Systematic review on effectiveness of interventional programmes in treating childhood obesity

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Abstract

**Background:** The prevalence of childhood obesity is alarming and studies have shown that overweight and obese children carry more risk of developing a range of related health problems when they become older. The aim of this systematic review was to evaluate the effectiveness of childhood obesity intervention programmes.

**Methods:** Systematic review of published literature from 2008 to 2015. Articles were excluded if they were published before 2008, if they were not published in English; if they had incomplete statistical data; and if the participants did not belong to the age category of 6 to 12 years. All eligible articles were independently reviewed by two reviewers to assess study quality.

**Results:** Ten studies met the inclusion criteria. Most were conducted in a healthcare setting (n = 5) or school-based setting (n = 4), including one in a rural area. Half of the articles were published in 2013 and all studies had an almost equal gender distribution. All studies sought reduction in anthropometric/body composition as their main outcomes. Only three studies were rated as strong in quality while the others were moderate.

**Conclusions:** Most of the interventional studies included in our review showed a significant improvement for obese children. Four out of 11 studies showed that physical activity and diet had a great impact on child obesity, while other studies showed that a hospital-care setting or school-based setting and parental involvement were more beneficial in treating obesity.


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Introduction

Globally, nearly 22 million children under 5 years of age were overweight in 2013 [1]. Numerous studies demonstrate that overweight and obese children have an 80% chance of becoming obese adults; however, this can be avoided if they reach and maintain a healthier body weight. Moreover, studies revealed that children who are obese or overweight are more at risk of developing a range of related health problems when they become older [2]. It is increasingly important, therefore, that we act to seek to improve the health and well-being of our young generation.

Childhood obesity has started to be an issue in Asian countries; according to the National Health Morbidity Survey (NHMS) carried out in Malaysia in 2011, which reported a prevalence rate of obesity among children aged less than 18 years old of 6.1% [3]. Meanwhile, the Malaysia Global School-based Student Health Survey (GSHS) 2012 reported a higher prevalence rate of 7.9%, which is much higher compared to the prevalence reported for Indonesia.
(1.3%, GSHS in 2007) and the Philippines (2.8%, GSHS in 2011) [4-6].

It is important to treat obesity as early as possible to prevent future health complications, as studies have shown that obese children tend to have metabolic (dyslipidaemia, glucose intolerance, hypertension) or mechanical consequences (obstructive sleep apnoea, orthopaedic disorders) [7].

The aim of this systematic review was to identify the effectiveness of childhood obesity interventional programmes in treating childhood obesity.

Methods

This systematic review was conducted and reported in accordance with Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines [8]. The flow diagram for the identification of relevant studies is shown in Figure 1. First, PubMed and the Cochrane Library were searched by analysis of keywords contained in the title and abstract. The following search terms were used: (1) childhood, child; (2) obesity, weight, overweight; and (3) clinical trial, intervention. This review focuses on studies published in the English language from 2008 to the end of 2015. This review was restricted to literature published during this period to focus on recent studies with the greatest potential implications for childhood interventions programs.

Childhood obesity is defined as a body mass index (BMI) at or above the 95th percentile for children and teens of the same age and sex, and overweight is defined as a BMI at or above the 85th percentile [9]. Other definitions also include a BMI Z-score of more than 2 [10].

Inclusion/exclusion criteria

Prior to this review, a standard protocol was developed for study selection and data abstraction. Study selection for this review were: 1) randomized controlled trial and must have a comparable group; 2) target population for intervention: children aged 6-12 years old only, which includes both sexes; 3) reported at least one outcome pertaining to childhood intervention programs (anthropometric, diet, physical activity, or sedentary behaviour outcomes). Articles were excluded if 1) statistic data were incomplete or not reported; 2) a literature review 3) or a qualitative study; 4) the respondents were over 12 years of age or had undergone surgery; or 5) if obesity was due to pharmacotherapy or a congenital disorder.

