Effectiveness of Physical Activity Enhancement and Obesity Prevention Programs in Children and Youth

Child Health

December 2004

Partially funded by Health Canada Grant # 6795-15-2002/5440007
Effectiveness of Physical Activity Enhancement and Obesity Prevention Programs in Children and Youth

September 2004

Helen Thomas, RN, MSc
Donna Ciliska, RN, PhD
Sandra Micucci, MSc
Jessica Wilson-Abra, MA
Maureen Dobbins, RN, PhD

1 McMaster University, School of Nursing, HSC-3N28C, 1200 Main Street West, Hamilton, Ontario L8N 3Z5
   Phone: 905-525-9140, 22299; Fax: 905-521-8834; thomash@mcmaster.ca

2 City of Hamilton, Public Health and Community Services, PHRED Program, 2 King Street West, Dundas, Ontario L9H 6Z1
   Phone: 905-546-2424, 1578; Fax: 905-628-5617

3 McMaster University, School of Nursing, HSC-3H48C, 1200 Main Street West, Hamilton, Ontario L8N 3Z5
   Phone: 905-525-9140, 22529; Fax: 905-526-7949; ciliska@mcmaster.ca

4 City of Hamilton, Public Health and Community Services, PHRED Program, 2 King Street West, Dundas, Ontario L9H 6Z1
   Phone: 905-546-2424, 1579; Fax: 905-628-5617; smicucci@hamilton.ca

5 McMaster University, School of Nursing, HSC-3N28C, 1200 Main Street West, Hamilton, Ontario L8N 3Z5
   Phone: 905-525-9140, 22299; Fax: 905-521-8834; micuccis@mcmaster.ca

6 City of Hamilton, Public Health and Community Services, PHRED Program, 2 King Street West, Dundas, Ontario L9H 6Z1
   Phone: 905-546-2424, 1580; Fax: 905-628-5617; jwilson@hamilton.ca

7 McMaster University, School of Nursing, HSC-3H46D, 1200 Main Street West, Hamilton, Ontario L8N 3Z5
   Phone: 905-525-9140, 22726; Fax: 905-521-8834; dobbinsm@mcmaster.ca
Effective Public Health Practice Project (EPHPP) Steering Committee 2004

Steering Committee Membership

<table>
<thead>
<tr>
<th>Joanne Beyers</th>
<th>Maureen Cava</th>
<th>Nancy Edwards</th>
<th>Denise Grafton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valerie Mann</td>
<td>Sandra Micucci</td>
<td>Isabelle Michel</td>
<td>Marlene Mirza</td>
</tr>
<tr>
<td>Elizabeth Rolland</td>
<td>Jane Soldera</td>
<td>Helen Thomas</td>
<td>Jessica Wilson-Abra</td>
</tr>
</tbody>
</table>

EPHPP Team

<table>
<thead>
<tr>
<th>Project Leader</th>
<th>Project Coordinator</th>
<th>Research Analyst</th>
<th>Research Assistant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helen Thomas</td>
<td>Sandra Micucci</td>
<td>Jessica Wilson-Abra</td>
<td>Marlene Mirza</td>
</tr>
</tbody>
</table>

Project Support

| Elena Goldblatt | Barb Allen | Danielle Simandl |

Summary Statements

To determine the effectiveness of interventions included in the Mandatory Health Programs and Services Guidelines (MHPSG), the following systematic reviews and summary statements were completed and funded by the Public Health Research, Education and Development (PHRED) Program of the Public Health Branch, Ministry of Health and Long-Term Care.

GENERAL STANDARDS

**Equal Access**

**Health Hazard Investigation**

- Effectiveness of public health in organized response to non-natural environmental disasters * 1999
- Effectiveness of environmental awareness interventions * 1999

**Program Planning and Evaluation**

- Web sites for promoting health 2003
- The effectiveness of on-line health information for consumers 2002
- Mass media interventions: Effects on health services use 2001
- A meta-analysis of fear appeals: Implications for effective public health campaigns 2001
- Electronic social support groups to improve health * 2000

CHRONIC DISEASE AND INJURIES

- Effectiveness of environmental awareness interventions * 1999

**Chronic Disease Prevention**

- Exercise as an aid in smoking cessation 2003
- Young people and healthy eating: A systematic review on barriers and facilitators 2003
- The effectiveness of routinely taught breast self-examination in reducing mortality 2003
- The effectiveness of patient diabetes education in the management of type 2 diabetes 2002
- The effectiveness of school based strategies for the primary prevention of obesity and for promoting physical activity and/or nutrition, the major modifiable risk factors for type 2 diabetes: A review of reviews 2002
<table>
<thead>
<tr>
<th>Topic</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness of school-based strategies for primary prevention of eating disorders</td>
<td>2001</td>
</tr>
<tr>
<td>Using school-based programs to improve heart healthy eating behaviours of children</td>
<td>2001</td>
</tr>
<tr>
<td>Effectiveness of interventions to promote healthy eating in pre-school children aged 1 to 5 years</td>
<td>2001</td>
</tr>
<tr>
<td>Effectiveness of smoking cessation interventions</td>
<td>2001</td>
</tr>
<tr>
<td>Limited (information only) patient education programs for adults with asthma</td>
<td>2001</td>
</tr>
<tr>
<td>The effectiveness of health promotion interventions in the workplace</td>
<td>2001</td>
</tr>
<tr>
<td>The effect of exercise training on bone mass among pre- and post-menopausal women</td>
<td>2001</td>
</tr>
<tr>
<td>The effectiveness of the health promoting schools approach and school-based health promotion interventions</td>
<td>2001</td>
</tr>
<tr>
<td>Effectiveness of home based support for older people</td>
<td>2001</td>
</tr>
<tr>
<td>The effectiveness of school-based interventions in promoting physical activity and fitness among children and youth: A systematic review *</td>
<td>2001</td>
</tr>
<tr>
<td>Effectiveness of dust mite control to reduce asthma symptoms</td>
<td>2000</td>
</tr>
<tr>
<td>The effectiveness of interventions for preventing tobacco smoke in public places</td>
<td>2000</td>
</tr>
<tr>
<td>Effectiveness of a telephone intervention as a delivery strategy within the scope of public health nursing practice</td>
<td>2000</td>
</tr>
<tr>
<td>The effectiveness of community interventions to increase fruit and vegetable consumption in people four years of age and older *</td>
<td>1999</td>
</tr>
<tr>
<td>Effectiveness of coalitions in heart health promotion, tobacco use reduction and injury prevention: A systematic review of the literature 1990-1998 *</td>
<td>1999</td>
</tr>
<tr>
<td>Smoking cessation during pregnancy</td>
<td>1999</td>
</tr>
<tr>
<td>The effectiveness of community-based heart health projects: A systematic overview update *</td>
<td>1999</td>
</tr>
<tr>
<td>The effectiveness of workplace-based health risk appraisal in improving knowledge, attitudes or behaviours</td>
<td>1999</td>
</tr>
</tbody>
</table>

**Early Detection of Cancer**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness of strategies to increase cervical screening: A systematic review of the evidence (community-based) *</td>
<td>2000</td>
</tr>
</tbody>
</table>

