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Effectiveness of a multi-disciplinary family-based programme for treating childhood obesity (The Family Project).

Running Title-Multi-disciplinary programme for childhood obesity

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Conflict of Interest

The authors declare that they have no competing interests, financial or non-financial.

ABSTRACT

Background / Objectives: To determine if a multi-component family focused education package is more effective than a waiting list control group in treating overweight and obese children.

Subjects / Methods: A two year randomised controlled trial; Sixty-five overweight and obese children aged 6-14 years were allocated to active intervention in either the first or second year, with body composition monitoring alone in the control period. Anthropometric measurements were undertaken at six monthly intervals and a 7-day food and activity diary was issued.

Results: Over the two years of the study BMI SDS score fell significantly in the intervention/control (I/C) group, but not in the control/intervention (C/I) group. The difference between groups was 0.3, which was borderline significant (95% CI -0.62-0.02, $p=0.06$) before adjusting for potential confounding factors. Thirty-three percent of the I/C group and twelve percent of the C/I group achieved the target reduction of 0.5 BMI SDS. The I/C group had a significantly greater reduction in the percentage with a BMI above the 99.6th centile at 24 months ($p=0.04$) and gained 5.7kg less over the time of the study. There were no significant differences between groups for mean percentage attendance at physical activity sessions (I/C group = 24.1%, 95% CI 15.4-32.9, C/I group = 31.7%, 95% CI 22.4- 41.1, $p=0.229$).

Conclusions: Children given active intervention followed by body composition monitoring alone reduced their BMI SDS, and fewer children were classified as grossly overweight by the end of the study. If these findings are true, there are important implications for the provision of services managing overweight in the community.**Keywords:** Children, Families, Obesity, Lifestyle Intervention, BMI SDS.

Introduction, Background and Setting

Childhood obesity is increasing rapidly worldwide. The National Child Measurement Programme in England (2006/07 school year) showed that for 4-5 year olds, 9.9% were obese and 22.9% were overweight (including obese), (95% CI \pm 0.1%) (The Information Centre, 2008). In the island of Jersey, the prevalence is similar and as a result, the Health Improvement Strategy for Jersey (2008-2018) has set a target of *“reducing childhood obesity to below 10% in 5 year olds by 2018”*(New Directions, Health for Life,2008).

The "Obeldicks" multicomponent intervention programme in 130 obese children found a significant improvement of cardiovascular risk factor profile if the BMI SDS decreased by at least 0.5 over a year (Reinehr & Andler, 2004). The mean decrease in BMI SDS was 0.36 at the end of the 1 year intervention and 0.46 four years after the intervention (Reinehr et al, 2010) A minimum reduction of 0.5 is further supported by a study carried out by Hunt et al;2007. More recently Ford et al 2010 have found that a minimum reduction of 0.25 in BMI SDS is required and that greater benefits were obtained from losing at least 0.5 BMI SDS .

NICE (2006) recommends that 'the aim of weight management programmes for children and young people may be either weight maintenance or weight loss depending on their age and stage of growth.' The recent SIGN guidelines (2010) recommend that 'weight maintenance is an acceptable goal in overweight children (91st to < 98th BMI centile) and in most obese children (\geq 98th BMI centile). For those with a BMI \geq 99.6th BMI centile) a gradual weight loss to a maximum of 0.5-1.0kg/month is acceptable.'

Limited data are available to ascertain which intervention is more effective in child and adolescent obesity. NICE Guidelines (2006) and SIGN guidelines (2010)

recommend multi-component interventions (nutritional advice, physical activity, behaviour modification) involving the whole family. This is further supported by the Cochrane Review (Oude Luttikhuis et al, 2009).

Emerging evidence from studies in the UK support the importance of family-based interventions (Hughes et al;2008, Rudolf et al; 2006, Sabin et al; 2007, Sacher et al; 2007).