Figure 1. Flow diagram of selection process for identification of relevant articles

Study selection and data extraction

The titles and abstracts identified using the search criteria were screened by one reviewer and articles that did not meet the inclusion criteria were excluded. Twenty-six articles met the inclusion criteria. Two reviewers were assigned for a full assessment, in which both reviewers extracted the data independently. Each reviewer extracted data from the articles using a standardised form. For each article, the following data were extracted where available: leading author, year published, target group, study setting/location, sample size, participant’s age and sex, description of intervention (grouping, duration, and follow up), and the study’s outcomes.
Quality of reporting

The consistency and quality of each of the ten articles were checked based on the Quality Assessment Tool for Quantitative Studies developed by the Effective Public Health Practice Project, Canada [11]. The tool consists of a list of items that are recommended to assess RCTs to facilitate critical appraisal and interpretation of trials. This tool has a six-component rating scale which assesses selection bias, study design, confounders, blinding, data collection methods, and withdrawals and dropouts. Then, a rating of weak, moderate or strong is given for each component. Finally, a global rating is given: weak (two or more weak components rated as weak), moderate (less than four strong ratings and one weak rating), or strong (four strong ratings with no weak ratings). For each article, both reviewers independently assessed the study quality according to the tool. If there were any discrepancies in component ratings, a mutual consensus approach was used to resolve the discrepancies.

Results

Study selection

A total of 134 articles were identified through the database search strategy for the review process in which 16 articles were excluded as duplicate reports. The selection process (Figure 1) resulted in 26 articles eligible for this review, of which 12 articles were excluded because they were not relevant and 3 articles were removed as they had no suitable control group. Thus, 10 articles were eligible for full review, seven from PubMed and three from Cochrane Library.

Study characteristics

The baseline characteristics of studies are summarized in Table 1. Most of the studies were carried out in the United States of America [12-17], two in the Netherlands [13, 14], and one each in Spain [15] and Norway [10]. Of the 10 articles, five were published in 2013 [10, 14-17] and the remainder were published in 2008 to 2012.

Target group

Apart from the targeted overweight or obese children, four studies also recruited parental involvement [10, 12, 14, 15], three studies specifically targeted overweight and obese children [16, 19, 20], and two studies involved children recruited from all body mass index categories [13, 18].

Study setting/location

A health care setting was the most popular location for interventions [10, 12, 14, 19]; four studies carried out the intervention in a school-based setting [13, 15, 16, 18], while one study chose both a health care and home-based setting to conduct their study [20]; only one study did the intervention in a community-based setting [17].

Sample size, sex distribution, and age of participants

On average, all of the studies had an equal sex distribution except for two studies [14, 19]. However, one study did not report on the sex distribution of the participants [17]. In terms of sample size, six studies had less than a hundred participants [10, 12, 14-16] while two studies had more than a thousand participants [12, 17]. The target age for the majority of studies was 6-12 years old.

Intervention vs Control Group description

Eight of the studies had two groups, an intervention group and a control group [10, 13-19], but two studies had three groups [12, 20].

Study duration and follow-up

The shortest study duration was 8 weeks [15, 16]. Most of the studies conducted an intervention between 3 and 9 months [10, 12, 14, 19, 20], but three studies carried out interventions of more than 2 years [13, 17, 18]. The mean study duration was 12.25 ± 11.46. In terms of follow-up, seven studies had a follow-up duration of less than 1 year [10, 13-15, 16, 19, 20].
Table 1. Summary of studies: focus, study setting/location, sample size, intervention description, and the outcome (ordered by year of publication)