**Injury Prevention Including Substance Abuse Prevention**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interventions to prevent the recurrence of elder abuse</td>
<td>2003</td>
</tr>
<tr>
<td>The effectiveness of preventative home visits to elderly people living in the community</td>
<td>2003</td>
</tr>
<tr>
<td>Interventions for increasing pedestrian and cyclist visibility</td>
<td>2003</td>
</tr>
<tr>
<td>Child pedestrian safety</td>
<td>2003</td>
</tr>
<tr>
<td>The effectiveness of physical exercise for sleep problems in adults aged 60+</td>
<td>2002</td>
</tr>
<tr>
<td>Effectiveness of a telephone intervention as a delivery strategy within the scope of public health nursing practice</td>
<td>2000</td>
</tr>
<tr>
<td>Effectiveness of video for health education</td>
<td>2000</td>
</tr>
<tr>
<td>Effectiveness of anticipatory care interventions with community-dwelling elderly persons</td>
<td>2000</td>
</tr>
<tr>
<td>Effectiveness of coalitions in heart health promotion, tobacco use reduction and injury prevention: A systematic review of the literature 1990-1998 *</td>
<td>1999</td>
</tr>
<tr>
<td>Prevention of unintentional injuries in childhood and young adolescence</td>
<td>1999</td>
</tr>
<tr>
<td>Effectiveness of school-based interventions in reducing adolescent risk behaviour: A systematic review of reviews *</td>
<td>1999</td>
</tr>
<tr>
<td>The effectiveness of school-based curriculum suicide prevention programs for adolescents *</td>
<td>1999</td>
</tr>
</tbody>
</table>
## FAMILY HEALTH

### Sexual Health
- The effectiveness of public health interventions to reduce or prevent spousal abuse toward women * 2001
- The effectiveness of the health promoting schools approach and school-based health promotion interventions 2001
- Peer health promotion interventions for youth 2000
- Using school-based programs to reduce adolescent risk behaviour * 1999
- Primary prevention of adolescent pregnancy * 1999
- Preventing sexually transmitted diseases (STDs) in adolescents * 1999

### Reproductive Health
- The effectiveness of folate supplementation for the prevention of neural tube defects 2002
- Antenatal education for childbirth/parenthood 2001
- The effectiveness of public health strategies to reduce or prevent the incidence of low birth weight in infants born to adolescents: A systematic review * 2001
- Postpartum smoking relapse prevention strategies 2000
- Smoking cessation during pregnancy 1999
- The effectiveness of home visiting as a delivery strategy for public health nursing interventions to clients in prenatal and postnatal period: A systematic review * 1999

### Child Health
- Optimal duration of exclusive breastfeeding 2002
- Community based interventions to improve child mental health: Review of reviews 2002
- The effectiveness of school social work from a risk and resilience perspective 2002
- The effectiveness of school-based violence prevention programs for children at risk 2002
- The effectiveness of public health interventions to reduce or prevent spousal abuse toward women * 2001
- The effectiveness of the health promoting schools approach and school-based health promotion interventions 2001
- Support for breastfeeding mothers 2001
- Effectiveness of pre-school screening for hearing, speech, language and vision 2001
- Antenatal education for childbirth/parenthood 2001
- Parent-training programmes for improving maternal psychosocial health 2001
- Effectiveness of a telephone intervention as a delivery strategy within the scope of public health nursing practice 2000
- Effectiveness of video for health education 2000
- Smoking cessation during pregnancy 1999
- Effectiveness of school-based interventions in reducing adolescent risk behaviour: A systematic review of reviews * 1999
- A systematic review of the effectiveness of peer/paraprofessional 1:1 interventions targeted toward mothers (parents) of 0-6 year old children in promoting positive maternal (parental) and/or child health/development outcomes * 1999
- Effectiveness of parenting groups with professional involvement in improving parent and child health/development outcomes * 1999
- The effectiveness of home visiting as a delivery strategy for public health nursing interventions to clients in prenatal and postnatal period: A systematic review * 1999
- Promotion of healthy feeding in infants under one year of age 1999
<table>
<thead>
<tr>
<th>Topic</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>The effectiveness of school-based curriculum suicide prevention programs for adolescents *</td>
<td>1999</td>
</tr>
</tbody>
</table>

**INFECTIOUS DISEASES**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioterrorism preparedness</td>
<td>2003</td>
</tr>
<tr>
<td>Needle exchange programs</td>
<td>2000</td>
</tr>
</tbody>
</table>

**Control of Infectious Diseases**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Effectiveness of Methoprene for Controlling Mosquito Populations in Ontario That Can Carry West Nile Virus</td>
<td>2004</td>
</tr>
</tbody>
</table>

**Food Safety**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness of food safety interventions *</td>
<td>2001</td>
</tr>
<tr>
<td>Food safety in community-based settings</td>
<td>1999</td>
</tr>
</tbody>
</table>

**Infection Control**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness of day care centre infection control interventions *</td>
<td>1999</td>
</tr>
</tbody>
</table>

**Rabies Control**

**Safe Water**

**Sexually Transmitted Diseases**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness of video for health education</td>
<td>2000</td>
</tr>
<tr>
<td>A systematic review of the effectiveness of primary prevention programs to prevent sexually transmitted diseases (STDs) in adolescents *</td>
<td>1999</td>
</tr>
<tr>
<td>Effectiveness of needle exchange programs in modifying HIV-related outcomes: A systematic review of the evidence 1997-1999 *</td>
<td>1999</td>
</tr>
</tbody>
</table>

**Tuberculosis Control**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhancing adherence to tuberculosis treatment</td>
<td>1999</td>
</tr>
</tbody>
</table>

**Vaccine Preventable Diseases**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effect of patient reminder/recall interventions on immunization rates</td>
<td>2001</td>
</tr>
<tr>
<td>The effectiveness of the health promoting schools approach and school-based health promotion interventions</td>
<td>2001</td>
</tr>
</tbody>
</table>

* indicates a review completed by the Effective Public Health Practice Project. Completed reviews and summary statements are added to our web site as they become available. Please check http://www.hamilton.ca/phcs/ephpp/ regularly for new or updated information.

---

City of Hamilton, Public Health and Community Services Department  
Public Health Research, Education and Development Program (PHRED)  
Effective Public Health Practice Project (EPHPP)  
2 King Street West, Dundas, Ontario  L9H 6Z1  
E-mail: ephpp@hamilton.ca

The conclusions of the reviews and summary statements are based on the available evidence. They do not necessarily represent the views of the Public Health Branch, Ministry of Health and Long-Term Care. This report may be copied for circulation as appropriate. Please ensure that the PHRED Program, Public Health Branch, Ministry of Health and Long-Term Care is acknowledged.
# Table of Contents

