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ORIGINAL ARTICLE

Effectiveness of short-term, community- and school-based strategies aimed at tackling childhood obesity

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Abstract:
The prevalence of children in Scotland who are overweight/obese has reached alarming proportions. The aim of this study was to test the effectiveness of two short-term (6-10 weeks) programmes aimed at reducing childhood obesity. One of the programmes was delivered within a community setting whilst the other was school-based. For comparison, we examined the effect of the well established MEND programme. All of the initiatives consisted of a mixture of physical activity and nutrition education and involved varying degrees of parental participation. The programmes also varied in their intensity and duration. The primary outcome measure was a change in BMI/BMI-SDS (BMI-standard deviation score). All three programmes were successful in reducing BMI-standard deviation score (BMI-SDS) albeit with varying degrees of success (range 0.065-0.18) . It is apparent that the reduction in BMI-SDS was dependent upon the number of weekly sessions and the duration of the programme. The community based programmes had a greater effect on the primary outcome than the school-based initiative. The reduction in BMI-SDS was still evident 6 months after the completion of the community-based programmes. The results could help inform the development of longer-term community- and school-based strategies aimed at reducing paediatric adiposity.

Keywords: : childhood obesity, community-based interventions
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Introduction

The prevalence of childhood obesity in Scotland, like many developed countries, has reached an alarming level and is developing into a potential public-health crisis. A recent Government survey revealed that 28.2% of children in Scotland are overweight including 14.4% who are either obese or severely obese [1]. There is a tendency for obese children to become obese adults many of whom will develop type 2 diabetes and cardiovascular disease [2, 3]. Not only does obesity affect morbidity but there is a distinct possibility that childhood obesity could lead to a reduction in life expectancy within affluent societies [4]. Furthermore, the increase in obesity-related morbidity will continue to place a significant burden on the Scottish health-care system.

The development of multi-level strategies aimed at attenuating the rise in paediatric obesity is of paramount importance [5]. There are numerous reports in the literature relating to the effectiveness of initiatives whose aim is to reduce the prevalence of childhood obesity [6]. However, most of the studies have been conducted in either academic or clinical centres rather than in the community and primary care settings where, ultimately, the battle against the obesity epidemic has to be fought [6]. The purpose of the present study was to examine the effectiveness of two short-term initiatives developed by us which were aimed at children who were either overweight or obese. In particular, we wanted to examine the efficacy of programmes whose frequency and intensity made it feasible for them to have the potential to engage large numbers of participants. One was a community based programme (JumpStart) whilst the other was a school-based programme (JumpStart Choices). Both initiatives consisted of a mixture of physical activity and nutrition-based education and had varying degrees of parental involvement. For comparison, we tested the effect of the well established MEND (Mind, Exercise, Nutrition, Do it) programme. MEND is an international programme developed in 2004 at the Great Ormond Street Hospital for Children and the University College London Institute for Child Health [7, 8]. The Jumpstart programme was similar to MEND but was less intensive (1 weekly session instead of 2). JumpStart Choices was modelled on Jumpstart but was school-based and was run over a shorter period (6-8 weeks rather than 10 weeks). The primary outcome for all of the programmes was BMI/BMI-SDS.

The results show that each of the programmes reduced BMI/BMI-SDS but with varying degrees of success. The merits of each programme are discussed in the context of developing long-term strategies aimed at tackling the problem of childhood obesity.

Methods

MEND programme

The MEND programme was run according to the method described by Sacher et al [8]. The programme consisted of twice-weekly sessions each lasting 2 hours held over a 10 week period. All sessions were group-based and comprised of nutrition focussed education, behavioural modification sessions and fun-based physical activity sessions. Children were either referred via school nurses, paediatricians, General Practitioners or self-referred in response to local advertisements. The criteria for inclusion was that children were aged between 7 and 13 and had a BMI > 91st centile. Furthermore, each child had to be accompanied by at least one parent/carer. Assessments were performed at the beginning and end of the 10 week intervention and 6 months after the completion of the programme. All children who enrolled onto the programme completed it.

