

**Obesity Prevention Programs for Children and Youth:  
Why are Their Results so Modest?**

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## **Abstract**

The purpose of this paper is to critically reflect upon the mixed/modest results of the primary studies related to the effectiveness of physical activity enhancement and improving nutritional intake in obesity prevention programs for children and youth. The results of a recent review of this topic that included 57 randomized controlled trials provide the basis for this discussion. Only four primary studies reported both statistically and clinically significant outcome differences between intervention and comparison groups. Although there are some similarities, there are differences among the four studies. These differences relate to program duration, frequency and intensity, targeted age of participants and level of involvement of students, the school as a community/institution and parents. Frequent methodological limitations of the studies included inadequate sample selection, lack of masking of outcome assessors, inappropriate data analysis and lack of important sub-analyses. Program design and implementation issues included lack of monitoring of program integrity and “dose” received by participants. Theoretical basis for interventions were rarely stated and never used to explain the results. The effectiveness of parental involvement is unclear. The question of statistical versus clinical significance needs to be addressed by clinical experts. Based on this reflection, several potential future directions are outlined.

## Introduction

The purpose of this paper is to critically reflect upon the reasons for the mixed/modest results of most of the primary studies related to the effectiveness of physical activity enhancement and improving nutritional intake programs for obesity prevention in children and youth. The results of a recent review of this topic provide the basis for this discussion.

The World Health Organization has declared obesity a global epidemic [1]. In a recent study, Tremblay et al estimated that the prevalence of childhood obesity among 7-13 year olds in Canada between 1981 and 1996 rose from 5% to 13.5% for boys and from 5% to 11.8% for girls [2]. As well, the prevalence of overweight among boys almost doubled (from 15%-28.8%). For girls it rose from 15% to 23.6%. Ogden et al reported that in the United States in 2003-2004 17.1% of children and adolescents were overweight [3]. From 1999-2000 to 2003-2004 the prevalence of being overweight among females in this age group rose from 13.8% to 16.6%. Among males it rose from 14.0% to 18.2% in the same period [3, 4]. Similar trends in childhood obesity have been noted in Australia [5].

The connection between child and adult obesity is complex. A review of 15 study populations reported a positive association between anthropometric measures of obesity in childhood and adulthood [6]. The risk for obese children becoming obese adults was 2 to 6.5 times higher than for non-obese children. However, a considerable number of obese adults (more than 50%) had not been obese as children.

In a longitudinal study of a 1947 birth cohort, Wright et al found that only children reported as obese at age 13 years showed an increased risk of adult obesity [7]. They concluded that many

thin children become obese adults. As well, the thinnest children, if they became obese adults, appeared to have the highest risk for symptoms of chronic disease (e.g. elevated blood pressure, high cholesterol levels, and elevated glucose tolerance tests). Given that some obese children become obese adults, many do not and that those thin children who become obese adults are at high risk for morbidity, providing preventive strategies to all children could reduce child and adult obesity.

The impact of physical activity on reducing obesity or maintaining normal weight has been studied in a number of settings. Results of a study of the relationship between physical activity and obesity in children and youth indicate that low physical activity can be a contributing factor to obesity [8]. Among adults, DiPietro et al reported that a modest increase in physical activity prevented weight gain over a four year period [9]. Several studies have demonstrated that although dietary restrictions have the largest impact on weight gain, physical activity combined with dietary restrictions has a larger impact than either alone [10]. As well, in a randomized controlled trial, Slentz et al found that there was a dose-response relationship between the amount of exercise and decrease in body weight [11].

Physical activity patterns track from childhood into adulthood [12, 13]. Following a nationally representative sample of American adolescents from ages 11-18 years until 18-26 years of age, Gordon-Larsen et al found that in comparison to Time 1, there was a dramatic decrease in the number of young adults engaging in regular moderate to vigorous activity and an increase in weekly TV and video viewing time at Time 2 [14]. Therefore, the best preventive strategy for increasing youth and adult physical activity may be creating a lifestyle pattern of physical fitness in childhood and youth that will extend into adulthood.