## EFFECTIVENESS OF PHYSICAL ACTIVITY ENHANCEMENT AND OBESITY PREVENTION PROGRAMS IN CHILDREN AND YOUTH

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>TABLE OF CONTENTS</td>
<td>1</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>5</td>
</tr>
<tr>
<td>PREFACE</td>
<td>7</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>8</td>
</tr>
<tr>
<td>Implications for Policy and Program Delivery</td>
<td>9</td>
</tr>
<tr>
<td>Implications for Research</td>
<td>9</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>11</td>
</tr>
<tr>
<td>Background</td>
<td>12</td>
</tr>
<tr>
<td>Research Questions</td>
<td>14</td>
</tr>
<tr>
<td>METHODS</td>
<td>14</td>
</tr>
<tr>
<td>Searching the Literature</td>
<td>14</td>
</tr>
<tr>
<td>Relevance</td>
<td>15</td>
</tr>
<tr>
<td>Quality Assessment</td>
<td>16</td>
</tr>
<tr>
<td>Data Extraction</td>
<td>16</td>
</tr>
<tr>
<td>Synthesis/Analysis of Data</td>
<td>16</td>
</tr>
<tr>
<td>RESULTS</td>
<td>17</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>17</td>
</tr>
<tr>
<td>Implications for Policy and Program Delivery</td>
<td>20</td>
</tr>
<tr>
<td>Implications for Research</td>
<td>21</td>
</tr>
<tr>
<td>CONCLUSIONS</td>
<td>22</td>
</tr>
<tr>
<td>Figure 1: Flow Chart of Articles</td>
<td>23</td>
</tr>
<tr>
<td>Appendix 1: Relevance Tool</td>
<td>24</td>
</tr>
<tr>
<td>Appendix 2: Search Strategy</td>
<td>25</td>
</tr>
<tr>
<td>Appendix 3: Hand Searching</td>
<td>26</td>
</tr>
<tr>
<td>Appendix 4: Quality Assessment Tool</td>
<td>27</td>
</tr>
<tr>
<td>Appendix 5: Core Data Extraction Form for HWR</td>
<td>32</td>
</tr>
<tr>
<td>Appendix 6: Relevant Project Accounts</td>
<td>37</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>58</td>
</tr>
</tbody>
</table>

## INTERVENTIONS TO IMPROVE NUTRITIONAL INTAKE IN CHILDREN AND YOUTH

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUMMARY STATEMENT</td>
<td>62</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>66</td>
</tr>
<tr>
<td>METHODS</td>
<td>66</td>
</tr>
<tr>
<td>RESULTS</td>
<td>66</td>
</tr>
<tr>
<td>Description of Relevant Studies</td>
<td>66</td>
</tr>
<tr>
<td>Quality Assessment of Relevant Studies</td>
<td>67</td>
</tr>
<tr>
<td>Findings from Relevant Studies</td>
<td>68</td>
</tr>
<tr>
<td>Improved Nutrition: Interventions for Primary School Students</td>
<td>68</td>
</tr>
<tr>
<td>Improved Nutrition: Interventions for High School Students</td>
<td>70</td>
</tr>
<tr>
<td>Prevention of Eating Disorders</td>
<td>71</td>
</tr>
<tr>
<td>DISCUSSION AND IMPLICATIONS</td>
<td>72</td>
</tr>
<tr>
<td>Improved Nutrition</td>
<td>72</td>
</tr>
<tr>
<td>Prevention of Eating Disorders</td>
<td>72</td>
</tr>
<tr>
<td>Implications for Practice and Policy</td>
<td>72</td>
</tr>
</tbody>
</table>
ENVIRONMENTAL INTERVENTIONS TO IMPROVE NUTRITION AND INCREASE PHYSICAL ACTIVITY IN CHILDREN AND YOUTH

SUMMARY STATEMENT ........................................................................................................ 219
INTRODUCTION ..................................................................................................................... 223
METHODS ................................................................................................................................ 223
RESULTS ................................................................................................................................... 223
  Description of Relevant Studies ............................................................................................... 223
  Environmental Component Only ............................................................................................ 224
  Multi-Component Interventions to Improve Nutrition .............................................................. 225
  Multi-Component Interventions to Improve Nutrition and Increase Physical Activity .............. 226
DISCUSSION ............................................................................................................................ 227
IMPLICATIONS ......................................................................................................................... 228
  Implications for Policy and Practice ....................................................................................... 228
  Implications for Research ...................................................................................................... 229
CONCLUSIONS ......................................................................................................................... 229
TABLES ..................................................................................................................................... 230
  Table 1 Quality Assessment Rating of Relevant Studies ......................................................... 230
  Table 2 Results of Relevant Studies ........................................................................................ 231
REFERENCES ........................................................................................................................... 251
Acknowledgements

This project was partially funded by Health Canada Grant number 6795-15-2002/440007.

Thank you to the PHRED clinicians who participated in the relevance and quality assessment, and in critiquing the final draft of the various sections of the review as outlined below.

Interventions to Improve Nutritional Intake in Children and Youth

Joanne Beyers
Researcher, Nutrition and Lifestyles
Sudbury and District Health Unit

Charlene Beynon
PHRED Director
Middlesex-London Health Unit

Meizi He
Nutrition Researcher and Educator
Middlesex-London Health Unit

Carol Woods
Research Associate
Sudbury and District Health Unit

Interventions to Reduce Physical Inactivity in Children and Youth

Joanne Beyers
Researcher, Nutrition and Lifestyles
Sudbury and District Health Unit

Jo-Anne Peterson
Research Associate
Kingston, Frontenac and Lennox-Addington Health Unit

Michelle Sangster-Bouck
Research Associate
Middlesex-London Health Unit

Jane Simpson
Program Planning and Evaluation Officer
City of Ottawa, Public Health and Long-term Care Branch

Interventions to Increase Physical Activity in Children and Youth

John Dwyer
Clinical Consultant
Hamilton PHRED Program
Erica Clark
Research Analyst
Hamilton Public Health and Community Services

Interventions to Increase Physical Activity and Nutritional Intake in Children and Youth

Suzanne Brown
Program Evaluation Coordinator
Hamilton Public Health and Community Services

Lisa Ashley
Clinical Nurse Specialist
Ottawa Public Health

Kate Zhang
Research Assistant
Hamilton Public Health and Community Services

Karen Scott
Research Officer
Ottawa Public Health

A huge thank you to the project staff, Sandra Micucci and Jessica Wilson-Abra, for all their work and flexibility in filling in along the way. Finally, Marlene Mirza organized the circulation of papers and collated responses. As well she formatted the final version of the review. Without her we could not have completed this task.
PREFACE

Research is one component in evidence-based decision-making, along with past experience, patient preference, and available resources. Making research results available to consumers, practitioners, policy-makers, and other researchers is essential to fostering evidence-based practice and decision-making. In the Ontario Public Health, Health Promotion and Primary Care area, lack of access to research evidence can be a barrier to using research in policy and practice (Camiletti & Huffman, 1998); (Ciliska, Hayward, Dobbins, Brunton, & Underwood, 1999).

The Public Health Branch of the Ministry of Health and Long-Term Care and the City of Hamilton fund the Public Health Research, Education and Development (PHRED) Program in Hamilton. A similar program is in place in four other health units across the province. One role of the PHRED Program is to conduct and disseminate clinically relevant public health, health promotion and primary care research, and to foster evidence-based practice and policy-making.

The Effective Public Health Practice Project (EPHPP) is one initiative within the PHRED Program. This project involves public health researchers, practitioners, and policy-makers from across the province. The EPHPP project members conduct systematic reviews that evaluate the effectiveness of relevant interventions. This project, coordinated from the City of Hamilton PHRED, has produced numerous reviews and summary statements on the effectiveness of interventions for the Ministry of Health and Long-Term Care, Public Health Branch. Work is ongoing.