JumpStart programme

The JumpStart programme consisted of 10 weekly sessions each lasting 2 hours. The programme comprised of a) individual families being advised by a health coach b) group-nutrition based interactive sessions c) food and drink tasting sessions d) child activity sessions each lasting one hour and e) topic discussions involving parents. Children were either self-referred (as a consequence of local advertisements) or referred by health professionals such as dietitians, paediatricians, General Practitioners, accident and emergency personnel or school nurses. The basic criteria for inclusion on the programme was that the subjects had to be a) aged 5-15 b) above the 91st centile with respect to BMI and c) willing to attend 10 sessions accompanied by at least one parent/carer. Assessments were performed at the beginning and the end of the programme and 6 months after completion of the programme. Sixty children were enrolled onto the programme 58 of whom completed it.

JumpStart Choices programme

The JumpStart Choices programme was based upon the JumpStart programme described above. It was delivered within primary schools and involved a whole class approach. Although the programme was compulsory, parents were given the option to stop their children's height and weight measurements being taken and recorded. However, all children had their height and weight measurements taken. Each class contained a number of children with a BMI > 91st centile. The programme consisted of 6-8 sessions, with one session per week lasting one hour. A Health Coach presided over each session which consisted of twenty minutes of interactive health-topic discussions followed by 40 minutes of active games or exercise. Throughout the programme, children were set health tasks to be undertaken either individually or involving other family members. Teachers and parents were given a health pack and the latter were invited to meet the coaches. Assessments were performed at the beginning and end of the programme.

Anthropometric measurements

Body weight and height were measured using standardized procedures. Children were weighed using digital scales: measurements were taken to the nearest 0.1 kg with subjects wearing light clothing and no shoes. Height was measured to the nearest 0.1 cm using a stadiometer.

Social Deprivation

The social background of participants in the JumpStart and MEND programmes was determined according to residential postcode using the Scottish Index of Multiple Deprivation (SIMD). The SIMD provides a relative ranking of data zones based on a weighted combination of information relating to income, housing, health, education, skills and training, employment and crime.

Data Presentation and Statistical Analysis

All data are presented as means ± SD. Given that there is an ongoing debate as to the best measure of pediatric adiposity height/weight data were transformed into both BMI and BMI-SDS [9, 10]. BMI values (kg/m^2) were converted to BMI-SDS values using the LMS method described by Cole et al [11, 12]. The method relates the distribution at each age by its median (M), coefficient of variation (S) and a measure of skewness (L) according to equation 1:

$$BMI - SDS = \frac{(BMI / M)^{L} - 1}{LS} \quad (1)$$

Normality of distribution was examined using the Shapiro-Wilk W test. Consequently, non-parametric statistical tests were applied to all data with the exception of that relating to age. Differences between paired and unpaired samples were assessed using the Wilcoxon, matched-pairs, signed rank test and the Mann-Whitney test respectively. Friedman's test was used when more than 2 repeated measurements were compared: post-hoc analysis was performed using Dunn's multiple comparison test. Differences between proportions were assessed using Fisher's exact test and the Chi-square test for expected distribution. Differences were considered to be significant when $P < 0.05$.

Table 1. Demographic characteristics of participants in JumpStart, JumpStart Choices and MEND programmes.

	JumpStart (n:58)	JumpStart Choices (n:64)	MEND (n: 40)
Male	27	32	17
Female	31	32	23
Age, mean ± SD			
Male	9.94 ± 2.44	9.58 ± 1.86	10.67 ± 1.68
Female	10.18 ± 3.05	10.04 ± 1.45	10.73 ± 1.70
BMI, mean ± SD			
All	28.24 ± 5.34	22.70 ± 3.35	28.61 ± 4.51
Male	27.19 ± 4.26	22.27 ± 3.27	28.37 ± 3.58
Female	29.15 ± 6.05	23.14 ± 3.43	28.69 ± 5.14
BMI-SDS, mean ± SD			
All	3.051 ± 0.636	2.029 ± 0.594	2.896 ± 0.619
Male	3.038 ± 0.536	2.113 ± 0.588	3.014 ± 0.636
Female	3.062 ± 0.722	1.945 ± 0.597	2.810 ± 0.606

All children had a BMI > 91st centile. P > 0.05 for all comparisons between males and females with respect to age, BMI and BMI-SDS. Note that BMI and BMI-SDS were both lower in the JumpStart Choices group compared with the other two groups. This is a consequence of the JumpStart Choices programme having a larger proportion of children with a BMI between the 91st and 98th centiles compared to the other two groups.

