

Effectiveness of School-Based Intervention Programs in Reducing Prevalence of Overweight

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ABSTRACT

Objectives: To assess the effectiveness of school-based interventions program in reducing the prevalence of overweight or obesity among schoolchildren. **Data source:** Ovid Medline (1950-December 2012), Embase (1980-2012), CINAHL (1982-2012), secondary references, review articles, and expert in the field. **Study selection:** All published clinical trials were eligible for study if were randomized, methodologically strong-based on a validity assessment, aimed to evaluate a school-based intervention for childhood overweight or obesity, and measured outcome in term of prevalence/incidence difference in overweight and obesity among both groups. Studies involved in cost-effective analysis of school-based intervention have been excluded. Data from eligible studies abstracted and pooled for relative risk. **Results:** Five trials with 3,904 schoolchildren were included. Mean age of the students (boys and girls) ranges 8.6-12.6 years. Meta-analysis showed a statistical significance beneficial effect of school-based intervention programs on obesity status of schoolchildren (risk ratio (RR) 0.58, 95% confidence interval (CI) 0.43-0.78) and suggested 42% reduction in prevalence of obesity among schoolchildren through school-based intervention programs. Individual studies also showed effectiveness of these school-based interventions. **Conclusion:** School-based intervention programs are effective in prevention of childhood overweight and obesity problem and our results quantitatively supported this argument.

Keywords: Children, obesity, overweight, school-based intervention

Introduction

Childhood overweight and obesity is a global public health problem that is responsible for childhood morbidity and mortality and also increase the risk of obesity, cardiovascular disease (CVD), diabetes mellitus (DM), osteoarthritis, and many types of cancers in adulthood.⁽¹⁻⁴⁾ The prevalence of overweight was 17% among the US children (2-19 years).⁽⁵⁾ Similarly, 10-35% prevalence of overweight and obesity among children has been reported from the European countries.⁽⁶⁻⁹⁾ This problem is no longer detained to the developed world as

its rising trend has been observed now in the developing part of the world.⁽¹⁰⁻¹³⁾

It has potential adverse health consequences, that is, insulin resistance, cardiovascular diseases (CVD) risk factors, and early progression of atherosclerosis which lead to premature deaths.⁽¹⁴⁻¹⁷⁾ Therefore, preventing childhood overweight and obesity may be an effective means to reduce the risk of undesirable health outcomes.

It has been recognized that schools can be an avenue for interventions directing childhood obesity.⁽⁴⁾ Legislation and guidelines have been approved in a few countries for implementation of school-based intervention such as the US.^(18,19) Many of the studies⁽²⁰⁻²⁶⁾ have shown effectiveness of school-based interventions whereas other reported contrast results.⁽²⁷⁻³¹⁾ Hence, so far no conclusion has been drawn. The objective of this review is to assess the effectiveness of school-based interventions program compared to routine curriculum

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in reducing the prevalence of overweight or obesity among schoolchildren.

Materials and Methods

Searches

Terminologies such as overweight, obesity, physical activity, exercise, diet, schoolchildren etc., have been used for search. Main search engines were Ovid Medline (1950-December 2012), Embase (1980-2012), CINAHL (1982-2012), and PubMed. Secondary references and review articles were also scanned for thematic review. Hand search of the journal was also done. Language of studies was restricted to the English only.

Selection of studies

All published clinical trials were eligible for study if were randomized, aimed to evaluate a school-based intervention for childhood overweight and obesity, and measured outcome in terms of prevalence/incidence difference in overweight and obesity among both groups. There was no strict criterion applied for the control group. Studies involved in cost effective analysis, or done on high risk population only, or objectives were focused on physical activity/diet and not on overweight/obesity have been excluded.