The hypothesis being tested in this study was that a family based intervention ('Family project') was more effective than body composition monitoring alone in reducing BMI SDS in overweight children.

Methods

Design

'The Family Project' was a two year controlled trial where children were randomly allocated to receive the intervention either in year 1 or 2 (Intervention / Control (I/C) group or Control / Intervention (C/I) group); during the control period children were observed in the same way, but received no active input.

Participants

A total of 65 participants were recruited from either referrals from healthcare professionals (n= 33) or self-referral (n=32) as a result of media advertising via the local newspaper and television channel. Inclusion criteria were children aged 6-14 years with a BMI above the 91st centile. Children with intellectual disability were included if judged able to participate in the intervention activities. General practitioners of the children were asked to notify the dietitian of medical conditions which might impede physical activity. No medical problems were disclosed .Ethical approval was granted by the Jersey Hospital ethics committee and written consent was obtained from participants and a parent / guardian. The study design was

compliant with NICE guidelines on obesity (2006).

Interventions

The intervention involved two Saturday morning workshops (8 hours in total) held 1-2 weeks apart and attendance at two physical activity sessions of one hour / week during term-time throughout the one year intervention. Siblings aged 6-14 years and parents / guardians were also encouraged to participate. Workshops took place in a school (4-12 participants plus 2-10 parents/ guardians and siblings involved) and focused on healthy eating, physical activity, reducing sedentary behaviour, behaviour change and psychological well-being (Table 1). Workshops were designed and delivered by a dietitian, physical activity health promotion officer, an educational or clinical psychologist and 2 to 3 physical activity instructors. The physical activity sessions were led by physical activity instructors and included junior gym sessions (bikes and various weights), circuits, trampolining, rock-climbing, table-tennis, basketball, tennis, badminton, football and the bleep test. After one year, the intervention and waiting list control group crossed over with the waiting list control group receiving the intervention programme and the intervention group receiving no input.

Primary Outcome: Change in BMI SDS

Body weight (kg) was measured using calibrated Tanita electronic scales to one decimal point in light clothing and bare feet. One kg was allowed for clothing.

Height was measured to the nearest 0.1cm using a stadiometer. Body Mass Index (BMI) was calculated as weight/height squared (kg/m^2) and plotted on the Child Growth Foundation BMI Chart (1997). BMI was adjusted for age and gender to give BMI SDS (BMI-z score) using the British 1990 Growth Reference Data. The z score accounts for the child's age and sex and represents the deviation compared with an

average child of the same sex and age (Cole et al, 1995).

Secondary Clinical Outcomes

Waist Circumference

Waist circumference was measured in centimetres to one decimal point using a standard anthropometric tape at the maximal abdominal girth (Lohman et al, 1991). Results were plotted on the Child Growth Foundation Waist Circumference Chart (2005) and converted to waist circumference SDS (z score) using the British 1990 Growth Reference Data (Cole et al, 1995).

Body Fat

The Tanita Body Fat Monitor was used to analyse body fat to $\pm 0.5\%$ precision and results were plotted on the Child Growth Foundation Body Fat Chart (2005). In addition to this, 3 skinfold calliper measurements (mm) were taken at the calf, subscapular and tricep sites using the non-dominant side and averaged. Sum of 3 skinfolds was calculated.

Lifestyle Outcomes

Participants were asked to complete and return a 7 day food and activity diary at baseline and following each 6 month review appointment for 24 months. (Margetts and Nelson, 2007). Verbal and written instructions were provided by the dietitian. Semi-quantitative recording was allowed. Microdiet Version 2.52 was used to analyse the food diaries. Frequency of use of specific foods was extracted from the food diaries. This method was not validated. Participants were supplied with a Yamax Digi-Walker electronic pedometer to record number of steps undertaken daily during this 7- day period (Bravata et al, 2007). A record was also taken of amount of time (in minutes) of low, moderate and high intensity activity undertaken during the 7- day period. Examples were given of low, moderate and high activity.