Professional collaboration ensures high-quality scientific work that is clinically relevant to consumers, practitioners, and policy-makers. Members of the PHRED Program located in each of the health units have links with faculties such as health sciences, dentistry, nursing, nutrition, medicine, environmental health and geography at their local universities. The EPHPP also has links to the Cochrane Collaboration, an international research initiative, committed to summarizing and making the highest quality research available world-wide.

The EPHPP is committed to on-going consultation with health units within the province to define and review appropriate public health topics, and to collaboration with other groups equally committed to evidence-based practice and decision-making. In this way, the EPHPP continues to develop research that is timely, evidence-based, and relevant to the delivery of public health services in Ontario.
ABSTRACT

The purpose of this systematic literature review is to provide some national policy direction related to the effectiveness of interventions for promoting healthy weight, preventing overweight/obesity and increasing physical activity among school-aged children and youth.

Although the reported rates of childhood obesity/overweight in Canada vary, they are high. Over the past 15 years, obesity rates in children have doubled. Similar trends have been noted in Australia and the United States. Although not all obese/overweight children become obese adults, many do. Adult obesity is implicated in a number of chronic illnesses. The costs of obesity to the health care system, other systems, and the individual’s quality of life are substantial. Providing preventive strategies to all children could reduce child and adult obesity/overweight.

Few population frameworks to guide interventions to reduce obesity/overweight have been suggested. Canada and Australia have proposed similar models to address this issue. The models suggest there are three broad variables involved: biology/genetics, behavioural influences, and environmental influences. As well, there are macro and micro level factors associated with these variables. Much of the work to date has focused on the micro factors, primarily on education. Although there are limitations, schools are good settings for population-based interventions directed at children and youth, their families, and the community.

This series of reviews consists of several components. An overall comprehensive literature search for primary studies between January 1985 and June 2003 was carried out. The literature was divided into five topics: interventions for improving nutritional intake, reducing physical inactivity, increasing physical activity, multi-faceted interventions incorporating improving nutrition and increasing physical activity and changes to the school environment. Over 1,100 articles were retrieved. All articles were reviewed for relevance using standardized criteria. Those that were relevant (n=430) were then assessed for methodological quality. All relevant studies are reported in the tables. Only those with strong methodological rigour are described in the text. One should exercise caution when viewing the results of the weaker studies as they have several threats to internal and external validity.

Both randomized controlled trials (RCTs) and cohort studies are included. The RCTs were, in general, stronger than the cohort studies. The most frequent limitations of the RCTs included potential selection bias, lack of blinding of outcome assessors, lack of sample size calculation, and inappropriate analysis in that many investigators allocated students by school and then analyzed outcomes by individual. As well, many investigators did not report the consistency of the intervention or the amount of the intervention received by study participants. Few studies provided any long-term follow-up to assess whether positive impacts were sustained. The other difficulty is that when studies reported statistically significant differences in outcomes, the actual differences were small and their clinical significance was unknown.

Although the theory underlying many interventions was not explicitly stated, it appeared that many were based on either social cognitive or ecological theory. A few studies were found that used the environmental/systems-based approach. Although none of the
studies using this approach met the relevance criteria, some examples of work in this area are included in the environmental section as illustrations of possible future work.

Few studies reported the effect of culture, socioeconomic status and individual level of risk on outcomes. In attempting to identify factors contributing to obesity/overweight in children and youth, several investigators have noted the differences in rates based on cultural differences and on socioeconomic status. Of these factors, socioeconomic status may be the most important.

Many of the studies involved elementary school children. About one-third focused on adolescents. The effectiveness of parental involvement was mixed. One study demonstrated that teacher preparation positively impacted on the amount of physical activity students engaged in during physical education classes. However, classroom teachers led most of the interventions.

Overall, the results of these reviews state that positive outcomes are modest at best and many results are inconsistent between studies. Based on these reviews of the literature, the following are implications for policy, program delivery and research.

Implications for Policy and Program Delivery

- Increasing physical activity during school could be accomplished by addressing the balance of aerobic activity and skill development in physical education classes and by increasing the number of physical education classes, particularly in secondary school.

- The skill and motivation of teachers to comply with model programs needs to be addressed. Regular teachers who are leading physical education classes need access to/mentoring from specialists to maximize the amount of physical activity that students receive during classes.

- Since multi-faceted programs are more effective than others, the resources for planning, implementing, monitoring and evaluating these programs should be made available.

- Organizations mandated to fund research in the area of obesity/overweight prevention should be discouraged from funding projects that do not take the identified methodological limitations into account.

- Governments, the private sector and others need to work together to provide more rigorous evaluation of environment/systems based interventions.

Implications for Research

- Research studies must make the theoretical basis explicit. Combinations of theories should be encouraged.

- Strategies to reduce selection bias, improve blinding of outcome assessors, present sample size calculations, reduce analysis errors, monitor the fidelity of interventions and report the amount of the program received by participants need to be included in future research plans/protocols.
- All analysis and sample size calculations should include subgroup analysis of at least gender, socioeconomic status and culture to determine their impact on programs.

- Long-term follow-up of successful programs is necessary to determine the sustainability of positive changes.

- Clinicians and researchers need to work together to determine a clinically significant difference in both improving nutrition and increasing physical activity.

- Qualitative methods could improve understanding of the barriers to improving nutrition and increasing physical activity for children, their families, and the community.
INTRODUCTION

The purpose of these systematic literature reviews is to provide policy direction related to the effectiveness of interventions for promoting healthy weight, preventing overweight/obesity and increasing physical activity among school-aged children and youth.

The World Health Organization has declared obesity a global epidemic (World Health Organization, 2000). In a recent study, Tremblay et al (Tremblay, Katzmarzyk, & Willms, 2002) 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. As well, the prevalence of overweight among boys almost doubled (from 15%-28.8%). For girls it rose from 15% to 23.6%. Ball and McCargar (Ball & McCargar, 2003) recently reviewed the prevalence estimates of childhood obesity in children. Although they caution that the regional differences reported might reflect real differences, the differences are also influenced by the different methods for calculating obesity and the varying methodologies used in the various studies. In spite of these limitations, the range of rates of childhood obesity remains high. Similar trends in childhood obesity have been noted in Australia and the United States (Dollman, Olds, Norton, & Stuart, 1999; Troiano & Flegal, 1998).

Health consequences for youth related to obesity include risks to the cardiovascular, endocrine, pulmonary, orthopedic and gastroenterological systems and to the development of healthy lifestyles and positive self-esteem and body image (Ball et al., 2003). Although the causes of obesity are multiple and complex, programs directed at healthy eating and increasing physical activity or both are relevant to obesity reduction/prevention.

Few frameworks for defining the context of obesity (and potential solutions) from a population perspective have been suggested. Glasgow et al (Glasgow et al., 1999) proposed a population-based approach to chronic illness. Egger and Swinburn (Egger & Swinburn, 1997) adapted this model to obesity and both Australia and Canada have presented similar ecological models for obesity prevention (National Health and Medical Research Council (Australia), 1997; Mooibroek, 2001). 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, they 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, peers’ 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 (Egger et al., 1997).