Assessment of validity

According to Cochrane Collaboration's recommendations, the quality of the included studies was assessed for the appropriateness of randomization, intervention allocation, blindness, follow up, sample size, and intention-to-treat analysis based on criterion of Guyatt *et al.*⁽³²⁾

Extraction of data

Data was extracted for the year of publication, journal's name, study's objectives, design, place, population, age, gender, type and duration of intervention, control group, randomization, blindness, sample size, power calculation, outcome, type of analysis, and results. Double data entry was done in Review Manager 5.

Quantitative data synthesis

Meta-analysis was based on post-intervention prevalence of overweight and obesity in both groups. Relative risks were used as the measure of risk along with 95% confidence intervals. Mantel-Haenszel (statistical method), fixed effects (analysis model), and risk ratio (effect measure) were used to make comparison among studies. Heterogeneity among studies was assessed by I^2 statistics, χ^2 , and a P -value. $I^2 > 50\%$ and P -value of $\chi^2 < 0.05$ was considered as high level of heterogeneity. The effect of an individual study on an overall summary measure was assessed by Jackknife analysis.

Results

Search identified 325 citations from Ovid Medline, 275 from Embase, 468 from CINAHL, and 213 from PubMed. Additional studies were found by hand searched ($n = 3$) and secondary references ($n = 5$). The total number of citations was 1,289 which reduced to 156 after title screening. After removing 37 duplicate studies, a total of 119 studies were left. Abstract screening excluded 76 nonexperimental studies, and 28 studies were either community-based, both school- and community-based, or involved parents as well. The remaining 15 potentially appropriate studies were examined for inclusion/exclusion criteria and quality assessment. Ten of clinical trials were excluded because; involved cost effectiveness analysis of an intervention ($n = 1$),⁽³³⁾ outcome was other than overweight/obesity reduction ($n = 6$),⁽³⁴⁻³⁹⁾ conducted among the high risk population only ($n = 1$),⁽⁴⁰⁾ and nonrandomized clinical trials ($n = 2$).^(41,42) Prisma flow diagram shows the summary of study selection process [Figure 1]. Table 1 summarizes the characteristics of the excluded studies.

Study characteristics

Table 2 shows the five trials included in the review with a total of 3,904 schoolchildren, published between 1995 and 2009 [Table 2]. These trials were conducted in England,⁽⁴³⁾ France,⁽⁴⁴⁾ Canada,⁽⁴⁵⁾ US,⁽⁴⁶⁾ and Brazil.⁽⁴⁷⁾ All included trials were school-based and intervention duration ranged from 1 to 4 years.

Population characteristics

Study population was schoolchildren and it included both boys and girls. Mean age of the children ranged from 8.6 to 12.6 years.

Table 1: Characteristics of the excluded studies

Studies	Reasons for exclusion
Wang <i>et al.</i> ⁽³³⁾	Study assessed the cost-effectiveness (CE) of a school-based intervention
Haerens <i>et al.</i> ⁽³⁴⁾	Focus of the study was to assess improvement in physical activity and healthy eating after intervention
Burke <i>et al.</i> ⁽⁴⁰⁾	Study was conducted on high risk population only
Reynolds <i>et al.</i> ⁽³⁵⁾	Outcome of the interest was educational attainment, adult arrest, incarceration, health status, and economic well-being
McKenzie <i>et al.</i> ⁽³⁶⁾	Effect of intervention was assessed on student physical activity
Kalavainen <i>et al.</i> ⁽³⁷⁾	Assessed outcome was change of weight for height
Carrel <i>et al.</i> ⁽³⁸⁾	Assessed outcomes were cardiovascular fitness, body composition, and fasting insulin and glucose levels
Angelopoulos <i>et al.</i> ⁽³⁹⁾	Outcome of the study was changes in blood pressure after a school-based intervention
Kain <i>et al.</i> ⁽⁴²⁾	Nonrandomized controlled study
Foster <i>et al.</i> ⁽⁴¹⁾	Nonrandomized controlled study

