-height ⩾120% of the Chinese reference.

Study design

The study was conducted with each child being followed up for two years. Children in the treatment group received family based behavioural treatment for two years. The

Table 1 Baseline characteristics of a sample of obese children in a Beijing school

	Treatment (n = 33)	Control (n = 35)
Age (years)	13.3 (0.6)	13.2 (0.7)
M/F	20/13	21/14
Height (cm)	161.2 (4.1)	162.7 (3.4)
Weight (kg)	70.1 (5.7)	71.2 (6.4)
BMI	26.6 (1.7)	26.1 (1.5)

Results expressed as mean (SD).

controls had a normal school and family life and did not receive any special intervention. Assessments were conducted at baseline, at six month intervals, and at the end of the two year intervention.

Treatment components

The treatment was based on approaches adopted in other studies[9] and focused on dietary behaviour modification. One or two main behaviours which were related to obesity were chosen for each child based on an assessment of relevant dietary and exercise patterns at baseline. Then a new goal behaviour and interval behaviours were defined. Each goal and interval behaviour was discussed with the child and the parents and was agreed to by the child. A diary was kept by the children on their behaviour in order to monitor adherence to the recommended lifestyle changes. The parents monitored the diary and their child's progress in achieving the new behaviour(s).

Throughout the study, the researchers (paediatricians) in this study team visited the families once per month. During the visit the researchers observed the family environment and looked for where foods were stored, cooking styles, and what kinds of foods were used commonly in the family. The researcher checked the behavioural diary and discussed gaps in the recordings. Potential methods of reinforcement and penalty were also discussed with the parents and children during home visits.

During the two year family based behavioural treatment, a detailed dietary modification plan was implemented in each treatment group family. A ''traffic light'' food item list was given to the children to help decrease energy intake and promote a balanced diet: ''red light'' foods were those high in fat or calories; ''green light'' foods were low in fat and calories; and ''yellow light'' foods were intermediate. We urged the children to eat less red light foods and more green light foods. We also encouraged the parents to buy more green light foods instead of red light foods. In the treatment group the children and their parents were informed about the daily calorie requirements, based on the Chinese recommended daily allowance. We also gave the Chinese food composition tables to each family, so they could calculate the calorie intake of their child every day and compare with the calorie requirements. In order to avoid the feeling of hunger and limit the calorie intake, some dietary behaviours were suggested to the family, including eating slowly, having soup before meals, eating green light foods first, brushing teeth immediately after each meal, and having meals without staple foods for supper. What the child ate every day was recorded in the diary. The researchers checked the diary at home visits and evaluated the dietary intake. Dietary suggestions were given to the family after each evaluation.

The intervention aimed to increase physical activity as well. Exercise for 20–30 minutes per day for four days per week (three weekdays and one day on weekends) was advised. The children were asked to choose from running, playing football, climbing stairs, and using a skipping rope. During the four intervention semesters, physical education teachers monitored intervention children's exercise after class. Parents monitored their children's exercise on weekends, during vacations and on holidays. We also urged the children to decrease sedentary time, for example watching TV, and to go for a walk after supper instead.

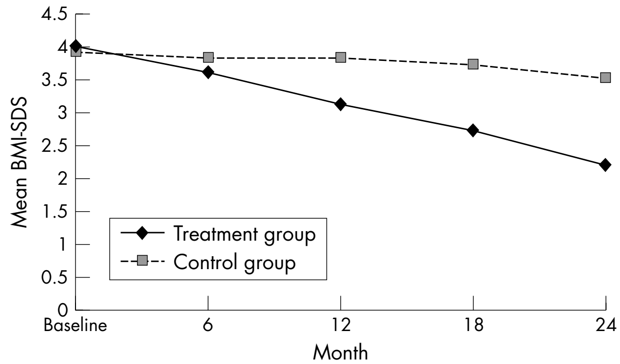

Figure 1 Mean BMI-SDs (Z scores) for treatment and control groups by duration of the trial.

The following case study provides a typical example of how the behaviour modification approach was tailored to individual family and child circumstances. It is based on a boy, 13 years old, height 159.4 cm, and weight 62.5 kg. One of the baseline behaviours chosen for modification was his habit of drinking one bottle (500 ml) of Coca Cola every day. The goal behaviour chosen was to stop daily Coca Cola drinking within six months. The interval behaviour strategy involved removing one rice wine cup (10 ml) of the soft drink and drinking the remainder (490 ml on the first day). Every three days, an additional wine cup of soft drink was taken away. The reinforcement chosen was as follows: if he met the interval behaviour, his parents gave him one red star on that day. He would receive a new study tool for every seven red stars and went to the playground once for every 15 red stars. The chosen penalty: he did not get the red star if he did not meet the interval behaviour.