Providing strategies that lead to healthy eating and increased levels of physical activity for all children could reduce health care costs from obesity and physical inactivity and improve the quality of life for many adults. Recent estimates of direct and indirect health care costs are

substantial. In Canada, costs for obesity and lack of physical activity represent 2.2% and 2.6 % respectively of total annual costs [15]. In a recent American study, Raebel et al demonstrated that median health care costs for obese people (\$585.54) were higher than for non-obese people (\$333.24) [16]. This was primarily because of the increased use of prescription drugs related to the increased prevalence of type 2 diabetes, hypertension and other chronic diseases among obese people. Finkelstein et al [17] cited the results of the Surgeon General's Report on Obesity [18] that concluded that the direct and indirect costs of obesity in the US may be as high as \$139 billion per year. This represents 5-7% of the total annual health care expenditures.

Few frameworks for defining the context of obesity (and potential solutions) from a population perspective have been suggested. Glasgow et al proposed a population-based approach to chronic illness [19]. Egger and Swinburn [20] adapted this model to obesity, and both Australia and Canada have presented similar ecological models for obesity prevention [21, 22]. The models suggest that there are three broad types of factors influencing weight/obesity. First, biology and genetics are important, but cannot explain the recent increase in obesity rates. As well, these factors are not yet very malleable. The other two factors, behavioural and environmental influences, are areas in which progress could be made. These factors affect both energy intake and energy expenditure. Behavioural factors include habits, emotions, cognitions, attitudes, and beliefs. Environmental factors fall into three main areas: physical, economic and socio-cultural. As well, they include macro level factors (those that affect populations) such as food laws, food taxes and subsidies, traditional cuisine and micro factors (those closer to the individual) such as costs of sports equipment and participation, peer activities, and family recreation. Egger and Swinburn point out that work to date has focused on the micro factors and even more narrowly, primarily on education [20].

Birch and Davison [23] have proposed a contextual model for childhood obesity based on Ecological Systems Theory [24]. Again, they emphasize the importance of focusing beyond the

child on parenting styles and characteristics, and community, demographic and societal characteristics.

Several reviews focusing on different aspects of obesity prevention have been published [25-31]. Overall, they concluded that some programs lead to modest positive results at best.

Although obesity prevention programs have been implemented in a variety of settings, schools provide an ideal environment for population-based primary prevention interventions directed at children and youth for two important reasons. First, almost all children in developed countries are in school for a considerable period of time. Second, children from all risk groups can derive some benefit, and targeting all children avoids stigmatizing some and misclassifying others.

However, school settings have limitations of time and other curricular demands. In addition, the role of the community in promoting physical activity is crucial because most activity among children and adolescents occurs outside the school.

## **Background**

In order to synthesize the results of the recent work related to the effectiveness of relevant strategies with a school-based component and to provide an overall statement about what is known about the effectiveness of obesity prevention interventions for children and youth, we recently completed a review to answer the following four questions [32].

1. What is the effectiveness of interventions to improve nutritional intake in children and youth?
2. What is the effectiveness of interventions to reduce physical inactivity in children and youth?
3. What is the effectiveness of interventions to increase physical activity in children and youth?
4. What is the effectiveness of interventions that focus on both improving nutritional intake and increasing physical activity in children and youth?

The rest of this article will briefly outline the process used in the review and then focus on some of the issues arising that could explain the modest results of many of the studies to date. The methodology and results of the review have been reported in detail elsewhere [32].

A comprehensive literature search from 1985-2003 was undertaken. Using pre-tested standardized instruments, relevance and methodological quality of the retrieved studies were determined. Primary studies included in the review had to meet all of the following four relevance criteria.

1. The participants were students in elementary or secondary school.
2. The intervention had to include a school component, but could also involve parents and/or the community.
3. Only studies with a comparison group were included.
4. A variety of outcomes were included. Studies that reported changes in knowledge and attitude only were excluded.

The most frequently reported reliable and valid outcomes were as follows:

- Self-reported changes in fruit, vegetable, fat and salt intake based on 24 hour dietary recall
- Changes in Body Mass Index (BMI)
- Changes in skin fold thickness
- Self-reported changes in Moderate to Vigorous Physical Activity (MVPA) and
- Self-reported changes in duration, frequency and intensity of physical activity.

The results were narratively summarized. The review included both Randomized Controlled Trials (RCTs) and other study designs. There was no specific trend toward effectiveness in the RCTs or the other study designs. Given that RCTs provide stronger evidence about the

effectiveness of interventions, the results of the 57 RCTs form the basis for this discussion.

References for the included RCTs are listed in Appendix 1.