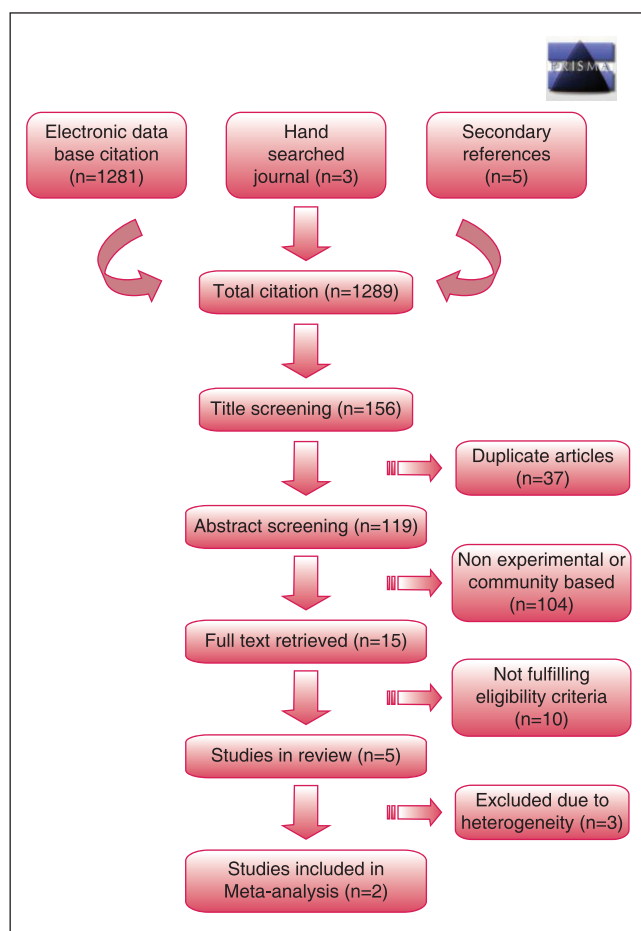


Figure 1: Prisma flow diagram

Types of interventions

There was variation among trials in terms of type of interventions. These interventions included; planet health program which included teacher training workshops, classroom lessons, physical education material,⁽⁴⁶⁾ education program focused on improving physical activity and discouraging sedentary lifestyle,⁽⁴⁴⁾ program contained classroom activities, banners and logo on water bottles for promoting healthy lifestyle,⁽⁴⁷⁾ program promoting healthy diet and discouraging consumption of carbonated drinks,⁽⁴³⁾ and aerobic dance.⁽⁴⁵⁾ Although, no strict criterion applied for the control group during selection of studies, the usual school curriculum promoting healthy lifestyle was considered as control in found studies.

Outcome (reduction in overweight or obesity) assessment

Reduction in overweight or obesity status has been assessed by change in body mass index (BMI),⁽⁴³⁻⁴⁷⁾ triceps skin fold (TSF) thickness,⁽⁴⁶⁾ and BMI Z-score change.⁽⁴³⁾

Methodological quality

All of the included studies were randomized clinical trial (RCT).⁽⁴³⁻⁴⁷⁾ Randomization was done with random number

table;⁽⁴⁶⁾ three of the trials used cluster randomization,^(43,44,47) while in one it was not clear.⁽⁴⁵⁾ Due to nature of intervention, blinding was not possible in any of the trials.⁽⁴³⁻⁴⁷⁾ Three of the trials showed sample size calculation and power analysis,^(43,44,47) whereas remaining two did not.^(45,46) All of the trials analyzed their data by using intention-to-treat analysis.⁽⁴³⁻⁴⁷⁾ Two of the studies had attrition rate <20%,^(46,47) whereas in the remaining three it was >20%.⁽⁴³⁻⁴⁵⁾

Narrative data synthesis

Description of included RCTs is summarized below in context of their intervention:

Promotion of healthy diet and discouraging of carbonated drinks

It was a RCT conducted in Christchurch, Dorset, England to assess the long-term effects of school-based intervention program on childhood obesity.⁽⁴³⁾ Mean age of students was 8.6 years. The intervention program had four sessions to promote healthy diet and to discourage the carbonated drinks. The main outcome was change in BMI Z-score. Intention-to-treat analysis was performed. There was a decrease of -0.01 (SD 0.58) in BMI Z-score in intervention group, but increased in the control group by 0.10 (SD 0.53), with a significant mean difference of 0.10 (95% confidence interval (CI), 0.00-0.21; P -value = 0.06) at 12 months of intervention. However, there was no difference in both groups after 3 years of intervention.

