Preventing childhood obesity by reducing consumption of carbonated drinks: cluster randomised controlled trial

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BMJ 2004;328;1237-; originally published online 23 Apr 2004;
doi:10.1136/bmj.38077.458438.EE

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Abstract

Objective To determine if a school based educational programme aimed at reducing consumption of carbonated drinks can prevent excessive weight gain in children.
Design Cluster randomised controlled trial.
Setting Six primary schools in south west England.
Participants 644 children aged 7-11 years.
Intervention Focused educational programme on nutrition over one school year.
Main outcome measures Drink consumption and number of overweight and obese children.
Results Consumption of carbonated drinks over three days decreased by 0.6 glasses (average glass size 250 ml) in the intervention group but increased by 0.2 glasses in the control group (mean difference 0.7, 95% confidence interval 0.1 to 1.3). At 12 months the percentage of overweight and obese children increased in the control group by 7.6%, compared with a decrease in the intervention group of 0.2% (mean difference 7.7%, 2.2% to 13.1%).
Conclusion A targeted, school based education programme produced a modest reduction in the number of carbonated drinks consumed, which was associated with a reduction in the number of overweight and obese children.

Introduction

One factor contributing to obesity in children seems to be the consumption of carbonated drinks sweetened with sugar.[1] These have a high glycaemic index and are energy dense. In the United Kingdom more than 70% of adolescents regularly consume carbonated drinks.[2]

Although school or family based programmes that promote physical activity, modification of dietary intake, and reduction of sedentary behaviours may help reduce obesity in children, few have been effective.[3] The United Kingdom based active programme prompting lifestyle in schools (APPLES) reported the effects of multiple interventions on obesity in children, but there is a paucity of studies on single factors considered to be important.[4] We aimed to determine if a school based educational programme for reducing the consumption of carbonated drinks could prevent excessive weight gain in children.

Participants and methods

The Christchurch obesity prevention project in schools (CHOPPS) took place between August 2001 and October 2002 over one school year. The project was based in six junior schools with children aged 7 to 11 years.

Outcome measures

We took anthropometric measurements at intervals of six months. Height was measured by one investigator (JJ) to the nearest 0.1 cm, weight was measured to the nearest 0.1 kg, and waist circumference was measured according to published centile charts.[5] We converted body mass index (weight (kg)/(height (m)^2)) to standard deviation scores (or z scores) and to centile values using the British 1990 growth reference disc.[6]

The children completed diaries at baseline and at the end of the trial on drinks consumed over three days (average glass size 250 ml). Collecting data in this way has been shown to provide comprehensive results.[7]

Intervention and statistical methods

One investigator (JJ) delivered the programme. The main objective was to discourage the consumption of "fizzy" drinks with positive affirmation of a balanced healthy diet. The children were told that by decreasing sugar intake they would improve their overall health and that by reducing the consumption of diet carbonated drinks they would benefit dental health. A one hour session was assigned for each class each term. Teachers helped in the sessions and reiterated the message in lessons. Sessions focused on the balance of good health and promotion of drinking water and comprised a music competition, presentations of art, and a quiz. The children tasted fruit to learn about the sweetness of natural products, and each class was given a tooth immersed in a sweetened carbonated cola to assess its effect on dentition. The children were also encouraged to access the project's website (www.b-dec.com).

Clusters were randomised according to a random number table, with blinding to schools or classes. Based on data from a pilot study conducted in the same geographical area, we estimated that we needed an average of 12 children in each class.[8] Data were analysed using SPSS (version 11). We used the independent sample t test to establish significance between intervention and

This is the abridged version of an article that was posted on bmj.com on 27 April 2004: http://bmj.com/cgi/doi/10.1136/bmj.38077.458438.EE

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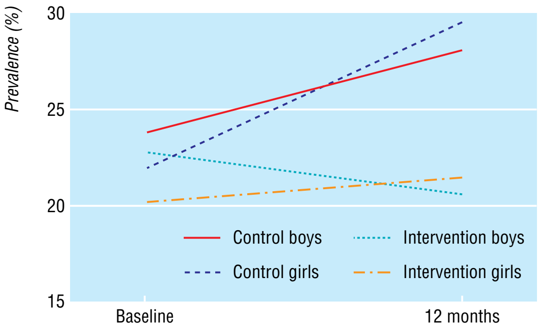
BMJ 2004;328:1237–9



Mean change in proportion of overweight and obese children from baseline to follow up at 12 months according to clusters

control clusters and the paired *t* test to establish the significance of changes within clusters. Intracluster correlation coefficients and 95% confidence intervals were calculated, with adjustment for variable cluster size.[9]

Results

Each of 29 classes (two of the 31 clusters were excluded because they were mixed age classes) was considered as a cluster. Fifteen were randomised to the intervention group and 14 to the control group (see bmj.com). In total, 644 of 914 (70.5%) parents and children gave written consent. The average age at baseline was 8.7 (SD 0.9) years (range 7.0 to 10.9 years). The groups were similar at baseline for distributions of age, sex, consumption of sweetened carbonated drinks, and percentage of overweight or obese children (see bmj.com).[10] Body mass index was measured in 602 (93.5%) children at six months and 574 (89.1%) at 12 months.