Results

Baseline characteristics

Table 1 shows the ages, BMI and BMI-SDS for the participants in the MEND, JumpStart and JumpStart Choices programmes. There were no differences between males and females with respect to any of the baseline parameters. Fifty eight children enrolled on the JumpStart programme of whom 56 were obese (BMI > 98th centile) and 2 were overweight (BMI > 91st centile). The mean BMI-SDS of the group was 3.051 ± 0.636. Forty children participated in the MEND initiative: 36 were classified as obese and 4 were overweight. The mean BMI-SDS was 2.896 ± 0.619. Two hundred and two children engaged with the JumpStart Choices programme 64 of whom were either obese or overweight (BMI > 91st). The mean BMI-

SDS of this group, taken as a whole, was 2.029 ± 0.594. However, the mean BMI-SDS of those participating on the JumpStart Choices programme who were obese or overweight was respectively 2.575 ± 0.385 (n = 29) and 1.577 ± 0.257 (n = 35). Figure 1 illustrates the social background of participants in the MEND and JumpStart programmes as adjudged by the Scottish Index of Multiple Deprivation: the majority of participants were from socially-deprived backgrounds.

Table 2. The effect of the JumpStart and MEND programmes on BMI **and BMI-SDS**

	JumpStart	MEND
Pre-BMI	28.24 ± 5.34	28.61 ± 4.51
Post-BMI	27.77 ± 5.46	27.68 ± 4.51
Difference	0.47 ± 1.16[a]	0.93 ± 0.65[b†]
Pre-BMI-SDS	3.051 ± 0.636	2.896 ± 0.619
Post-BMI-SDS	2.915 ± 0.664	2.716 ± 0.679
Difference	0.136 ± 0.228[b]	0.180 ± 0.125[b*]

*[a]p < 0.01; [b]p < 0.001 refers to differences between pre- and post-intervention values which were assessed using the Wilcoxon matched-pairs signed rank test. *p < 0.05; †p < 0.01 refers to differences between the JumpStart and MEND programmes which were assessed using the Mann-Whitney U test.*

The effect of JumpStart and MEND on BMI and BMI-SDS

It is evident from Table 2 that both programmes significantly reduced the average BMI and BMI-SDS. The programmes were equally effective for both males and females (results not shown). Table 3 details the number and percentage of children who decreased, increased or did not change their BMI/BMI-SDS. The MEND initiative proportionally reduced the BMI-SDS of more children than JumpStart. It is apparent that MEND was more effective at reducing both BMI and BMI-SDS than JumpStart ($P < 0.01$ for BMI; $P < 0.05$ for BMI-SDS). Children who were referred to the JumpStart programme by a health professional had a higher initial BMI-SDS than those who self-referred (3.308 ± 0.147 n = 20 v 2.915 ± 0.095, n = 38; $P < 0.05$; Mann-Whitney U test). However, there was no difference in the reduction in BMI-SDS between those who self-referred or were referred to the programme by a health professional (0.167 ± 0.250 v 0.127 ± 0.281; $p = 0.641$).

Children who completed the Jumpstart and MEND programmes were invited to attend an assessment 6 months after finishing the course. The attendance at the assessment was respectively 39.7% and 65.0% for the JumpStart and MEND programmes. The results shown in Table 4 suggest that there was no further reduction in BMI or BMI-SDS between the immediate end of the interventions and that found 6 months later. However, both BMI and BMI-SDS were still significantly lower than the pre-intervention values. The pre- and post-intervention BMI and BMI-SDS values did not differ between those who attended the 6-month assessment and those who did not (results not shown).