Promotion of physical activity

It was a RCT conducted in Ban-Rhin, France to assess the effect of an intervention (promotion of physical activity) which integrate environmental changes to prevent obesity among schoolchildren through.⁽⁴⁴⁾ Mean age of students was 11.7 years. The focus of the intervention program was physical activity and sedentary lifestyle along with routine curriculum. The outcome was change in the prevalence of overweight and obesity. After 4th year of intervention, 4.2% of the initially normal weight children were overweight in intervention group, compared to 9.8% in control group (OR, 0.41; 95% CI 0.22-0.75; P -value = 0.01). Similarly, there was significant improvement in physical activity (P -value = 0.0001) of participants with reduction in duration of watching TV/video (P -value = 0.01) in intervention group.

Aerobic dance and health education

It was a RCT conducted in East Palo Alto to assess the effect of dance on students' aerobic capacity, weight reduction, level of physical fitness.⁽⁴⁵⁾ Mean age of students (boys and girls) was 12.6 years. There was a 50 min class thrice a week, 10 min for warm up, and 40 min for aerobic dance. For health education class students met twice/week. Main outcome of the studies included; number

Table 2: Characteristics of the included studies

Study	Methods	Participants	Interventions	Outcome
James <i>et al.</i> ⁽⁴³⁾	A randomized clinical trial. Included a total of 29 classes from six schools. Cluster randomization was done. Intention-to-treat analysis was performed and sample size calculation and power analysis was done. Attrition rate was >20%	Total: 434 IG: 219 CG: 215	Programs promoting a healthy diet and discouraging the consumption of carbonated drinks	Change in number of overweight and obese children
Simon <i>et al.</i> ⁽⁴⁴⁾	A randomized controlled trial. Random selection of 8/77 schools; 4 intervention, and 4 control. Cluster randomization was done. Intention-to-treat analysis was performed and sample size calculation justified. Attrition rate was >20%	Total 954 IG: 479 CG: 475	A program focusing on physical activity and sedentary behaviors in addition to the standard school curriculum	Change in prevalence of overweight and obesity
Flores ⁽⁴⁵⁾	A randomized clinical trial. Randomization of classes was done but process unclear. Intention-to-treat analysis was performed but power calculation was not justified. Attrition rate was >20%	Total: 81 IG: 43 CG: 38	Aerobic dance thrice/week, health education twice/week	Change in overweight/obesity status, resting heart rate
Gortmaker <i>et al.</i> ⁽⁴⁶⁾	A randomized controlled trial. Total of 10 schools; 5 interventions, and 5 controls. Randomization was done by using random number table. Intention-to-treat analysis was done while sample size calculation was not justified. Attrition rate was <20%	Total 1,295 IG: 641 CG: 654	The Planet Health program; included teacher training workshops, class room lessons, and physical education material	Change in prevalence, incidence, and remission of obesity
Sichieri <i>et al.</i> ⁽⁴⁷⁾	A randomized, controlled trial. Total cluster 47; 23 intervention, 24 control schools. Cluster randomization was done. Intention-to-treat analysis was performed and sample size calculation justified. Attrition rate was <20%	Total: 1,140 IG: 435 CG: 608	A healthy lifestyle education program via classroom activities, banners, and logo on water bottles	Change in overweight/obesity status

IG: Intervention group, CG: Control group

of mile run, resting heart rate, BMI change, and attitude towards physical activity. Intention-to-treat analysis was performed. Intervention significantly reduces BMI and heart rate among girls, but not in boys.