<table>
<thead>
<tr>
<th>First Author, Year</th>
<th>Country</th>
<th>Target group</th>
<th>Study setting/ location*</th>
<th>Sample size (percent male)</th>
<th>Age (mean ± SD)</th>
<th>Intervention vs Control Group description</th>
<th>Intervention duration</th>
<th>Follow-up</th>
<th>Outcome‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Janicke DM, 2008</td>
<td>USA</td>
<td>Overweight or obese children (BMI ≥ 85th percentile) and their parent</td>
<td>HBS: in rural area</td>
<td>71 (40% male)</td>
<td>Behavioral family-based intervention: 11.4; vs Behavioral parent-only intervention: 11.0; vs wait-list control group: 11.0</td>
<td>3 groups: Behavioral family-based intervention (n = 24) vs Behavioral parent-only intervention (n = 26), vs wait-list control group (n = 21)</td>
<td>4 months</td>
<td>10 months</td>
<td>No benefit</td>
</tr>
<tr>
<td>Dzewaltowski DA, 2010</td>
<td>USA</td>
<td>Students at selected schools</td>
<td>SBS: 7 schools</td>
<td>246 (50% male)</td>
<td>Physical activity + nutrition: 9.21 ± 0.66; vs Control groups: 9.37 ± 0.63</td>
<td>2 groups: Physical activity + nutrition (4 schools, n = 112) vs Control groups (3 schools, n = 134)</td>
<td>3 years</td>
<td>3 years</td>
<td>PA</td>
</tr>
<tr>
<td>Jansen W, 2011</td>
<td>Netherlands</td>
<td>Grade 3-8 students at selected schools</td>
<td>SBS: 20 schools</td>
<td>2622 (50% male)</td>
<td>6-12 years</td>
<td>2 groups: Physical activity (10 schools, n = 1240) vs Control (10 schools, n = 1382)</td>
<td>2 years</td>
<td>2 years</td>
<td>BMI WC</td>
</tr>
<tr>
<td>De Niet J, 2012</td>
<td>Netherlands</td>
<td>Overweight and obese children</td>
<td>HCS</td>
<td>141 (36% male)</td>
<td>9.9 ± 1.3</td>
<td>2 groups: SMS Maintenance Treatment (SMSMT) (n = 73) vs Control group receiving no SMSMT (n = 68)</td>
<td>38 weeks</td>
<td>12 months</td>
<td>Unclear</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Year</td>
<td>Country</td>
<td>Setting Description</td>
<td>Sample Size</td>
<td>Intervention Details</td>
<td>Study Duration</td>
<td>Z Score Location</td>
<td>Findings</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
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<td>---------------------</td>
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<td>----------------------</td>
<td>---------------</td>
<td>------------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>Lisón JF, 2012</td>
<td>Spain</td>
<td>Overweight or obese (BMI ≥ 85th percentile)</td>
<td>Mixed setting: HCS and HBS</td>
<td>110 (51% male)</td>
<td>Hospital clinic group: 12.3 ± 1.9; vs Home-based combined exercise–diet program: 11.9 ± 2.2; vs Control group: 11.2 ± 2.1</td>
<td>6 months</td>
<td>6 months</td>
<td>WC Fat</td>
<td></td>
</tr>
<tr>
<td>Boutelle KN, 2013</td>
<td>USA</td>
<td>Overweight or obese children, and their parents</td>
<td>HCS: Paediatrics clinic</td>
<td>50 (38% male)</td>
<td>Guided self-help: 10.3 ± 1.3 vs Delayed treatment control: 10.5 ± 1.4</td>
<td>5 months</td>
<td>11 months</td>
<td>Overweight % BMI Z score</td>
<td></td>
</tr>
<tr>
<td>Dalton III WT, 2013</td>
<td>USA</td>
<td>Overweight or obese (BMI ≥ 85th percentile), and their caregivers</td>
<td>SBS</td>
<td>67 (58% male)</td>
<td>2 groups: Weight control intervention (n = 28) vs Control group (n = 39)</td>
<td>8 weeks</td>
<td>12 months</td>
<td>No effect</td>
<td></td>
</tr>
<tr>
<td>Davis AM, 2013</td>
<td>USA</td>
<td>Overweight or obese (BMI ≥ 85th percentile) recruited</td>
<td>SBS: rural school</td>
<td>58 (71% male)</td>
<td>2 groups: Telemedicine (n = 31) vs Physician visit (n = 27)</td>
<td>8 weeks</td>
<td>6 months</td>
<td>Unclear</td>
<td></td>
</tr>
<tr>
<td>Economos CD, 2013</td>
<td>USA</td>
<td>Year 1 students at selected elementary school</td>
<td>CBS</td>
<td>1028 (NA)</td>
<td>2 groups: Physical activity + Diet (10 schools, n = 335) vs Control (20 schools, n = 693)</td>
<td>2 years</td>
<td>2 years</td>
<td>Weight Z score</td>
<td></td>
</tr>
</tbody>
</table>
Study outcomes