### **Summary of the Review Results**

The results were both modest and mixed. When statistically significant differences in outcomes between intervention and control groups were reported, the clinical significance of these differences was frequently modest. Some studies reported statistically significant results for some outcomes, but not others. These were classified as mixed differences. Table 1 outlines the results of the 57 studies. Of the 19 RCTs related to improving nutrition, six resulted in no between group differences, 12 had either modest differences or differences on some outcomes and not others. Only one, Gimme 5 in the High Schools resulted in clinically significant results [33]. Of the four studies related to decreasing physical inactivity, one reported no between group differences, two had mixed/modest results and only one had clinically significant differences [34]. Of the nine studies related to increasing physical activity, one resulted in clinically significant between group differences, four reported no between group differences and four had mixed/modest results. Finally, in the 25 studies related to both improving nutrition and to increasing physical activity only one demonstrated clinically significant differences in both outcomes [35]. Among the studies related to improving nutrition and increasing physical activity, 13 studies significantly changed some nutritional outcomes. However, in some cases, the impact was observed on select groups. In one study, Anglo-American students positively benefited while there was no change for Mexican-American students [36]. In another, those participants from high-income families showed significant improvement while those from low-income families did not [37]. Five studies performed sub-analysis by gender. The results were inconsistent in that some reported positive changes for boys and not for girls, where others only impacted on girls [38-42].



Significant reduction or small decreases in BMI or skin fold thickness were only reported in three studies [40-42]. Twelve studies reported significant increases in physical activity and/or fitness. When results were significantly different immediately post-test, few studies did any follow-up testing so whether or not these post-intervention changes were maintained is unknown.

There were similarities, but also a number of differences in the four statistically and clinically significant interventions [33, 43-45]. Table 2 outlines details about the participants, interventions, outcomes, results and additional comments for the four studies. They appeared to be implicitly or explicitly based on the social cognitive theory of behaviour change. All the studies included males and females, but few analyzed the results by gender. There were gender differences when those analyses were done. Three involved elementary school students [35, 39, and 45] and one targeted secondary school students [33]. All of the programs involved school teachers who received specific training in the intervention. In addition, two added school food services staff to make cafeteria changes [33, 35], and one used physical education teachers in a supervisor/monitoring role [45]. All programs provided some variation on knowledge, attitudes and skill for change. The programs had a range of intensity (i.e. 5-39 sessions) and duration (i.e. 7 weeks to 3 years). As well, the frequency of the sessions ranged from 5 per year to 20 in 7 weeks.

### **Methodological Issues**

The following discussion highlights the methodological issues within the primary RCTs included in the review that may have impacted on the results. There were both methodological strengths and limitations. The strengths were that they almost always used reliable and valid outcome measures and most studies reported drop-out/withdrawal rates of less than 20%. The

limitations related to sample selection, masking (blinding) of outcome assessors and data analysis.

Over half of the RCTs did not include the number of students approached to engage in the studies (potential selection bias). Therefore, one cannot determine how generalizable the results might be. As well, since many studies did not report sample size calculations it is probable that for many interventions, the study did not have adequate statistical power to detect between group differences. Therefore one cannot determine whether the lack of between group differences resulted from lack of statistical power or from ineffective programs.

Masking of the outcome assessors was frequently not reported or not done. When assessors who were not masked performed the measurements, the potential for bias existed.

Randomization by school and analysis by individual without a cluster analysis were frequently reported, resulting in a unit of analysis error. The results then do not take the potential differences/similarities between students within each school into account. It is possible, for example that the students in the schools in the intervention group may have differed on important variables related to physical activity and nutrition from the students in the control group. Cluster analysis allows these differences/ similarities to be accounted for in the overall between group differences in outcomes.

Several studies reported analysis of outcomes by gender and found different outcomes for boys and girls [38-40, 42, 45-47]. It may be that when results are not analyzed by gender, the lack of overall difference between intervention and control groups' results from the combination of different outcomes for males and females. It may also be that different programs are required for males and females. This issue needs to be addressed in future work.

Other variables that were often not reported include the effects of culture, socio-economic status and level of risk on outcomes. In the few studies that reported on culture, it appeared that this factor may have an impact on program effectiveness. As well, one study reported that interventions were more effective for children from high-income families than for others [37]. However, sub-analysis of results separating out the effects of these variables was rarely reported. All of these potential factors should be accounted for in future work.