The modest effects from educational programs on reducing obesity rates or increasing physical activity may result in part from their failure to address the many other factors.
influences. However, there are a number of other questions related to school-based programs that need clarifying. For example the intensity, duration and frequency of programs to produce an effect is unknown. The optimum age for different interventions is also unknown. Comparisons of the impacts of different interveners on outcomes have not been studied. Factors that might influence the impact of interveners include educational preparation in the subject, skill at interacting with students, age and enthusiasm for the topic. Finally, it appears that subgroups of students (e.g. girls or boys) may react differently to programs. This means that gender specific programs may have to be developed (Dobbins et al., 2001).

Background

Adult obesity is implicated in a variety of chronic illnesses including cardiovascular disease, hypertension, type 2 diabetes, and some cancers (Birmingham, Muller, Palepu, Spinelli, & Anis, 1999). The connection between child and adult obesity is complex. A review of 15 study populations (Serdula et al., 1993), reported there was a positive association between anthropometric measures of obesity in childhood and adulthood. 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. These findings led the authors to conclude that preventive programs should be directed at all children and should focus on healthy nutrition and adequate physical activity.

Using a 1947 birth cohort, a recent longitudinal study gathered height, weight, and risk factors for chronic disease data available for 529 (44%) men and women of the original sample at age 50 years (Wright, Parker, Lamont, & Craft, 2001). They found that only children reported as obese at age 13 years showed an increased risk of adult obesity. They confirmed the results of the above review 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, elevated glucose tolerance tests). The investigators in both of these studies clearly state the limitations of longitudinal work and of the use of inconsistent measures to assess obesity. However, in spite of the limitations, the results are similar, adding strength to the argument that although some obese children become obese adults, many do not and that those thin children who become obese adults are at high risk for morbidity. These findings strengthen the hypothesis that providing preventive strategies to all children could reduce child and adult obesity.

Two-thirds of Canadian children ages 5-17 are not active enough to promote health benefits (Canadian Fitness and Lifestyle Research Institute, 1997). As well, a considerably smaller proportion of females than males are active enough to provide health benefits. Although activity declines for both genders during adolescence, this is more marked in females than males (Stone, McKenzie, Welk, & Booth, 1998). Since children are increasingly demonstrating risk factors for cardiovascular disease (e.g. elevated blood lipids, hypertension and atherosclerotic coronary arteries at autopsy) that track into adulthood, it is important to improve their physical fitness (Dobbins et al., 2001). Physical activity patterns track from childhood into adulthood, as well (Harvard Family Research Project, 2003). The prevalence of physical inactivity among Canadian adults is 62% (Katzmarzyk, Gledhill, & Shephard, 2000). 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.

Recent estimates of the direct and indirect health care costs of obesity and physical inactivity in Canada are substantial. The total cost of adult obesity in Canada in 2001 was estimated to be $4.3 billion (Katzmarzyk & Janssen, 2004). These same investigators calculated the cost of physical inactivity to be $5.3 billion. These costs represent 2.2% (obesity) and 2.6% (physical inactivity) of the total health care costs in Canada (Katzmarzyk et al., 2004). The population attributable fraction due to adult physical inactivity for seven chronic diseases ranged from 11% to 35.8%. This represented 25.5% of the costs of treating coronary artery disease, stroke, hypertension, colon and breast cancer, type 2 diabetes and osteoporosis for that year. A 10% reduction in physical inactivity would produce savings of about $150 million per year in direct health care costs (Katzmarzyk et al., 2000). Given the association between obesity and physical inactivity, a portion of attributable costs for one is probably attributable to the other. However, it is unlikely that the costs are simply additive. Providing strategies that lead to healthy eating and increased levels of physical activity to all children could reduce health care costs of obesity and physical inactivity and improve the quality of life for many adult Canadians.

School settings are ideal environments for population-based interventions directed at children and youth for several reasons: almost all children in developed countries are in school for a considerable period of time, 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. Furthermore, evidence that the amount of actual activity that takes place during physical education classes is variable and the classes may be infrequent, calls into question their value in solely developing or maintaining physical fitness (Simons-Morton et al., 1990; Simons-Morton, Taylor, Snider, Huang, & Fulton, 1994). To achieve and maintain desired levels of physical activity, strategies to promote activity throughout the day are important. In addition, the role of the community in promoting physical activity is crucial because most activity among children and adolescents occurs outside the school.

A number of reviews have focused on obesity prevention and/or increasing physical activity in school-aged children and youth. Some are intervention site or disease specific (e.g. school-based interventions (Story, 1999), (Dobbins et al., 2001), or cardiovascular disease (Resnicow & Robinson, 1997) or both (McArthur, 1998)). Glenny et al (Glenny, O'Meara, Melville, Sheldon, & Wilson, 1997) reviewed interventions for the prevention and treatment of obesity and the maintenance of weight loss. This included all ages and populations at different levels of risk. More recently, Kahn et al (Kahn et al., 2002) completed an extensive review of interventions to increase physical activity. They included informational, behavioural and social, mass media, school-based educational, environmental and policy interventions. Although the effects on physical activity of some of these interventions are clear, they do not include any outcomes assessing the effectiveness of integrating obesity/overweight prevention strategies with physical activity. Micucci et al (Micucci, Thomas, & Vohra, 2002) provide a review of reviews of school-based interventions to reduce obesity, improve healthy eating and/or to increase physical activity. Jepson (Jepson, 2000) produced a review of reviews of the effectiveness of health-related behaviours including exercise and healthy diet among others. In a recent review of studies designed to prevent childhood obesity, Campbell et al (Campbell, Waters, O'Meara, Kelly, & Summerbell, 2002) concluded that reducing
sedentary behaviour and increasing physical activity might be successful interventions. Campbell et al did not include the myriad of work that has addressed healthy eating and/or increasing physical activity.

All of these reviews add to the knowledge about the effectiveness of interventions for promoting healthy weight, preventing overweight/obesity and increasing physical activity among school-aged children and youth. However, synthesizing these results and adding results of any other studies that assess the effectiveness of relevant strategies could provide an overall statement about what is known to date about the effectiveness of interventions. It could also identify areas for future direction, by providing insight into the factors from the Egger and Swinburn (Egger et al., 1997) model (described in the introduction of this paper) that have been investigated and those that require further work.

Research Questions

These reviews answer the following questions:

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?
5. What is the effectiveness of environmental interventions on improving nutrition and increasing physical activity in children and youth?

METHODS

Primary studies were reviewed. Studies related to therapeutic nutrition and physical activity programs were excluded as were studies including children with known illnesses or obese/overweight children.

Searching the Literature

The following electronic databases were searched without language restrictions: BIOSIS, MEDline, CINAHL, PsychINFO, Sociological Abstracts, EMBASE, ERIC, Sports Discus, the Cochrane Databases of Systematic Reviews and of Randomized Controlled Trials (RCTs) and CENTRAL. Search terms were selected based on the work of others and the Effective Public Health Practice Project. The search strategy is outlined in Appendix 1. All databases were searched for the period of January 1985 to August 2003.
Using the relevance criteria outlined below, two reviewers independently scanned the citations and abstracts for relevant articles. All citations selected by either reviewer were captured into Reference Manager (Network Edition, Version 10). All potentially relevant citations were retrieved. Due to time restraints, only French articles were translated. Twenty-four relevant peer-reviewed journals were hand searched for the period June 1998 to June 2003 inclusive (see Appendix 2). Relevant articles were retrieved and added to the database. Reference lists of all retrieved articles were reviewed and potentially relevant titles were retrieved.