After 12 months there was no significant change in the difference in body mass index (mean difference 0.13, −0.08 to 0.34) or z score (0.04, −0.04 to 0.12; table 1). At 12 months the mean percentage of overweight and obese children increased in the control clusters by 7.5%, compared with a decrease in the intervention group of 0.2% (mean difference 7.7%, 2.2% to 13.1%; figure).

Body mass indices between those children who returned the diaries and those who did not were similar (17.3 (2.3) *v* 17.5 (2.4), respectively, P=0.3 using the *t* test) Overall, 19.0% of the children were overweight at baseline. Baseline consumption of carbonated drinks was similar in children who did or did not return diaries at 12 months (1.8 *v* 1.9 glasses, −0.7 to 0.3 glasses)

Table 1 Body mass indices, z scores (standard deviation scores), and mean percentages above 91st centile at baseline and 12 months

Characteristic	Control clusters (n=14)	Intervention clusters (n=15)	Mean difference (95% CI)
Baseline*:			
Mean (SD) body mass index	17.6 (0.7)	17.4 (0.6)	0.0 (–0.5 to 0.5)
Mean (SDS) z score†	0.47 (0.2)	0.50 (0.23)	–0.03 (–0.2 to 0.13)
Mean percentage >91st centile (z score >1.34)	19.4 (8.4)	20.3 (6.3)	–0.9 (–6.6 to 4.8)
12 months*:			
Mean (SD) body mass index	18.3 (0.8)	17.9 (0.7)	0.4 (–0.2 to 1.0)
Mean (SDS) z score	0.60 (0.19)	0.48 (0.23)	0.12 (–0.04 to 0.28)
Mean percentage >91st centile (z score >1.34)	26.9 (12.3)	20.1 (6.7)	6.8 (–0.7 to 14.3)
Change over 12 months‡:			
Mean (SD) body mass index	0.8 (0.3)	0.7 (0.2)	0.1 (–0.1 to 0.3)
Mean z score	0.08 (0.13)	0.04 (0.07)	0.04 (–0.04 to 0.12)
Mean percentage >91st centile	7.5 (8.0)	–0.2 (6.3)	7.7 (2.2 to 13.1)

*Based on maximum number of children in each cluster.
†Age and sex specific body mass index converted to standard deviation score using revised 1990 reference standards.
‡Based on children with data at baseline and 12 months.

Table 2 Changes in consumption of drinks over 12 months in control clusters (n=14) and intervention clusters (n=15).* Values are means (SDs) unless stated otherwise

Type of drink	Baseline	12 months	Mean change (95% CI)	Difference in consumption (95% CI)†	P value‡
Total carbonated drinks:					
Control clusters	1.6 (0.6)	1.8 (0.6)	0.2 (–0.2 to 0.5)	0.7 (0.1 to 1.3)	0.4
Intervention clusters	1.9 (0.5)	1.3 (0.6)	–0.6 (–1.0 to –0.1)		0.02
Carbonated drinks with sugar:					
Control clusters	1.1 (0.6)	1.2 (0.5)	0.0 (–0.3 to 0.4)	0.1 (–0.4 to 0.5)	0.9
Intervention clusters	1.2 (0.3)	0.9 (0.6)	–0.3 (–0.6 to 0.1)		0.2
Diet carbonated drinks:					
Control clusters	0.4 (0.3)	0.6 (0.3)	0.1 (–0.1,0.4)	0.6 (0.2 to 1.1)	0.3
Intervention clusters	0.7 (0.3)	0.4 (0.2)	–0.3 (–0.6 to –0.1)		0.7
Carbonated drinks with caffeine:					
Control clusters	0.7 (0.4)	0.6 (0.5)	–0.1 (–0.3 to 0.1)	–0.0 (–0.4 to 0.3)	0.4
Intervention clusters	0.8 (0.3)	0.6 (0.3)	–0.2 (–0.4 to 0.1)		0.2
Water:					
Control clusters	2.9 (0.3)	5.1 (2.0)	2.2 (0.9 to 3.5)	0.3 (–1.3 to 1.9)	0.003
Intervention clusters	3.1 (1.1)	4.3 (2.0)	1.1 (0.2 to 2)		0.02

Cluster sizes are based on maximum number of children within each cluster.
*Units are number of glasses over three days (cluster is unit of analysis). All available data have been used in analysis.
†Based on children with data at baseline and 12 months.
‡Two tailed test.