In work not included in this review, others have provided empirical evidence for the impact of societal/cultural/ economic influences on obesity and physical activity. Crawford et al identified several factors that may contribute to different rates of obesity among African-American, Mexican-American and white children and youth [48]. These factors included adaptive mechanisms, socio-economic status, race, physical activity, dietary patterns, maternal factors and the home environment. The authors postulated that socio-economic factors may be the most important of these variables. In an extensive review, Drewnowski and Specter concluded that obesity and socio-economic status are inversely related [49]. Aside from all other factors impacting on obesity, the lack of money to purchase foods that are not energy dense is a major barrier for people who are poor, particularly women. It is possible that continuing to inform people of low income about the importance of a healthy diet leads to additional stress as they do not possess the resources to purchase what they know are healthier foods.

It is quite possible that interventions that do not take these factors into consideration and use a “one-size-fits all” approach are not relevant to certain student sub-groups. Qualitative work with students and their families from the different subgroups may assist in determining how to design relevant programs for implementation and evaluation.

## Program Design and Implementation Issues

Some of the studies reported which theory or theories their interventions were based upon. However, many did not. This omission makes determining why studies succeeded or failed difficult to assess. The most frequently cited theories guiding interventions were social cognitive/learning theory [50] and an ecological theory [24]. Whether significant or insignificant results were found, authors would have added to the knowledge in this area if they had more consistently speculated about the impact of the underlying theory. It is possible that a combination of several theories to inform intervention development may be necessary to find meaningful differences. Recently, Dzewaltowski et al [51] described an on-going project to impact on physical activity and fruit and vegetable consumption that is based on three theories: ecological, social cognitive, and behaviour-setting [52]. No studies used the environmental/systems based approach to reducing obesity through increased physical activity and improved healthy eating. Studies should be designed and implemented that test the effectiveness of interventions directed at the economic and socio-cultural environment, including both macro-level and micro-level factors. These studies will have to include policy makers, practitioners and representatives of targeted sub-groups, as well as researchers [20].

Two other problems that likely impacted on the findings were the consistency with which the interventions were delivered and the quantity of the intervention to which students were exposed. In both instances, little or no data were provided. For interventions that involved many groups of students, monitoring of the intervention is particularly important. Lack of differences in the results could be attributed to the variations in program implementation. When interventions go on for several sessions over time, the number of sessions each student received can also impact on the outcomes. It is possible that interventions fail to produce a between group difference because of an implementation problem rather than the intervention

being ineffective. However, this cannot be determined if the amount of intervention received is unknown. Very few studies provided any follow-up data to determine if the changes found post-intervention were maintained.

The effectiveness of parental involvement was mixed. It is difficult to compare across studies because the intensity, duration and activities that parents were involved in differed from study to study. Also, no study reported the proportion of parents that actually became involved. Qualitative work might improve the understanding of what involvement parents find acceptable. Closer monitoring of parental activities could assist in understanding the effectiveness of parental involvement.

The one study that compared the effects of teachers with different qualifications teaching the curriculum [53] reported that student groups led by physical education specialists had the largest increase in moderate to vigorous physical activity (MVPA). Those led by specially-trained teachers reported a greater increase in MVPA than those led by regular classroom teachers. In most of the interventions included in this review, regular classroom teachers with additional training led most of the student groups. The comparison of results from interventions employing these teachers versus physical education specialists needs to be replicated. If the results are similar, a policy decision within schools should be addressed.

Although some of the studies found statistically significant improvements in the intervention group, most improvements were very modest. Whether these differences are clinically significant is an issue. This field would benefit from clinical consensus about the amount of change in many of the frequently used outcomes that is required to be clinically important. Since most of the programs may go on over a period of time and involve students who are

growing, this is challenging. However, given the impact of these outcomes on health and the resources that are currently being utilized in this field, it is an important task.

## **Conclusions**

This paper has identified a number of methodological and other issues that should be addressed in order to determine the effectiveness of school-based prevention programs to reduce obesity. The research to date has illustrated a number of potential directions that should be further tested. The problem of child and adult obesity is a serious one that deserves the resources necessary to find effective preventive interventions.