Evaluation Outcomes

The cost of the project was also calculated and compared against standard dietetic treatment.

Statistical Analysis

Data were analysed using SPSS version 15. After checking for the normality of the distribution of the anthropometric data, results were presented as means with 95% confidence intervals. Difference between groups were assessed by analysis of variance with adjustment for baseline measures. Change between time periods were calculated at the individual level and the average of these changes was then calculated.

Results

Sixty five participants consented (along with their parents / guardians) to take part in the study. Written consent was provided by all. Thirty-five were randomised to the I/C group and 30 to the C/I group. A total of 15 participants (23%) dropped out of the study (n=10 I/C (15%), n= 5 C/I (8%). Data were excluded for 4 I/C participants for their second year as they continued to take part in the physical activity sessions. Baseline assessments were carried out for all participants (Table 2). There was a significant difference between groups at baseline for age ($p=0.007$), height ($p=0.011$) and sum of skinfolds ($p=0.018$). Children that dropped out were not significantly different for baseline characteristics from those that remained in the study. Figure 1 shows the flow of participants through the study.

Table 3 presents the changes in various measures of body composition over the 24 months of the study, broken down by treatment group. The main outcome measure focused on in this study was BMI SDS. In the group of children who received the intervention in the first 12 months they reduced their BMI SDS statistically

significantly in the first 12 months, and continued to reduce the score over the next 12 months, so that by the end of the study their BMI SDS score was 0.44 lower than at the beginning of the study. Children allocated to the body composition monitoring group alone for the first 12 months also reduced their BMI SDS scores (although not statistically significantly) in the first 12 months, and when put onto the active family intervention their BMI SDS score continued to fall but only marginally.

Other measures of change in body composition reported reflect the trends reported above for BMI SDS scores, although the effect sizes were smaller and the study was not powered to detect these smaller differences, so the differences were not statistically significant. The children who received the intervention first had a weight gain of nearly 6kg less over the course of the two years than the children who did not receive active intervention in the first 12 months. This effect was adjusted for any differences in ages between the treatment groups. Their percentage body fat fell by about 3% and the sum of skinfolds also fell over the course of the study suggested changes in body composition and loss of adiposity.

In routine clinical practice, BMI centiles are used to assess progress. Hence, we used the percentage of children with a BMI above the 99.6th centile at each time interval as a marker of change that would be considered relevant for measuring success in clinical practice (Table 4). Whereas about 60% of children were above the 99.6th centile at baseline, by the end of 24 months, 19% of I/C children compared with 48% of the C/I children were above the 99.6th centile value ($p=0.04$).

Lifestyle Outcomes

Dietary Composition

The percentage of food diaries returned at baseline was 85.7% (I/C group) and 80.0% (C/I group). This reduced to 61.9% (I/C) and 68% (C/I) at 24 months. There

were no significant differences between groups for average estimates of nutrient intakes (data not presented). The quantity of potato crisps consumed was significantly less in the C/I group at 24 months (mean= 25.0g/week, 95% CI -1.2-51.2g) compared to the I/C group (mean = 87.0g/week, 95% CI 41.2-132.8g).

Physical Activity Levels

There was no significant difference between groups for mean percentage attendance at physical activity sessions (I/C mean= 24.1%, 95% CI 15.4-32.9, C/I mean =31.7%, 95% CI 22.4-41.1, p=0.229). There were no significant differences in mean pedometer steps per day measured at baseline and follow-up visits. The total minutes of moderate activity undertaken per week was significantly greater for the C/I group at 24 months (I/C mean = 182.9 minutes, 95% CI -39.2-404.9; C/I mean = 606.9 minutes, 95% CI 202.7-1011.0, p=0.038). All other measures of activity were not different between groups or over time.

Cost.