The Planet Health program

It was a RCT conducted in Boston, USA to assess the effect of school-based health behavior intervention (Planet Health program) on childhood obesity students of grades 6-8 years.⁽⁴⁶⁾ Mean age of the students was 11.7 years. This program contained teacher training workshops, class room lessons, and physical education material. The main outcome was change in prevalence, incidence, and remission of obesity. Intention-to-treat analysis was done. Intervention significantly reduced prevalence of obesity among girls compared with controls (OR 0.47, 95% CI 0.24-0.93, *P*-value = 0.03), while among boys there was no difference.

A healthy lifestyle education program

It was a RCT conducted in Rio de Janeiro, Brazil, to assess the effect of an intervention program which discourages students from drinking sugar-sweetened drinks to reduce obesity.⁽⁴⁷⁾ Mean age of the students was 10.9 years. Main outcome was change in overweight/obesity status. In intervention group there was significant reduction in daily usage of sugar-sweetened drinks than control group (mean difference = -56 ml, 95% CI -19 to -7 ml), but without significant reduction in BMI (*P*-value = 0.33). However, there was a significant BMI reduction (*P*-value = 0.009) among girls.

Studies included in the review suggest the effectiveness of school-based programs for prevention of obesity among children especially among girls. The study that promoted physical activity reported 61% less risk of being obese in intervention group than control.⁽⁴⁴⁾ Another study which conducted 40 min aerobic dance thrice a week and health education class twice/week reported significant reduction in BMI and heart rate among girls only.⁽⁴⁵⁾ Similarly, the study with Planet Health program showed 53% risk reduction of being obese in intervention group as compare to control, but only among girls.⁽⁴⁶⁾ Discouraging of sugar-sweetened drinks use, although reduced uptake of drinks but failed to reduce significant BMI change of the students. However, this intervention causes significant BMI reduction among girls.⁽⁴⁷⁾ A similar study, which discouraged carbonated drinks along with promoting healthy diet showed promising results in term of reducing BMI Z-score at 12 months, however these results were not sustained in long run (at 3 years).⁽⁴³⁾

Quantitative data synthesis

Effectiveness of a school-based intervention was based on producing statistical significant differences between the intervention and control groups in terms of prevalence of overweight and obesity at the end of study. Meta-analysis was done on only two of the studies^(43,44) included in review. Heterogeneity was more than 50% if any of the remaining three studies were included,⁽⁴⁵⁻⁴⁷⁾ evident by $I^2 > 50\%$ and *P*-value of $\chi^2 < 0.05$. Removal of trials at risk of bias reduced heterogeneity and improved significance of our results. The studies included in meta-analysis showed a statistical significance beneficial

effect of school-based intervention programs on obesity status of schoolchildren (two trials, $n = 1,166$; risk ratio (RR) 0.58, 95% CI 0.43-0.78) (Figure 2). These results suggested 42% reduction in prevalence of obesity among schoolchildren through school-based interventions.

Discussion

The narrative review of school-based programs shows effectiveness of intervention targeted towards childhood obesity. It is important to note that the included studies in review were diverse in term of type of interventions, duration, and outcome assessment. Due to heterogeneity, 2/5 studies could be included in meta-analysis. Although meta-analysis result are in the favor of interventions, have limited generalizability due to small number of studies.

Our results are consistent with other studies reporting effectiveness of school-based interventions for childhood obesity.⁽²⁰⁻²⁶⁾ Contrarily, there are studies which reported ineffectiveness of school-based interventions.⁽²⁷⁻³¹⁾ The success and failure of interventions depend upon multiple factors such as duration of intervention, quality of education or diet programs, and more importantly adherence rate of schoolchildren to those interventions. Individual studies showed that these intervention work well in girls as compared to boys.⁽⁴⁵⁻⁴⁷⁾ This difference in effectiveness may be due to variation in casual factors among both gender, however there is dearth of knowledge to support this hypothesis. On the other hand, girls could be more accustomed to issue of weight, body shape, physical activity, and diet consequently more quickly responding to these interventions.⁽⁴⁵⁻⁴⁸⁾ As far as other success factors are concerned, a positive role of family has been acknowledged as a success factor for school-based interventions. Similarly, involvement of school teachers and staffs can also enhance and sustain the effect of interventions as recommended earlier.⁽⁴⁹⁾