The intracluster correlation for consumption of carbonated drinks was −0.009 (−0.03 to 0.05), suggesting independence between members of each cluster (table 2).[9] At 12 months, consumption was less in the intervention group than in the control group (mean difference 0.7, 0.1 to 1.3). Water intake increased in both groups, but there was no difference between intervention and control clusters.

Discussion

A school based educational programme aimed at reducing the consumption of carbonated drinks to prevent excessive weight gain in children aged 7-11 was effective. Our findings are important, especially as a recent Cochrane review has highlighted the lack of good quality evidence on the effectiveness of interventions in this area on which to base national strategies or to inform clinical practice.[7]

At the end of our 12 month study both the intervention group and the control group showed a significant increase in consumption of water, related to promotion of water in local schools. In accordance with local dental guidelines, the intervention children were encouraged not to drink carbonated drinks but to switch to water or to fruit juice diluted 1:3 with water.

Limitations of study

Some limitations to our study may have occurred due to contamination, as randomisation was by classes and not schools; transfer of knowledge may have taken place outside the classroom, although this would have been minimised by the cluster randomisation design.[11] We had two fewer clusters than anticipated owing to mixed year groups. The low return rate of drink diaries at baseline and completion may have resulted in a response bias; however, the proportion of children who were overweight was similar in those who did or did not return the diaries. A further limitation was the use of the diaries over only three days. The validity of self collected dietary data can be questioned because there is a tendency for under-reporting of energy intake, particularly in those who are overweight or obese.[7]

Most studies on obesity prevention in children have been multifaceted.[12] However, only one school based US study has shown benefit for reducing obesity rates.[13] A similar intensive and multifaceted approach was used in the UK based active programme prompting lifestyle in schools study.[4] In that study, children's consumption of vegetables increased but the prevalence of obesity did not change. Our intervention was simple, involved no teacher training, and could be easily implemented by a health educator working in several schools.

Small changes in energy intake and output seem to have a major impact on the risk of obesity. Reducing daily intake by a nominal amount of energy or by increasing energy output (the "energy gap") may help to prevent weight gain.[14]

Recently the World Health Organization recommended that free sugars should account for no more than 10% of daily energy intake.[15] This has not been universally accepted, particularly from within the food industry.[16] Reducing easy access to energy dense foods may help to limit the opportunities for overeating.[17] Although our targeted approach was modestly beneficial, other external influences on children's eating habits and leisure activities need to be debated widely in society.

What is already known on this topic

Obesity in children is a major public health problem

Although the cause is multifactorial it has been linked to the consumption of drinks sweetened with sugar

Previous school based interventions have been relatively ineffective in preventing obesity

What this study adds

A school based education programme to discourage children from drinking carbonated drinks reduced the number of overweight or obese children in a school year

Schools can have an important role in preventing obesity in children

We thank the headmasters, teachers, parents, and children at the participating schools, William Askew for writing and producing Ditch the Fizz, Julia Knott for help with data entry, Ruth Angel for discussion and advice, and the staff of the Bournemouth Diabetes and Endocrine Centre for help with anthropometric measurements.

Contributors: See bmj.com

Funding: This project was funded from unrestricted educational grants from GlaxoSmithKline, Aventis, and Pfizer and from internal resources within Bournemouth Diabetes and Endocrine Centre. The external funding bodies had no input into protocol development, data collection, or analyses or interpretation. JJ received a research scholarship from the Florence Nightingale Foundation.

Competing interests: DK and DC each had a child attending one of the schools involved in the Christchurch obesity prevention project in schools.

Ethical approval: This study was approved by the East Dorset research and ethics committee.