Anthropometric measurements

Weight was measured without outer clothing and calibrated to 0.1 kg. Height was measured without shoes and calibrated to 0.1 cm. BMI standards of Chinese children by age and gender were used in the calculation of BMI standard deviation scores (BMI-SDs). Height and weight measurements were performed by a trained researcher in this study team (JJX). All children in the two groups were measured for height and weight every six months at the same time periods.

Table 2 Height and weight changes over a two year period among obese children in a Beijing school

	Treatment (n = 33)		Control (n = 35)		
	Follow up	Change	Follow up	Change	p value*
Height (cm)	170.4 (6.0)	8.2 (4.3)	171.7 (4.9)	8.0 (3.9)	0.846
Weight (kg)	69.7 (4.4)	−0.3 (4.3)	76.7 (6.6)	5.5 (3.5)	<0.001
BMI	24.0 (0.9)	−2.6 (1.6)	26.0 (1.6)	−0.1 (1.1)	<0.001

Results expressed as mean (SD).
*Comparison of the treatment and control groups regarding changes between baseline and follow up, using independent *t* test.

Table 3 Changes in blood pressure and serum lipid values between baseline and follow up for obese Beijing schoolchildren in the treatment versus control groups

	Treatment			Control			
	Baseline	Follow up	Change	Baseline	Follow up	Change	p value*
SBP (mm Hg)	116.1 (4.3)	116.2 (4.9)	−1.5 (2.5)	117.5 (5.2)	118.4 (3.6)	2.3 (2.0)	0.001†
DBP (mm Hg)	72.9 (4.8)	72.5 (3.2)	−0.8 (1.8)	73.8 (4.5)	74.2 (2.6)	1.49 (2.19)	0.003§
Cholesterol (mmol/l)	4.57 (0.3)	4.32 (0.39)	−0.26 (0.14)	4.61 (0.4)	4.55 (0.36)	−0.03 (0.14)	<0.001§
Triglyceride (mmol/l)	0.72 (0.12)	0.65 (0.13)	−0.08 (0.05)	0.73 (0.15)	0.73 (0.14)	0.01 (0.05)	<0.001†

Results expressed as mean (SD).
SBP, systolic blood pressure; DBP, diastolic blood pressure.
*Comparing the treatment and control groups in changes between baseline and follow up by †independent *t* test or §Mann-Whitney test.

Blood pressure measurements and laboratory analysis

Blood pressure (BP) and serum lipids were measured at baseline and after two years. A single trained observer (XXL) took all measurements of BP. Venous blood samples were collected in the morning when the children were fasting. Serum total cholesterol and triglycerides were determined by 7020 Auto Maticinilyzer (made in Japan).

Statistical analysis

SPSS (version 10.0, SPSS Inc., Chicago, USA) was used for the statistical analyses. Independent *t* tests, Mann-Whitney test, ANOVA, and correlation were used to compare the differences between groups. Statistical significance was assigned at the 0.05 level of probability.

RESULTS

Description of sample

The baseline characteristics of the sample children are presented in table 1. The treatment and control groups did not differ on age, weight, height, or BMI (kg/m^2).

Change in height, weight, and BMI

During the two year follow up, both groups of children had a similar linear growth velocity. Mean height increased 8.2 and 8.0 in treatment and control groups, respectively ($p = 0.846$). Children in the treatment group decreased 0.3 kg in weight, while the control group increased by 5.5 kg (table 2). There was significant difference in weight change between the two groups ($p < 0.001$).

Mean BMI-SDs (Z scores) at various follow-up times for each group are displayed in fig 1. There were significant differences in change of BMI-SDs between the two groups by repeated measures ANOVA ($F = 9.3$ for groups, $F = 103.8$ for times, $F = 50.9$ for time and groups, $p < 0.001$). Compared with the initial value, the average BMI showed a significant reduction only in the treatment group (mean change = 2.6, 95% CI 2.06 to 3.18, $p < 0.001$).

Change in BP and serum lipid

In the treatment group, there was a significant correlation between change in BMI and change in triglycerides (mmol/l) ($r = 0.488$, $p = 0.004$). Table 3 shows that after two years of treatment, total cholesterol decreased 5.5% and triglycerides 9.7% in the treatment group. There were no significant changes in the controls. Between-group changes in systolic blood pressure (SBP), diastolic blood pressure (DBP), total cholesterol, and triglycerides were also statistically significant.