A search for unpublished literature included contacting experts in the areas, contacting other key informants, and searching Canadian, American, Australian and European government agency websites.

Relevance

To be relevant, studies had to meet all five of the following criteria (see Relevance Tool, Appendix 3).

1. The study had to report on a primary prevention intervention relevant to public health/health promotion in Canada.

2. The population included school-aged children and youth from 6 to 18 years of age.

3. Relevant interventions included: studies that assessed the effectiveness of interventions focused either solely or in an integrated way on improving nutritional intake, enhancing physical activity and decreasing physical inactivity; studies that addressed one intervention or integrated a number of types of interventions (e.g. educational information, support groups, increasing activity during physical education classes); and, studies where the intervention was carried out in either the school, the family and/or the community.

4. Studies with one or more of the following child and youth outcomes were included: changes in total caloric intake and percent calories from fat, fruit and vegetable intake, changes in body fat, changes in perception of body image, self reported changes in the duration, rate and frequency of physical activity, changes in VO₂max, and, self-reported changes in inactivity (proxy measures include the number of hours per day of use of video devices).

   In spite of some discussion in the literature, BMI as a measure of changes in body fat was included as an outcome measure based on the establishment of a standard definition for worldwide use for child overweight and obesity (Cole, Bellizzi, Flegal, & Dietz, 2000). Studies that only measured changes in vitamin or fibre intake were excluded. Changes in knowledge and attitude related to physical activity and nutrition were not included because, although they may be necessary for behaviour change, they do not have much impact on it (Atkinson & Nitzke, 2001).

5. Only prospective studies with a control group were considered relevant.

Two reviewers independently rated all retrieved articles for relevance. Differences were resolved through consensus.
Quality Assessment

Relevant studies were assessed for methodological quality. Following the guidelines set out by Mulrow et al (Mulrow, Cook, & Davidoff, 1997) and Jadad (Jadad et al., 1996), a tool to assess the methodological quality of primary studies has been developed and tested by the Effective Public Health Practice Project (Thomas, Ciliska, Dobbins, & Micucci, 2004). This tool consists of six criteria: selection bias, allocation bias, confounders, blinding of outcome assessors, data collection methods, and withdrawals and dropouts. The quality assessment tool is presented in Appendix 4. An accompanying dictionary is available from the first author. Two reviewers independently rated each relevant article for methodological quality. According to a predetermined scale outlined in the dictionary, all criteria were rated as strong, moderate or weak. Depending on the topic, decisions were made a priori about the most important methodological criteria. The studies that rated strong on those criteria are discussed in the results section of each topic and bolded in the tables. Because there were multiple outcome measures used in some studies, it is possible that there were two or more ratings for the criteria of blinding, data collection methods, and withdrawals and dropouts for one study. Discrepancies in quality assessment ratings were resolved by consensus.

Data Extraction

Data were extracted from all of the relevant studies. A standardized data extraction form was used (See Appendix 5). The form includes the study’s country of origin, a description of the target population (e.g. age, gender, ethnicity, socioeconomic status), including numbers in the control and comparison groups, details of the intervention (including actual exposure to the intervention, how quality control was maintained, and any potential contamination/co-intervention), the intervention setting(s), and length of follow-up after the end of the intervention. The theoretical framework upon which interventions were based was collected to determine whether any framework impacted on the effectiveness of interventions and which framework(s) showed the most promise. All statistically significant and non-significant outcomes that were considered to be of relevance to the review in question were reported.

Our previous work in this area has demonstrated that there are a number of potential difficulties in methods of analysis. To be able to comment comprehensively on this area of primary studies, we extracted the following factors related to the analysis. First, because many studies had small sample sizes and no difference in results (potential Type III error), we identified whether or not a sample size calculation or a power calculation was reported (Polit & Hungler, 1989). Second, we reported whether the statistical methods were appropriate. Third, whether or not the correct unit of analysis was used was recorded (i.e. in much school-based work, samples are allocated by school and then data are analyzed by individual). Finally we reported whether or not the analysis was performed by intervention allocation status (i.e. intention-to-treat) or by actual intervention received.

Synthesis/Analysis of Data

Due to the short timeline for completion of these reviews, it was not feasible to contact authors and obtain the additional data required to do a meta-analysis. The data are instead summarized narratively.
RESULTS

Figure 1 outlines the number of articles involved in these reviews. Over 1200 articles were marked for retrieval from the electronic search. Of these, 1136 (90.59%) were retrieved and reviewed. The remainder could not be accessed before the cut-off date to be included in the review. Of the 1136 articles, 706 (62.4%) were not relevant. The 430 relevant articles included 65 articles that were retrieved for background information, and were not intervention studies. The intervention studies included 76 related to nutrition only, 17 related to physical inactivity, 26 related to increasing physical activity, and 241 related to a combination of interventions and five studies that implemented an environmental component only.

Investigators in several intervention studies have written more than one paper about the intervention. All available papers were reviewed and the overall results are presented as a project account. In most cases, project accounts are referred to by their program name in the text and tables. There were 38 relevant project accounts.

The tables of included studies in each review contain all of the relevant studies. However, given the variation in methodological rigour among the studies, those that are not bolded should be viewed with caution as their methodology was judged to contain several threats to internal and/or external validity.

The tables of quality assessment of included studies in each review display the evaluation of the methodological rigour of the studies. In the Data Collection column, the denominator refers to the total number of relevant measurements used. The numerator is the number of relevant measures that were valid or reliable.

DISCUSSION

These reviews included a large number of primary studies. Both cohort and RCTs were included. The cohort studies had a number of threats to internal and external validity and their results should be viewed with caution. Among the RCTs in all areas there were some common methodological weaknesses. 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. In most of the studies where blinding of the outcome assessors should have been done, it was either not reported or stated that it was not done. When an unblinded assessor took the measurements, the potential for bias existed.

There were two frequent problems in the analysis of the interventions. First, sample size calculations were not reported and so insignificant differences in findings may have resulted either from inadequate power or from ineffective programs. Second, randomization by school and analysis by individual without a cluster analysis was frequently reported. The results then do not take the potential differences/similarities between students in each school into account. It is possible, for example that the students in the schools in the intervention group may differ 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.
Two other problems in the papers 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. This lack of reporting of program fidelity or integrity makes it impossible to explain the between group differences or lack thereof. 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. Future investigators need to address these methodological shortcomings. The methodological strengths of most of the studies were that they, for the most part, used valid and reliable outcome measures. As well, most reported acceptable rates (<20%) of withdrawal/drop-outs during the intervention.