Recommendations

Despite lack of rigorous data to support specific intervention, we would recommend that school-based intervention programs be placed for intervention of childhood obesity. An intervention might work differently across gender and there may be need to use different gender specific techniques to enhance effectiveness, especially in context of developing countries such as India, Pakistan, and Bangladesh where higher proportion of boys than girls are studying in schools. Along with school-based interventions, attention should also be paid on environments and cultural practices, that is, involvement of parents, teachers, and school staff that could support and encourage children. More importantly, interventions need to be developed and implement into existing operating systems, instead of demanding extra resources. Further researches should include home component along with school-based interventions to address overall health behavior of children especially of younger age group (< 3 years).

Limitations

There are certain limitations of review which should be considered during interpretation of results. Inclusion of studies published in English only might have induced the reporting bias. Though, selected studies were of good methodological quality, but often not included details of training, qualifications of intervention provider, and the extent to which they followed the protocol. Moreover, the variation in school-based interventions and end points of studies, represent a significant challenge to meaningfully evaluate these interventions as a whole especially in meta-analysis.

Conclusion

Childhood overweight and obesity is a global public health issue that needs urgent attention of health policy makers. Schools are the best avenue to address this global

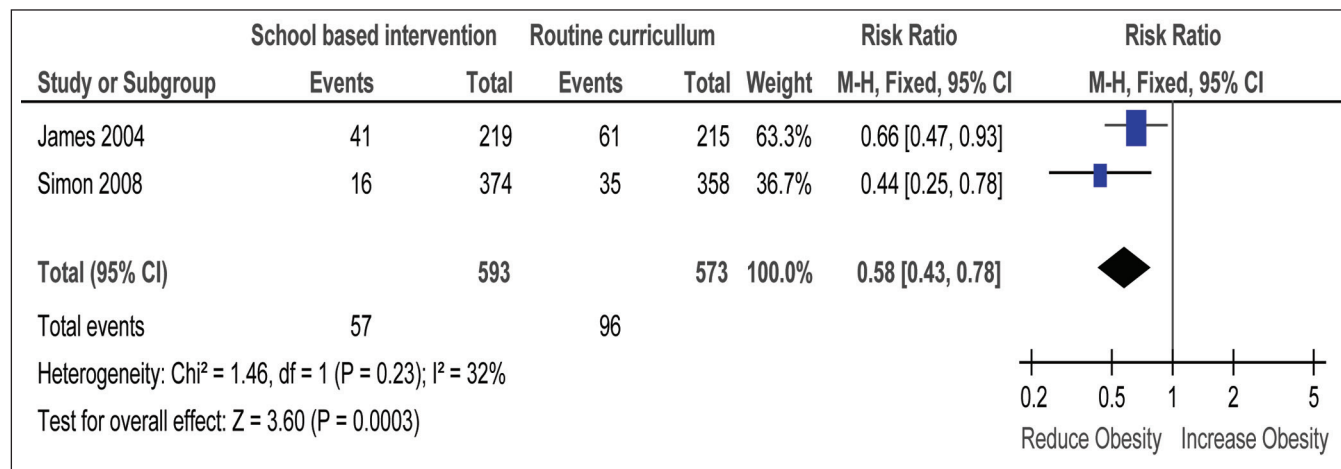


Figure 2: Meta-analysis output graph

problem and our results quantitatively supported this argument. The best school-based intervention program will be one which will reduce incidence and prevalence of overweight/obesity across gender without initiating an inappropriate weight controlling behaviors. Public health persons especially health services researchers have to lead in identifying pragmatic and cost effective school-based programs.

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