The main study outcomes of the 10 articles can be classified into four main components: anthropometric/body composition, behavioural changes (dietary improvement and changes in physical activity status), improvements in psychosocial well-being, and changes in metabolic indicators (Table 2). Of the 10 studies, three studies focused on a combination of anthropometric/body composition and behavioural changes [13, 14, 17], while three sought to improve diet and changes in anthropometric/body composition [10, 12, 20], and one focused on physical activity status [18].

Synthesis of significant outcomes

The outcome measures significantly affected by the intervention during the first follow-up period are indicated in Table 2. Seven studies reported a statistically significant (between-group) effect at the first post-intervention follow-up for at least one of their focus outcomes [10, 13, 14, 17, 18, 20]. None of the studies reported significant psychosocial changes.

Quality of reporting

The quality of each article varied considerably. Only two studies were classified with an overall rating of strong quality as they scored more than three strong ratings, as described in Table 3 [14, 18] while the remaining studies were classified as moderate.

Most of the studies described the withdrawals and dropouts in detail except for one study [15]. Nine studies failed to report on the blinding of participants and the assessors; only one study described the blinding of participants in detail [15].

Discussion

There are many components that can affect intervention and effectiveness. This review revealed that all four studies that conducted interventions in a health care setting had a beneficial study outcome [10, 13, 14, 19]. All of the studies were conducted in a specialist clinic that focused on childhood obesity prevention, which obviously aided in making the intervention fruitful. Despite the variety in sample populations, study duration, and outcome measures, two studies reported effective interventions resulting in changes in anthropometric/body composition [10, 14].

In addition, this review identified four studies that used school as their place of intervention [13, 15, 16, 18]. Of these, the longest study duration was two and three years [13, 18]. Both of these studies resulted in positive outcomes and also involved teachers at the selected schools.

Moreover, all of the selected schools were proactive and gave full commitment to ensure the interventions ran successfully. These studies demonstrate that school can be the best place to start an intervention for childhood obesity prevention. The role of schools in promoting a healthy diet and physical activity among children needs to be address. Children spent most of their time in a school environment and can easily be influenced by unhealthy behaviour.
Table 2. Post-intervention outcome measures by study (ordered by year of publication)

<table>
<thead>
<tr>
<th>First author, Year</th>
<th>Anthropometric/body composition</th>
<th>Metabolic</th>
<th>Behavioural</th>
<th>Psychosocial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight % overweight</td>
<td>BMI</td>
<td>BMI Z-score</td>
<td>Body fat % (by BIA)</td>
<td>Waist circumference</td>
</tr>
<tr>
<td>Janicke DM, 2008</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Dzewaltowski DA, 2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jansen W, 2011</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>De Niet J, 2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lisón JF, 2012</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Boutelle KN, 2013</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Dalton III WT, 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Davis AM, 2013</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Economos CD, 2013</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Hystad HT, 2013</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Shaded squares indicate those outcomes for which post-intervention data were reported.
✓ Indicates a statistically significant (between-group) effect for that outcome at the first post-intervention follow-up.

BMI = body mass index; HDL = high-density lipoprotein; LDL = low-density lipoprotein; and QOL = quality of life.