DISCUSSION

For growing obese children, it is not suitable to evaluate treatment effects by weight loss. Weight maintenance, rather than weight loss, may for many be a more appropriate goal. Development of a healthier lifestyle for the long term may also be more important than short term weight loss. Many behavioural programmes have improved both diet and physical activity, having either short term or long term beneficial effects on BMI in participants.[10 11] In the present study, family based behavioural treatment decreased BMI significantly in schoolchildren in the treatment group. At month 24, the obese children in the treatment group had a 9.8% reduction in initial BMI and the controls had none. The overall impact was related not just to weight loss but to the high velocity of height growth at this age.

The complications of obesity that are associated with cardiovascular disease include hypertension and dyslipidaemia.[12] In this study, the blood pressure was lower in the treatment group after the two year follow up, an effect which has been shown earlier.[13] Obesity is associated with hyperlipidaemia not only in adults, but also in children.[14] Significant improvements were observed in total cholesterol and triglyceride levels in our study, as in earlier studies.[15 16] We also found a significant correlation between BMI reduction and triglyceride reduction in the treatment group, suggesting that the treatment may have had a beneficial effect on serum lipids. These obese children thus benefited from a reduction in key cardiovascular disease risk factors with behavioural treatment in this study.

No adverse effects were observed with the treatment. The obese children in both groups had a similar linear (height) growth to that of normal weight children.

During two years of treatment, neither any parents nor any children in the treatment group had such serious problems with the programme that they dropped out of it. Thus behaviour treatment approach which we adopted produced similar positive results to those found in other studies, suggesting that it is feasible to adopt in China.

On the other hand, we did not monitor the children after the two years of treatment were complete. Thus we do not know the long term impact of this intervention. An additional weak point of this study was the fact that we used a large quantity of highly skilled manpower in implementing the treatment programme.

However, after completing this study, we have modified the approach developed in it for use in an outpatient clinic and in two primary schools in Beijing. Dietary behaviour modification (including food selection, eating behaviours, choice of a light supper, and parental monitoring) was implemented with family involvement in each case. These programmes, covering several thousand children (results have not been shown here) show that family behaviour treatment can be used in China after adapting it to each circumstance.

Effective interventions are needed to reduce childhood obesity in China. We believe that modification of family environments to support healthful dietary and exercise behaviour is one effective approach.

What is already known on this topic

- Childhood obesity has become an increasing problem in China over the past decade
- Family based behavioural treatment programmes may beneficially alter dietary habits, but their potential efficacy in obese Chinese children is unknown

What this study adds

- A two year family based behaviour treatment focused on dietary behaviour modification has beneficial effects on BMI, blood pressure, and serum lipid concentrations in obese Chinese children
- Such a behavioural intervention may be feasible for the treatment of obesity in Chinese children

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ARCHIVIST

Activity and obesity in adolescence

People who take little exercise tend to become overweight. In a longitudinal US study reported in 2002 the prevalence of overweight and obesity in girls doubled during adolescence (between the ages of 9 and 19 years), primarily because of reduced activity rather than increased food intake. Now further data from the same study (the National Heart, Lung, and Blood Institute's Growth and Health study) have underlined the importance of adolescent inactivity in the development of obesity (Sue YS Kimm and colleagues. *Lancet* 2005;**366**:301–7; see also editorial, ibid: 266, and comment, Ibid: 268–9).

At three sites (in San Francisco, Cincinnati, and Washington DC) between 1987 and 1997 a total of 2287 girls were followed up from age 9–10 years to age 18–19 years. Body mass index (BMI) and skinfold thicknesses were recorded annually and activity was assessed at baseline and at 3, 5, and 7–10 years. Throughout the study black girls (n = 1152) had significantly higher BMI, skinfold thicknesses, and energy intake than white girls. White girls were more likely to remain active, more likely to smoke, and less likely to give birth to a child. For every reduction in physical activity of 10 metabolic equivalent (MET) –times per week, BMI increased by 0.14 kg/m^2 in black girls and 0.09 kg/m^2 in white girls and sum of skinfold thicknesses by 0.62 and 0.63 mm. At ages 18–19 years BMI was 2–3 kg/m^2 greater in inactive girls than in active girls. In both races habitual activity scores declined considerably between the ages of 9 and 19 years and the decline was more marked among girls who were relatively inactive at the start of the study. Energy intake increased over time among black girls but not white.

The authors of this paper conclude that encouraging continued activity among adolescents could be an important method of preventing obesity.