The cost per child to take part in the Family Project was estimated to be £403 (based on running the intervention as a clinical service) compared with £45 for usual care of 1.5 hours individual dietetic consultations. For Jersey this would mean that considerable funding is required before this programme could be rolled out even in the current format.

Discussion

The study has shown that children given active intervention in the first year of the study followed by 12 months of body composition monitoring alone were able to sustain BMI loss over the 24 months of study, such that by the end of the study they had statistically significantly lower BMI SDS score and the proportion of children with a BMI centile above 99.6th fell from 57% to 19%. Children who received the active

intervention in the second twelve months of the study also reduced their BMI SDS throughout, but nowhere near as much as in the group that had the intervention first.

This suggests that a modest programme of family based interventions (two half days of family activity, followed by weekly activity during term time- although attendance was poor at these weekly sessions) followed by a period of body composition monitoring was effective.

The findings of this study have important implications for routine clinical care of overweight children. If a short dietitian lead programme can be sustained by simple body composition monitoring (which could be done by any trained staff –such as health trainers) this has the potential of reaching far more children in a cost effective way. However, before drawing strong conclusions from these findings a number of limitations need to be considered. The study was originally powered to detect a difference in effect on BMI SDS score of 0.5. After the study was completed we calculated the actual power of the study for an effect size of 0.3 for BMI SDS and it was about 60%.Another limitation of the study was that children did not participate in the twice weekly leisure centre based sessions as much as we had expected. The taster for activity offered during the intensive family activity may have been sufficient to stimulate the children and their families to be active outside of the sessions that were run in the leisure centre- ie the extra leisure centre sessions may not be necessary. The measures of activity used in this study may not have been sufficiently sensitive to detect small but important changes in sedentary activity. The benefits of a randomised trial are that differences in baseline characteristics can only be by chance, and given all children were followed for the same length of time and in the same way in each group, it is unlikely that differences in baseline characteristics, such as age, whether children had reached puberty or not, could not cause any

differences between treatment groups. It may be argued that adjusting for any differences in baseline characteristics that occurred by chance is unnecessary. This may be true, and was the reason we presented both adjusted and unadjusted measures of effects. Broadly, adjusting made relatively little difference (as would be expected by the study design).

A higher percentage in the I/C group were self referrals (60% versus 36.7%). A waiting list control group may also not have been the best comparison, since enrolment into the study may have had a placebo effect. Recruitment was also more difficult than anticipated. Twelve months was likely to have been too long to wait for the waiting list control group who also may have had an extra 3 months to wait depending on recruitment time. Motivation and self-esteem were not assessed and would have provided useful measures. Pott et al (2009) have found that risk of nonresponse in a child and adolescent obesity programme are elevated in older children, those with obese siblings, maternal depression and avoidant attachment attitude. All of these issues may have impacted on our results. Measuring body fatness is fraught with difficulty due to differences in stage of maturation and gender. The lead investigator was also not blind to the treatment allocation. The accuracy of reporting in the food diaries is questionable. Under-reporting tends to be higher in older age-groups and in overweight children (Livingston & Robson, 2000 & Rennie et al, 2006). Limited dietary education may not have been sufficient to influence dietary changes. Collecting data on the frequency of use of specific foods from food diaries may not have been the most accurate method. A food frequency questionnaire would have been a more useful tool. However, the modest changes in diet are reflective of the wider societal challenge with regard to availability of unhealthy food. Those in the C/I group may have consumed significantly less potato crisps and undertaken

significantly more moderate activity per week at 24 months as they had just finished the intervention. However, there was not a significant difference when both groups had just completed the treatment component of the study.

How do the results of this study fit with previously published work

Our findings are similar to those reported in the 'Obeldicks' study in terms of longer term improvements (Reinehr et al, 2010). However, their study was in motivated children and there was no control group. Twenty-eight percent of the "Obeldicks" participants achieved the 0.5 target at 12 months (Reinehr & Andler, 2004). In our study, 10.7% of the I/C group achieved this target at 12 months compared with 11.1% in the C/I group. This may be due to the effect of monitoring. However, the effect was enhanced at 24 months with 33.3% of the I/C group achieving it and 12% of the C/I group but if we looked at them in 12 months time we may see the effect enhanced.