The importance of parental involvement towards tackling childhood obesity was also highlighted by this review. Most studies involved exclusively overweight/obese children but 4 studies also included parental involvements [10, 13-15] of which three had positive outcomes. Since dietary behaviour is linked to energy intake and risk of obesity, parental involvement is crucial in diminishing the risk of obesity. Children’s diet is particularly influenced by their parents’ dietary habits, thus by involving parents in the intervention, the parents held the responsibility while also having the opportunity to make healthy food accessible for their children in the home [21]. Ultimately, this review revealed that parental involvement can boost the intervention program’s effectiveness. One systematic review that examined the parental role in obesity prevention reported that direct methods of parental involvement were more likely to result in beneficial outcomes [21].

This review revealed that all the studies’ focus outcome related to anthropometric/body composition – which is mainly reduction in BMI, BMI Z-score and waist circumference. These three indicators were the best methods to determine obesity and can be derived from simple measurements. However, the studies interested in behavioural and psychosocial changes
had the most negative findings. This is because the measurements were based on participant recall. In contrast, the anthropometric/body composition and metabolic measurements provide solid evidence as the measurements do not rely on the participants.

With regards to the study quality, most of the ten articles did not describe details of blinding, which ultimately affected their study quality. Blinding is essential in controlled trial as it can prevent performance and ascertainment bias. For example, assessors who are blind to the intervention or control status of participants are less biased than other assessors that are aware of the status of the participants. Similarly, the methods of randomisation of the participants can affect selection bias. This is because randomisation allows participants to have an equal chance of being allocated in either the intervention or control group, and can also facilitate the blinding process [22].

<table>
<thead>
<tr>
<th>First author, Year</th>
<th>Selection Bias</th>
<th>Study design</th>
<th>Confounding</th>
<th>Blinding</th>
<th>Data Collection Methods</th>
<th>Withdrawals and dropouts</th>
<th>Overall rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Janicke DM, 2008</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>2</td>
</tr>
<tr>
<td>Dzewaltowski DA, 2010</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>2</td>
</tr>
<tr>
<td>Jansen W, 2011</td>
<td>Strong</td>
<td>Strong</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>1</td>
</tr>
<tr>
<td>De Niet J, 2012</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Strong</td>
<td>Moderate</td>
<td>2</td>
</tr>
<tr>
<td>Lisón JF, 2012</td>
<td>Strong</td>
<td>Strong</td>
<td>Moderate</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>2</td>
</tr>
<tr>
<td>Boutelle KN, 2013</td>
<td>Strong</td>
<td>Strong</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>1</td>
</tr>
<tr>
<td>Dalton III WT, 2013</td>
<td>Moderate</td>
<td>Strong</td>
<td>Moderate</td>
<td>Strong</td>
<td>Moderate</td>
<td>Moderate</td>
<td>2</td>
</tr>
<tr>
<td>Davis AM, 2013</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>Moderate</td>
<td>Strong</td>
<td>Moderate</td>
<td>2</td>
</tr>
<tr>
<td>Economos CD, 2013</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>Moderate</td>
<td>Strong</td>
<td>Moderate</td>
<td>2</td>
</tr>
<tr>
<td>Hystad HT, 2013</td>
<td>Strong</td>
<td>Strong</td>
<td>Moderate</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>2</td>
</tr>
</tbody>
</table>

Study quality was assessed by a six-component rating scale described in the Methodology section. Studies were given a global rating: 1, strong; 2, moderate; 3, weak.

**Conclusions**

Most of the interventional studies included in this review showed a significant improvement for obese children. Four out of the 10 studies showed that physical activity and diet had a great impact on child obesity, while other studies showed that a hospital-care or school- base setting, as well as parental involvement was more beneficial in treating obesity. Childhood obesity intervention programmes are still a controversial issue in terms of their effectiveness in preventing and treating obesity among children.

**References**