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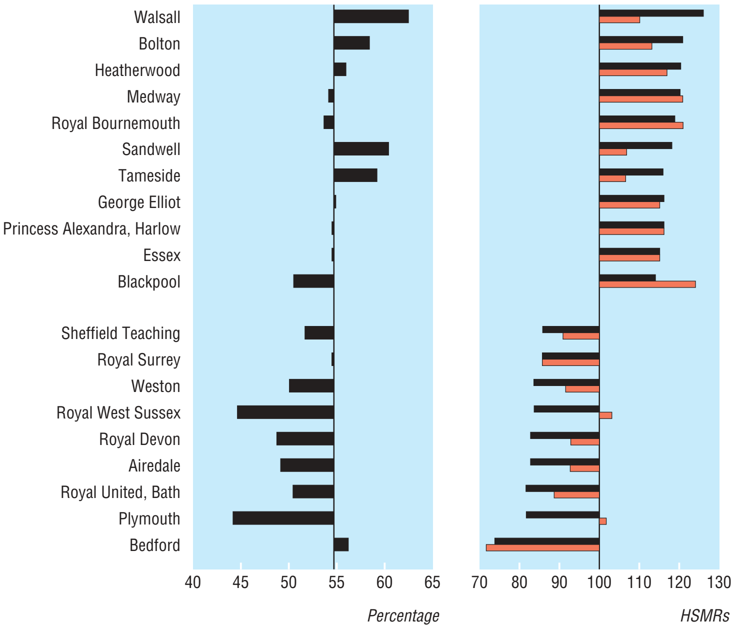
(Accepted 9 March 2004)

doi 10.1136/bmj.38077.458438.EE



Percentages of deaths occurring in NHS hospitals for catchment areas of hospitals (vertical line is percentage for England) and hospital standardised mortality ratios (HSMRs) as published (black) and after adjustment (red). Hospitals are plotted in ranking order of published HSMRs[1]

Statistics on place of death (NHS hospital, hospice, home, etc) of residents of different areas are published routinely.[4] These were available for two of the three years on which the published hospital league tables were based (1999 and 2000). We used hospital episode statistics to identify the individual health authorities that corresponded most closely to the catchment area of the 20 selected hospitals, and we used the published figures on place of death to calculate the percentage of deaths of residents of each catchment area that occurred in NHS hospitals. We then adjusted the published HSMRs to allow for geographic differences in the percentages of deaths occurring in hospital in the hospitals' catchment areas. We did this by scaling down the values when proportionately more deaths of residents occurred in NHS hospitals compared with England as a whole and scaling up those when proportionately fewer deaths occurred in hospital. For instance, for every 1000 deaths of residents of Walsall Health Authority, on average 623 occurred in NHS hospitals. For England overall, the average was 546. We reduced the published HSMR for the Walsall hospitals, 126, by the scaling factor 0.88 (546/623), which gave an adjusted HSMR of 110.

The percentages of deaths of residents of health authorities that occurred in NHS hospitals varied from less than 45% in Plymouth and West Sussex to over 60% in Walsall and Sandwell (figure, and see table on bmj.com). In most cases the adjustment brought the HSMRs closer together and closer to 100. It also changed the rankings.

Comment

Geographical differences in the provision of facilities for the dying are a plausible explanation for some of the differences between hospitals in their in-hospital death rates. Calculation of in-hospital death rates, aggregated across a wide clinical spectrum, including a mixture of admissions for treatment, cure, and palliative and terminal care, gives rates that are difficult to interpret as quality measures.

We thank Pamela Evans for typing the manuscript.

Contributors: MJG proposed the study; VS analysed the data. Both designed the study, wrote the manuscript, and will act as guarantors.

Funding: VS is funded by the Research and Development Directorate of the Department of Health and Social Care (South). MJG holds a grant from the Department of Health for the Oxford site of the National Centre for Health Outcomes Development (NCHOD). The funding body had no role in the design or writing of the work covered by this report.

Competing interests: None declared.

Ethical approval: Not needed.

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(Accepted 17 December 2003)

doi 10.1136/bmj.38058.517118.47

Corrections and clarifications

Preventing childhood obesity by reducing consumption of carbonated drinks: cluster randomised controlled trial
Two errors crept into table 2 of the full version (on bmj.com only) of this paper by Janet James and colleagues (22 May, p 1237). Firstly, the parentheses should be around the second set of values (which are the percentages) not the first set of values (which are the numbers). Secondly, the control girls consumed 95 (not 5) glasses of carbonated drinks in three days. The authors also want to make clear that data in the table relate to overweight children who fall between the 91st and 98th centiles and to obese children above the 98th centile.

Minerva
Minerva was reminded by a reader that she had forgotten to insert a reference for one of the items in the issue of 24 April (p 1024). The reference for the final item (about fatigue in patients with primary biliary cirrhosis) is *Gut* 2004;53:587-92.

Length of patient's monologue, rate of completion, and relation to other components of the clinical encounter: observational intervention study in primary care
In this Primary Care paper by Israel Rabinowitz and colleagues (28 February, pp 501-2), a misspelling of the surname of the second author (Rachel Luzzati) persisted to publication. There is only one "t" in Luzzati (not two). This has been corrected on bmj.com.

Integrating health care for mothers and children in refugee camps and at district level
The name of the first author in reference 8 was wrongly spelt in this Education and Debate article by Assad Hafeez and colleagues (3 April, pp 834-6). The correct spelling is Rahman.