A weight gain of 5.7kg less in the I/C group along with the other enhanced results in the second year for the group that underwent the intervention in the first year suggests that the sooner interventions are started after recruitment , the greater the effect. Seventy-seven percent of participants completed 24 months in the study which was encouraging. However, the mean percentage attendance at physical activity sessions was poor (I/C group 24.2%, C/I group 31.7%) with no significant difference between groups. There were no significant differences between groups for mean pedometer steps per day at baseline, 12 months and 24 months. However, the majority of participants reported achieving the British Heart Foundation recommended target of 10,000 steps per day.

Conclusions

The results of this study suggest that a period of active intervention, followed by

body composition monitoring alone can be an effective approach to reducing BMI SDS in overweight children, If this is true, and the power of the study to draw firm conclusions needs to be considered, the results have implications for the organisation of clinical care for overweight children. If body composition monitoring alone is itself an effective intervention this could be run by less expensive trained staff, and thus allow more children to be reached for less money.

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Table 1**CONTENT OF THE FAMILY PROJECT WORKSHOPS**

The Family Project	
Topic	Description
Week 1: <u>Parent/Guardians</u> Introduction & programme Objectives	Ice-breaking session and introduction to the project and each other. Discussion on the programme objectives and personal objectives.
Week 1: <u>Parents/Guardians</u> Health Eating Workshop	Explore childhood obesity - what do we know about it; why is it increasing; why worry; aims. Examine the 'balance of good health' model. Inform about sensible healthy eating including information on healthy lunch box choices and healthy drinks.
Week 1: <u>Parents/Guardians</u> Physical Activity Workshop	Session on increasing understanding of how physical activity of varying intensity and duration, benefits the body and to understand the health implications of sedentary behaviour. To explore barriers to regular physical activity and identify solutions to these barriers.
Week 1: <u>Young People</u> Practical Cookery	Practical cookery session involving the young people in making healthy smoothies, fruit kebabs and pitta pockets with health fillings. Tasting session and discussion at the end for young people and their parents/guardians.
Week 1: <u>Young People</u> Introduction to physical activity	Session on increasing understanding of what physical activity is and the importance of intensity. Specific forms of activity are identified that will provide health benefits. Explore how physical activity can be enjoyable and why it is important for the body utilising quiz during session using body labels.
Week 1: <u>Young People</u> Rock Climbing	One hour rock climbing taster session with a physical activity instructor (qualified in rock climbing). Last 15 minutes of session observed by parents/guardians.
Week 2: <u>Parents/Guardians</u> Dealing with difficult meal times	Explore internal and external food triggers and other things you can do to help deal with this.
Week 2: <u>Parents/Guardians</u> Dealing with bullying	Feedback about the increased risk of lower self esteem and bullying associated with obesity. Definition - what is bullying? Exercise in pairs about myths around bullying. Why don't they Tell? Sharing personal experiences. The importance of family support and liaison with schools. How to raise resilient children. (Feedback on their children's comments, if they had workshop first).
Week 2: <u>Parents/Guardians</u> Food labelling & quiz	Explore food labelling including a practical demonstration and address how to identify healthy food choices. Undertake food quiz at end of session and provide feedbacks.
Week 2: <u>Young People</u> Body Image/Bullying	Name Game. Sharing personal info game. Group brainstorm, 'What is bullying?' Exercise, 'Is this bullying?' In pairs, share, 'Causes of bullying, why people get bullied, why victims don't tell.' Group brainstorm and information, 'What can be done?' Share – who noticed something positive about you this week?