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**Table 1****Between Group Outcomes in RCTs**

Outcome	Differences in Between Group Outcomes		
	No Statistically Significant Difference	Modest/Mixed Difference	Clinically Significant Difference
Improving Nutrition n= 19 RCTs	6	12	1
Reducing Physical Inactivity n = 4 RCTs	1	2	1
Increasing Physical Activity n = 9 RCTs	4	4	1
Improving Nutrition and Increasing Physical Activity n = 25 RCTs	9	15	1

**Table 2: Randomized Control Trials with Statistically and Clinically Significant Results**

Author (date) Country Project	Participants	Intervention(s)	Outcomes and Results	Additional Comments
<p><b>Gimme 5 High School</b></p> <p><b>Nicklas et al. (1997, 1998, 2000);</b> <b>O'Neil et al. (2002)</b></p> <p><b>United States</b></p>	<ul style="list-style-type: none"> <li>• 12 schools (matched pairs, then randomised)</li> <li>• Grade 9 students randomized to Gimme 5 or control</li> <li>• Followed to grade 12</li> </ul>	<ul style="list-style-type: none"> <li>• Intervention over 3 years</li> <li>• Mass media campaign in school</li> <li>• Curriculum of 5 workshops of 55 minutes each re: knowledge, attitudes and skills</li> <li>• Teachers trained</li> <li>• Cafeteria increased availability, variety, appeal of F &amp; V</li> <li>• Brochures to parents, taste-testing, recipes, calendar with food tips</li> </ul> <p>Control:</p> <ul style="list-style-type: none"> <li>• Usual health curriculum</li> </ul> <p>Theory:</p> <ul style="list-style-type: none"> <li>• PRECEDE model</li> </ul>	<ul style="list-style-type: none"> <li>• Significant increase in fruit and vegetable intake in intervention group (<math>p &lt; .05</math>) reported at 1 year and maintained at 2 years; not maintained at 3 years</li> </ul>	<ul style="list-style-type: none"> <li>• Significant increase in knowledge in intervention group (<math>p &lt; .05</math>)</li> <li>• Increased fruit and vegetable consumption maintained in the intervention group at follow-up; increased intake by control group resulted in no significant differences</li> <li>• Control group increase attributed to <i>5-A-Day</i> campaign</li> <li>• Stages of Change: fewer intervention students in pre- and contemplation and more in preparation stage at posttest</li> </ul>

Author (date) Country Project	Participants	Intervention(s)	Outcomes and Results	Additional Comments
<p><b>SPARK</b></p> <p><b>Sallis (1999)</b></p> <p><b>United States</b></p>	<ul style="list-style-type: none"> <li>955 4<sup>th</sup> and 5<sup>th</sup> grade children from 7 elementary schools</li> <li>Schools were randomized to two intervention groups (specialist-led and teacher-led) and a control group</li> </ul>	<ul style="list-style-type: none"> <li>2 year physical education program divided into one group led by three certified PE specialists and one group led by regular PE teachers who received training; same activities in both groups</li> </ul> <p><i>Physical Education Specialists</i></p> <ul style="list-style-type: none"> <li>3 30 min session/wk focused on high levels of physical activity; 15 min health-fitness activity, 15 min skill-fitness activity</li> <li>10 health-related activity units; intensity, duration and complexity was increased during intervention; 9 skill-related fitness units</li> <li>Students recorded fitness level</li> </ul> <p><i>Physical Education Teachers</i></p> <ul style="list-style-type: none"> <li>Taught behaviour change skills to generalize activity outside school</li> <li>Weekly 30 min classroom sessions included goal setting, self-monitoring, stimulus control, and self-reinforcement</li> <li>Homework and monthly newsletters to promote parent-child activity</li> </ul> <p>Control:</p> <ul style="list-style-type: none"> <li>Usual physical education program</li> </ul> <p>Theory:</p> <ul style="list-style-type: none"> <li>Health Belief Model</li> <li>Social Learning Theory</li> </ul>	<ul style="list-style-type: none"> <li>Final data collection at the end of the intervention</li> <li>Significant difference between interventions and control for moderate to vigorous physical activity (min/wk) (<math>p &lt; .001</math>)</li> <li>Specialist-led group more active than teacher-led</li> <li>All intervention students expended significantly more kcal/kg/wk than controls (<math>p &lt; .001</math>); specialist-led significantly better than teacher-led</li> <li>All intervention students spent significantly more time in PE class/wk than controls (<math>p &lt; .001</math>); specialist-led group significantly higher than teacher-led</li> <li>No differences on physical activity outside of school</li> <li>No difference between groups for boys on all fitness measures</li> <li>Girls in specialist-led group had significantly shorter mile runs (<math>p &lt; .03</math>) and did significantly more sit-ups/min (<math>p &lt; .03</math>) than girls in the teacher-led or control groups</li> <li>No difference on other fitness outcomes</li> </ul>	<ul style="list-style-type: none"> <li>Evidence of strong impact with this intervention when increased minutes of physical activity is the goal</li> <li>Draws into question to some degree whether various fitness level measures are good indicators of program effectiveness</li> <li>Physical education specialists maximized activity versus teacher led</li> </ul>