Some of the studies reported which theory their interventions were based upon. However, many did not. This omission makes determining why studies succeeded or failed difficult to tease out. The most frequently cited theories guiding interventions were social cognitive/learning theory (Bandura, 1986) and an ecological theory (Brofenbrenner, 1994). Many papers that did not explicitly state the theoretical basis appeared to be related to the two theories identified. There was no discussion within the papers about the impact of the theory on the results and suggested future changes in interventions. Results of studies using either model were mixed. Two multi-school interventions (Plotnikoff, Williams, & Fein, 1999; Sallis et al., 1999) described in some detail the challenges of delivering a program based on the ecological theory within the schools. The community intervention model of heart health and illness prevention provided underpinnings to the large Heart Health (community-wide) programs. Brenner (Brenner, 2002) explains the features of this model and its evaluation.

When 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 (Dzewaltowski, Estabrooks, & Johnston, 2002) described an ongoing project to impact on physical activity and fruit and vegetable consumption that is based on three theories: ecological, social cognitive, and behaviour-setting (Barker, 1968). The authors used this combination of theories to “…address both potential systematic, institutional or environmental variables that exist in real-world contexts and individual level variables associated with behaviour change” (p 542).

No studies used the environmental/systems based approach to reducing obesity through increased physical activity and improved healthy eating. Studies need to 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 (Swinburn & Egger, 2002). Recently,
Dwyer et al (Dwyer et al., 2003) described one model of planning for such an intervention.

Regardless of the focus (i.e. physical activity, nutrition, or both) of the interventions, the results are mixed in all of the quality studies. Most of the studies involved elementary school students. Most of the studies randomized students to the intervention group and to a usual practice control group. These control groups received the usual physical activity and health/nutrition program. The studies that found a statistically significant difference were usually interventions provided in addition to the regular program. The duration and frequency of interventions are often discussed as possible reasons for a lack of between group change, which is certainly possible. However, the interventions that were effective have a range of intensity and duration, therefore other factors need to be examined. Gender differences are demonstrated for a variety of outcomes in a number of studies. It may be that where gender results are not analyzed separately, the lack of overall difference results from the combination of 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 and all analysis should be by gender.

Other variables that were often not reported include the effects of culture, socio-economic status and level of risk on outcomes. In a few studies that reported on culture, it appears that this factor may have an effect on outcome. As well, when reported, interventions were usually more effective for children from high-income families than for others. Since one of the eating disorder studies found a difference between groups for body satisfaction based on level of risk, it may be that this factor is an important consideration in the other areas as well. However, sub-analysis of results for these variables was rarely reported. All of these potential factors need to be accounted for in future work.

Others have provided empirical evidence for the impact of societal/cultural/ economic influences on obesity and physical activity. Crawford et al (Crawford, Story, Wang, Ritchie, & Sabry, 2001) identified several factors that may contribute to different rates of obesity among African-American, Mexican-American and white children and youth. These factors included adaptive mechanisms, socio-economic status, race, physical activity, dietary patterns, maternal factors and the home environment. The authors postulate that socio-economic factors may be the most important of these variables. In an extensive review, Drewnowski and Specter (Drewnowski & Specter, 2004) concluded that obesity and socio-economic status are inversely related. 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 who are poor 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. As well as individual, family, and community interventions, activities to reduce the income disparity among groups are necessary (Gauvin, 2003).
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. Basing parental involvement on a theory might standardize involvement. As well, qualitative work might improve the understanding of what involvement parents find acceptable. Parental uptake of activities must be monitored to explain outcomes.

The one study that compared the effects of teachers with different qualifications teaching the curriculum (SPARK: Project Account, 1999) reported that student groups led by physical education specialists had the largest increase in MVPA (moderate to vigorous physical activity). 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 or without supervision/support led most of the student groups. Therefore, replication of the assessment of groups led by these teachers needs to be implemented. If the results are similar, a policy decision within schools should be addressed. At this point, it seems clear that physical education classes focused on aerobic activity are more effective than those focused on skill development.

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 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.

Based on the overall results of the reviews the following implications for policy, program delivery and research are recommended.

**Implications for Policy and Program Delivery**

- All of the programs that resulted in increased physical activity actually increased aerobic activity among the intervention students. Therefore, reviewing policy/programs and adjusting the balance of aerobic activity and skill development in physical education classes could lead to increased physical activity among students.

- Since most interventions increased activity because of increased class time focused on activity, it would be prudent to increase the frequency of physical activity classes as well as increasing the number of physical education credits required in secondary school. The preparation of teachers to lead physical activity classes is an important issue. Although there is little research, it appears that physical education specialists assure more MVPA than do teachers with additional training or regular classroom teachers. For now, it is important that regular teachers who are leading physical education classes have on-going mentoring to at least maximize the amount of physical activity that students receive during classes.
• Educational messages regarding healthy eating should be targeted to changing the actual behaviour rather than improving knowledge and attitudes.

• Interventions that are multi-faceted (e.g. targeting students, school cafeterias, parents and the community) are more effective than others. In reviewing school policies that could reduce obesity, all of these interventions should be implemented simultaneously and be given equal importance. These are complex interventions, involving several stakeholders and requiring considerable planning and co-operation. In schools that choose to implement multi-faceted strategies, additional resources must be made available for planning, implementing, monitoring and evaluating the programs.

• Organizations that are mandated to fund research in the area of obesity prevention should be discouraged from funding projects that have not taken account of the methodological limitations outlined below. For multi-faceted interventions, they must be prepared to also fund program development and implementation as well as evaluation.

Implications for Research

• There are several methodological limitations that need to be addressed in future research addressing the primary prevention of obesity. The number of eligible participants in each study needs to be included to reduce selection bias. Given the methodological problems in cohort studies and the ability to implement RCTs in these areas, only RCTs should be funded. A description of processes to blind outcome assessors should be included in any protocol submitted for funding. Calculation of adequate sample sizes must be included to assure that the project has sufficient power to detect a difference if one is present. Statistical analysis must be by the unit of allocation and cluster analysis must be performed. In studies that will involve a number of groups, protocols must include a method for monitoring the fidelity of the program within the groups and across all intervention groups. As well, there needs to be a monitoring system in place to determine what proportion of the intervention group actually received the intervention or what dose they did receive. Long-term outcomes need to be included to assess whether or not effective programs maintain their effects over time. Finally, there should be some effort to assess the cost-effectiveness in all studies.

• All quantitative studies (where relevant) should include subgroup analysis to determine the impact of gender, culture, socioeconomic status and level of risk, because of the possible influence of these factors on program outcomes.

• Whether or not parental involvement positively impacts on outcomes is difficult to determine to date because involvement has been poorly described. This issue needs to be addressed in future work that involves parents.

• Theoretical frameworks that underlie the intervention should be provided and their usefulness assessed at the completion of the study. Innovative studies that combine more than one theory should be encouraged. Testing of other interventions related to the environment/system-based approach should be encouraged as they may hold promise for reducing obesity and have not been tested.
Although the results of the studies in this review are mixed, there are some clear actions for policy, practice and research.