	Choosing own Strength Cards for Kids. (If time, also did drawing around each other's body and drawings of bullies/ victims)
Week 2: <u>Young People</u> Healthy Eating Workshops	Use the 'balance of good health' mat to play a game which helps distinguish between food groups and discuss healthy choices. Undertake a food quiz and provide feedback. Brain-storming session on why we eat and tactics to use when not hungry. Discussion on a volunteer's previous days food intake.
Week 2: <u>Young People</u> Yoga Session	One hour yoga taster session with a qualified yoga instructor for children.
Week 2: <u>Young People</u> Trampolining & Games Session	One hour trampolining and games taster session with 2 physical activity instructors. Last 15 minutes of session observed by parents/guardians

Table 2-Demographic and body composition measures at baseline

	Intervention / Control Group (n=35)	Control /Intervention Group (n=30)
Age (months, mean)	133.4	116.9
Gender (%)		
Female	62.9	70.0
Male	37.1	30.0
Weight (kg, mean, 95% CI)	63.3 (57.9-68.7)	55.6 (48.6-62.5)
Height (cm, mean, 95% CI)	149.4 (145.3-153.6)	141.4 (136.6-146.2)
Body Mass Index (kg/m ² , mean, 95% CI)	28.0 (26.7-29.3)	26.9 (25.0-28.8)
Body mass Index SDS (mean, 95% CI)	2.7 (2.6-2.9)	2.8 (2.5-3.0)
Waist Circumference (cm, mean, 95% CI)	86.8 (83.3-90.4)	85.7 (80.7-90.7)
Waist Circumference SDS (mean, 95% CI)	3.0 (2.8-3.3)	3.3 (3.0 -3.5)
Sum of skinfolds (mm, mean, 95% CI)	93.1 (89.1-97.0)	84.9 (79.2-90.7)
Body fat percent (Tanita)	37.5 (35.4-39.7)	38.3 (35.6-40.9)
Parent's Marital Status (%)		
Married	51.4	60.0
Living Together	5.7	0
Divorced	14.3	13.3
Separated	28.6	23.3
Single	0	3.3
Referral Source (%)		
Self	60.0	36.7
Health Professional	40.0	63.3

Table 3- Change in measures of body composition (mean with 95% confidence intervals) by intervention group by time