Author (date) Country Project	Participants	Intervention(s)	Outcomes and Results	Additional Comments
<b>Planet Health</b>  <b>Gortmaker, Peterson et al. (1999)</b>  <b>United States</b>	<ul style="list-style-type: none"> <li>• 1, 295 children grades 6 and 7</li> <li>• 5 intervention schools</li> <li>• 8 control schools</li> </ul>	<ul style="list-style-type: none"> <li>• Training for teachers</li> <li>• 32 lessons taught by classroom teachers over 2 year period</li> <li>• Content on reducing TV time, total fat, saturated fat and increasing activity level and fruit and vegetable intake</li> </ul> Theory: <ul style="list-style-type: none"> <li>• Behavioural-Choice Theory</li> <li>• Social-Cognitive Theory</li> </ul>	<ul style="list-style-type: none"> <li>• TV viewing in the intervention group was reduced for boys, 0.4 hours/day (<math>p &lt; .0001</math>) and girls, 0.58 hours (<math>p = .001</math>)</li> <li>• Minutes in physical activity did not differ significantly</li> <li>• Prevalence of obesity for girls reduced in the intervention schools (OR 0.47, CI 0.24 to 0.93, <math>p = .03</math>); not for boys</li> <li>• Girls in the intervention ate 0.32 more servings of fruit and vegetables each day (<math>p = .003</math>) and consumed 575kJ/day less total energy</li> </ul>	<ul style="list-style-type: none"> <li>• Intention-to-treat analysis</li> <li>• Clinical significance of changes is unknown</li> </ul>

Author (date) Country Project	Participants	Intervention(s)	Outcomes and Results	Additional Comments
<b>CATCH</b>  <b>Luepker (2003)</b>  <b>United States</b>	<ul style="list-style-type: none"> <li>• Grade 3 children in 96 elementary schools</li> <li>• 28 schools received the school-based intervention</li> <li>• 28 schools received the school- and family-based intervention</li> <li>• 40 schools served as controls (usual curriculum, food service, and physical education program)</li> </ul>	<ul style="list-style-type: none"> <li>• Implemented over 2½ yrs half-way through gr 3 to end of gr 5 by trained classroom and PE teachers and food service staff</li> <li>• <i>School-Based Classroom Curricula</i></li> <li>• Adventures of Hearty Heart &amp; Friends (gr 3): 15 sessions in 5 wks</li> <li>• -focus on exercise and eating</li> <li>• Go for Health (gr 4-5): 24 sessions in 12 wks: monitoring, goal setting, skills training, GO foods</li> <li>• <i>School Environment</i></li> <li>• Eat Smart School and Nutrition Program: modification to lunch menus, food purchasing, recipes, food preparation and production</li> <li>• CATCH PE: increase moderate to vigorous activity in PE</li> <li>• <i>Family-Based</i></li> <li>• Home Team Program: Hearty Heart Home Team, Stowaway to Planet Strongheart, Unpuffables, Health Trek: activities for home skill development</li> <li>• <i>Family Fun Nights</i></li> <li>• Hearty Heart's Fun Night Planet, Strongheart Night: 2hr night activity</li> <li>• Theory:</li> <li>• Behavioural-Epidemiological model of distal to proximal risk</li> <li>• Health Belief model</li> </ul>	<ul style="list-style-type: none"> <li>• Final data collection at the end of the intervention</li> <li>• Intervention schools significantly increased the intensity of moderate to vigorous physical activity compared to controls (p&lt;.02)</li> <li>• Intervention schools significantly decreased total fat in lunches compared to controls (p&lt;.001)</li> <li>• Intervention schools significantly decreased % of calories from saturated fat as compared to controls (p&lt;.01)</li> <li>• Significant reduction in total fat intake among students in intervention schools (p&lt;.001)</li> <li>• Significant reduction in saturated fat intake among students in intervention schools (p&lt;.01)</li> <li>• Significant increase in self-reported vigorous physical activity (p&lt;.003)</li> <li>• No difference in total minutes of daily physical activity between groups</li> </ul>	

## Appendix A: Randomized Control Trials Included in the Review (n=57)

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