Table 3. The relative effect of the JumpStart and MEND programmes on BMI and BMI-SDS

	JumpStart (n :58)	MEND (n: 40)
BMI		
Decrease	43(74.1)	37(92.5)
Increase	13(22.4)	2((5)
No change	2(3.5)	1(2.5)
BMI-SDS		
Decrease	47(81.0)	39(97.5)*
Increase	11(19.0)	1(2.5)

**p = 0.0246 for BMI-SDS; Fisher's exact test. The numbers in parentheses are percentages.*

The effect of the JumpStart Choices programme on BMI-SDS

The school-based JumpStart Choices intervention engaged 202 children of whom 29 were obese, 35 were overweight and 138 who were neither obese nor overweight. Table 5 shows the effect of the programme on the BMI-SDS of the three groups. The intervention reduced the BMI-SDS of obese and overweight children: the reduction was similar for both groups. On the other hand, JumpStart Choices did not reduce the BMI-SDS of children who were neither obese nor overweight.

Discussion

The Jumpstart and MEND programmes were similar regarding referral pathways, criteria for inclusion and mode of delivery and are thus comparable. The major difference was the number of weekly sessions (2 to 1 in favour of MEND). Both programmes significantly reduced the BMI and BMI-SDS over the course of the intervention. The change in BMI-SDS of 0.180 and 0.136 respectively found with MEND and JumpStart compares well to programmes of a similar intensity and duration but based in a clinical or academic setting (e.g. see [13]).

Table 4. Six month post-intervention BMI-SDS of JumpStart and MEND participants

Programme	Pre BMI-SDS	Post BMI-SDS	Difference between pre- and post-intervention values	6 month post-assessment BMI-SDS	Difference between 6 month and pre-intervention values	Difference between 6 month and post-intervention values
JumpStart (n=23)	2.853 ± 0.690	2.689 ± 0.691	0.163 ± 0.247[a]	2.644 ± 0.678	0.209 ± 0.244[b]	0.045 ± 0.269[NS]
MEND (n=26)	2.916 ± 0.693	2.718 ± 0.767	0.198 ± 0.141[b]	2.689 ± 0.783	0.227 ± 0.279[b]	0.029 ± 0.248[NS]

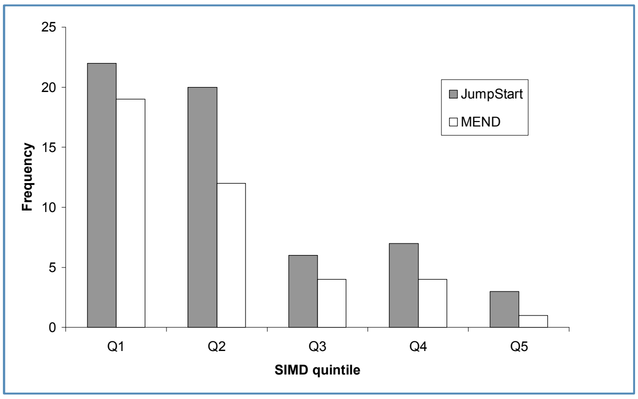
[a]p < 0.05, [b]p < 0.001; p values refer to differences within each programme. Differences were assessed using Friedman's test followed by Dunn's multiple comparison test. NS = not significant.

Table 5. The effect of JumpStart Choices on the BMI-SDS of children who were obese, overweight or normal weight

	Pre-intervention	Post-intervention	Difference	p
Not overweight	0.036 ± 0.668	0.021 ± 0.690	0.015 ± 0.207	0.5740
Overweight	1.577 ± 0.257	1.533 ± 0.284	0.044 ± 0.109	0.0168
Obese	2.575 ± 0.385	2.510 ± 0.406	0.065 ± 0.126	0.0121

Differences were assessed using the Wilcoxon matched-pairs, signed-ranks test

Figure 1. Social background of those who participated in JumpStart and the MEND programmes as adjudged by the Scottish Index of Multiple Deprivation (SIMD). Q1 is the most deprived; Q5 the least. p < 0.01; Chi-square test for expected distribution. JumpStart n = 58; MEND n = 40.