Variable	I/C group (n=35)		C/I group (n=30)		Mean difference/ F-ratio;(p-value)
	U*	A	U	A	
<u>Change 0-12 months</u>					
Weight (kg)	3.7 (1.6-5.8)	3.9 (1.76-6.05)	5.2 (3.1-7.3)	5.1 (2.8-7.3)	-1.5 (-4.4-1.4)/ 1.1; (0.31)
Waist circumference (cm)	3.4 (1.3-5.4)	4.2 (1.9-6.6)	5.2 (2.8-7.6)	4.1 (1.6-6.6)	-1.8 (-4.9-1.3)/ 1.35; (0.25)
Waist Circumference SDS	0.1 (-0.02-0.23)	0.14 (-0.003-0.28)	0.14 (-0.03-0.31)	0.07 (-0.09-0.21)	-0.03 (-0.24-0.17) 0.121; (0.73)
Sum of skinfolds (mm)	-8.8 (-13.0- -4.6)	-6.0 (-9.5- -2.5)	-0.9 (-5.3-3.6)	-4.0 (-7.8- -0.3)	-7.9 (-13.9- -1.9)/ 7.0;(0.01)
% Fat	-1.20 (-2.76-0.36)	-0.85 (-3.00- 1.29)	-0.48 (-2.99-2.02)	-0.98 (-3.28-1.32)	-0.72(-3.56-2.12 0.96;(0.33)
BMI SDS	-0.17 (-0.26 - -0.08)	-0.13 (-0.26 -0.008)	-0.08 (-0.24-0.07)	-0.14 (0.28- -0.001)	-0.09 (-0.26-0.09)/ 0.99;(0.32)
<u>Change 12-24 months</u>					
Weight (kg)	3.0 (-0.6-6.7)	3.1 (-0.4-6.6)	5.6 (3.5-7.6)	5.7 (2.5-8.9)	-2.5 (-6.4-1.4) 1.7; (0.2)
Waist circumference (cm)	1.1 (-2.2-4.4)	2.5 (-0.6-5.7)	1.6 (-0.5-3.7)	0.6 (-2.3-3.5)	-0.5 (-4.1-3.2) 0.07;(0.79)
Waist Circumference SDS	-0.02 (-0.24-0.19)	-0.04 (-0.27-0.19)	-0.07 (-0.24-0.1)	-0.015 (-0.23-0.2)	0.04 (-0.22-0.3) 0.117; (0.73)
Sum of skinfolds (mm)	-4.8 (-10.4-0.9)	-2.5 (-7.6-2.7)	-0.9 (-4.1-2.2)	-2.6 (-7.5-2.2)	-3.8 (-9.9-2.2)/ 1.62;(0.21)
% Fat	-1.64 (-4.31-1.02)	-.055 (-2.99-1.89)	0.06 (-1.96-2.08)	-0.86 (-3.04-1.33)	-1.70 (-4.89-1.49)/ 0.80;(0.38)
BMI SDS	-0.23 (-0.45 - -0.02)	0.21 (-0.45--0.021)	-0.14 (-0.29-0.01)	-0.14 (-0.35-0.079)	-0.09 (-0.35-0.16)/ 0.99;(0.32)
<u>Change 0-24 months</u>					
Weight (kg)	6.2 (0.6-11.7)	5.6 (0.6-10.5)	11.9 (9.0-14.8)	12.6 (8.0-17.1)	-5.7 (-11.5-0.1) 3.97;(0.05)
Waist circumference (cm)	3.5 (-0.8-7.8)	4.9 (0.7-9.0)	8.2 (5.2-11.1)	7.1 (3.1-11.0)	-4.6 (-9.6-0.3) 3.558;(0.07)
Waist Circumference SDS	0.06 (-0.22-0.33)	0.03 (-0.24-0.29)	0.16 (-0.01-0.33)	0.2 (-0.06-0.45)	-0.11 (-0.41-0.2) 0.498; (0.48)
Sum of skinfolds (mm)	-14.7 (-23.4- -6.0)	-9.3 (-15.9- -2.8)	0.3 (-5.1-5.7)	-4.4 (-10.4-1.6)	-15.0 (-24.7- -5.3)/ 9.71;(0.003)
% Fat	-3.29 (-6.57- -0.01)	-2.28 (-5.41-0.860)	-0.01 (-2.84-2.83)	-0.90 (-3.78-1.99)	-3.28 (-7.47- 0.90) 0.81; (0.37)
BMI SDS	-0.44 (-0.7- -0.18)	-0.41 (-0.71- -0.11)	-0.14 (-0.35-0.06)	0.16 (-0.43-0.11)	-0.3 (-0.62-0.02)/ 3.68;(0.06)

Shaded area covers period of active intervention.

U=Unadjusted, A=Adjusted for baseline measures of age, weight, height, sum at skinfolds, referral source & gender using analysis of variance.

Table 4- Percentage of children above 99.6th BMI Centile by intervention group by time

Measure % above 99.6th Centile for BMI	Intervention / Control Group	Control / Intervention Group	Pearson Chi Square (p)
Baseline	57.1	63.3	0.612
Six months	48.4	51.9	0.792
Twelve months	32.1	51.9	0.139
	No intervention 12-24 months	Intervention 12 -24 months	
Eighteen months	22.7	46.2	0.091
Twenty-four months	19.0	48.0	0.04
Twelve months (I/C group) compared with twenty-four months (C/I group)	32.1	48.0	0.239

Figure Legends

Figure 1. Flow of participants through the study

Figure 1