It is apparent that the MEND programme resulted in a greater reduction in both BMI and BMI-SDS. The decrease in BMI found in the present MEND programme compares well with that reported by Sacher et al [7](0.93 ± 0.65 v 0.9 ± 0.8 kg/m^2). It is tempting to suggest that the greater success of the MEND programme is attributable to the intensity of the initiative. Less encouraging is the finding that the participants in either the Jumpstart or the MEND programme did not further reduce their BMI/BMI-SDS over a prolonged period: there was no difference between BMI-SDS measured at the end of the 10 week intervention and that recorded 6 months later. However, BMI-SDS measurements were still significantly lower than the pre-intervention values suggesting that the initial benefits of the programmes had been sustained. However, we cannot at this point rule out the possibility that those who attended the six month follow up assessments were more motivated to sustain the reduction in BMI.

The mean reduction in BMI-SDS induced by the JumpStart (0.136) and MEND (0.18) programmes equates to less than a 2.9% reduction in body fat [10]. According to Hunt et al [10], the minimum decrease in BMI-SDS to be sure of a real reduction in adiposity is 0.5. Moreover, a recent study by Ford et al [14] suggests a reduction in BMI-SDS greater than 0.25 is associated with an improvement in cardiometabolic health. The reduction in BMI-SDS observed in the JumpStart and MEND programmes also falls short of that recommended by Ford et al [14]. However, it should be borne in mind that the subjects in the latter study participated in a 12 month weight loss programme delivered within a clinical setting.

Both programmes predominantly recruited children from socially-deprived backgrounds. A relationship between deprivation and childhood obesity has been established and could be a consequence of consuming low-cost, energy-dense foods, among other factors (see e.g. [15]). This reinforces the importance of including a nutritional component in programmes designed to tackle obesity in children from socially-deprived backgrounds.

The school-based JumpStart Choices programme successfully reduced the BMI-SDS of those participants who were either overweight or obese. The reduction in BMI-SDS of 0.065 for obese participants is similar to that found for a school-based weight loss programme for overweight Mexican American children [16]. It is notable however, that the effect was less than either JumpStart or MEND. This is probably due to a combination of shorter and fewer sessions. One major advantage of school-based programmes is the relatively ease of engaging/re-engaging with participants over long periods.

It has recently been reported that the prevalence of childhood obesity in Switzerland decreased between 2002 and 2007 [17]. The authors imply that physical activity/nutrition programmes within a school setting could be responsible for the decrease in paediatric adiposity. School-based programmes may therefore have a vital role to play in the fight to stem the obesity epidemic within Scotland and elsewhere.

Study strengths and limitations

The major strength of the present study is that all three intervention programmes were conducted in a community/school setting rather than within academic or clinical centres. This makes the findings relevant to the future design and implementation of large scale programmes aimed at tackling childhood obesity within the community. One other strength of the study was the attendance rate: all of the children who started the MEND and JumpStart programmes completed them. Also, no children opted-out of the school-based JumpStart Choices programme.

The major limitation of the study from a design and analytical point of view is the lack of a control/comparison group for both the JumpStart and MEND programmes. It could be argued that any reduction in BMI/BMI-SDS was due to self-motivation rather than the programmes *per se.* Control groups were not a feasible option since we wanted to engage all children who were referred onto the programmes. The finding that there was no further reduction in BMI/BMI-SDS between the immediate post-intervention period and the 6-month follow up assessment suggests that the positive outcomes were directly attributable to the programmes rather than self-motivation of the participants. In this connection, a recent randomized controlled trial of the MEND programme suggests that participants reduced their BMI/BMI-SDS in comparison to a control group [9].

Conclusions

Interventions aimed at reducing the prevalence of childhood obesity need to be of sufficient length and intensity to reduce BMI-SDS by at least 0.25 or more preferably 0.5: the latter equates to a real reduction in adiposity whereas the former will improve cardiometabolic health [10, 14]. All of the initiatives examined in this report were successful in reducing adiposity as adjudged by BMI-SDS, however, they fell short of the recommended value of 0.25. We are of course aware that initiatives aimed at reducing childhood obesity are labour intensive and thus costly. However, it is imperative that large scale community/school based initiatives should be funded long enough to a) improve cardiometabolic health and b) induce a real reduction in adiposity. Both JumpStart and JumpStart Choices have the potential to engage with large numbers of children and moreover have the capacity to engage children over long periods which in turn may induce long-term behavioural changes.

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