CONCLUSIONS

These reviews have integrated the results of the effectiveness of primary studies that addressed increasing physical activity, decreasing physical inactivity, improving healthy eating and reducing overweight/obesity for children and youth. The results were both modest and mixed. Although increases in physical activity were more frequently reported, changes in nutritional intake appear to be more difficult to achieve. The work in reducing physical inactivity has just begun, but some promising studies were found.
Figure 1: Flow Chart of Articles

1254 Articles marked for retrieval

1136 Articles accessed (90.59% retrieval rate)

Relevance Testing  →  706 Not Relevant

430 Relevant  →  65 Background

Nutrition     Physical Inactivity     Physical Activity     Multifaceted     Environmental
76            17                    26                    241              5
## Appendix 1: Relevance Tool

### Effectiveness of Strategies to Promote Healthy Weights

<table>
<thead>
<tr>
<th>Relevance Criteria</th>
<th>Y</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The study reports on a primary prevention intervention relevant to health promotion/public health in Canada.</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>2. The study reports outcomes for participants in the age group 4-18 years of age.</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>3. The intervention is based on any combination of the community, family and/or school (not clinic-based only).</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>4. The study intervention is aimed at preventing obesity – increasing physical activity, reducing physical inactivity, healthy eating, reducing total caloric intake, body image or satisfaction.</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>5. Information on outcomes are reported for anthropometric measures, dietary caloric, fat or carbohydrate intake, activity level/duration/frequency, inactivity level/duration/frequency, body image or body satisfaction (not just knowledge).</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>6. The study design is prospective and includes a control group (one group pre/post designs are not acceptable).</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>

**Reviewer Decision:**

1. Include in critical appraisal (only if answer ‘yes’ to all 6 relevance criteria). | Y | N |

**If Discrepancy in Inclusion Decision:**

- Reason for discrepancy:
  - Oversight | Y | N |
  - Difference in interpretation of criteria | Y | N |
  - Differences in interpretation of study | Y | N |

**Additional Comments:**

**FINAL DECISION:**

**INCLUDE IN STUDY** | Y | N |

---

### Bibliographic References
Please remember to check reference list for potentially relevant studies.

Healthy Weights Review 24
### Appendix 2: Search Strategy

<table>
<thead>
<tr>
<th>Effectiveness</th>
<th>Content</th>
<th>Strategies</th>
<th>Population</th>
<th>Public Health??</th>
</tr>
</thead>
<tbody>
<tr>
<td>effect:</td>
<td>obesity</td>
<td>program: child</td>
<td>“public health”</td>
<td></td>
</tr>
<tr>
<td>efficacy</td>
<td>“physical activit:”</td>
<td>intervention: adolescen:</td>
<td>“health promotion”</td>
<td></td>
</tr>
<tr>
<td>evaluat:</td>
<td>exercis:</td>
<td>project: youth:</td>
<td>“health education”</td>
<td></td>
</tr>
<tr>
<td>outcome:</td>
<td>“physical fitness”</td>
<td>coalition: teen:</td>
<td>“primary prevention”</td>
<td></td>
</tr>
<tr>
<td>impact</td>
<td>“physical education”</td>
<td>curricul: school-aged?:</td>
<td>“preventive health services”</td>
<td></td>
</tr>
<tr>
<td>evidence</td>
<td>strateg:</td>
<td>education: Family</td>
<td>“prevention”</td>
<td></td>
</tr>
<tr>
<td>assess:</td>
<td>nutrition</td>
<td>campaign: school</td>
<td>“education”</td>
<td></td>
</tr>
<tr>
<td>compar:</td>
<td>diet</td>
<td>surveillance</td>
<td>prophyla:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>eating</td>
<td>legislation</td>
<td>“population health”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“food preferences”</td>
<td>counsel:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“food services”</td>
<td>media</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“food habits”</td>
<td>school:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>fruit</td>
<td>marketing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>vegetable</td>
<td>activit:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“body image”</td>
<td>environment:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“eating disorders”</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Databases:
- BIOSIS
- CINAHL
- EMBASE
- Medline
- PsychINFO
- Sociological Abstracts
- Sports Discus

### Dates:
- 1984 to 2003

### Language:
- All languages
Appendix 3: Hand Searching

The following journals were hand searched for the period June 1998 to June 2003 inclusive.

American Journal of Clinical Nutrition
American Journal of Health Behavior
American Journal of Health Education
American Journal of Health Promotion
American Journal of Preventive Medicine
American Journal of Public Health
Annals of Epidemiology
Annual Review of Public Health
Canadian Journal of Dietetic Practice and Research
Canadian Journal of Public Health
Canadian Medical Association Journal
Eating Disorders: Journal of Treatment and Prevention
Health Education & Behaviour/Health Education Quarterly
Health Education Research
Health Promotion International
International Journal of Eating Disorders
Journal of the American Dietetic Association
Journal of Epidemiology and Community Health
Journal of Nutrition Education and Behavior
Journal of School Health
Medicine and Science in Sports and Exercise
Nutrition Reviews
Preventive Medicine
Social Sciences and Medicine
Appendix 4: Quality Assessment Tool For Quantitative Studies

COMPONENT RATINGS

A) SELECTION BIAS

(Q1) Are the individuals selected to participate in the study likely to be representative of the target population?

- Very Likely
- Somewhat Likely
- Not Likely

(Q2) What percentage of selected individuals agreed to participate?

<table>
<thead>
<tr>
<th>Agreement</th>
<th>80 - 100%</th>
<th>60 – 79%</th>
<th>Less than 60%</th>
<th>Not Reported</th>
<th>Not Applicable</th>
</tr>
</thead>
</table>

Rate this section (see dictionary) | Strong | Moderate | Weak

B) ALLOCATION BIAS

Indicate the study design

- RCT (go to i)
- Quasi-Experimental (go to C)
- Case-control, Before/After study, No control group, ___________________ (Score Weak and go to C)

(i) Is the method of random allocation stated?  
   - Yes
   - No

(ii) If the method of random allocation is stated is it appropriate?  
   - Yes
   - No

(iii) Was the method of random allocation reported as concealed?  
   - Yes
   - No

Rate this section (see dictionary) | Strong | Moderate | Weak

C) CONFOUNDERS

(Q1) Prior to the intervention were there between group differences for important confounders reported in the paper?

- Yes
- No
- Can’t Tell
- Not Applicable (Score Weak and go to D)

Please refer to your Review Group list of confounders.
Relevant Confounders reported in the study:

___________________  __________________  __________________
___________________  __________________  __________________

(Q2) If there were differences between groups for important confounders, were they adequately managed in the analysis?

Yes  No  Not Applicable

(Q3) Were there important confounders not reported in the paper?

Yes  No

Relevant Confounders NOT reported in the study:

___________________  __________________  __________________

For multiple data collection instruments, please complete the HEALTHY WEIGHTS REVIEW (HWR) QUALITY ASSESSMENT TOOL FOR MULTIPLE DATA COLLECTION INSTRUMENTS for each instrument used.

D) BLINDING

(Q1) Was (were) the outcome assessor(s) blinded to the intervention or exposure status of participants?

Yes  No  Not Reported  Not Applicable

E) DATA COLLECTION METHODS

(Q1) Were data collection tools shown or are they known to be valid?

Yes  No

(Q2) Were data collection tools shown or are they known to be reliable?

Yes  No
F) WITHDRAWALS AND DROP-OUTS

(Q1) Indicate the percentage of participants completing the study. (If the percentage differs by groups, record the lowest).

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Percentage</th>
<th>Less than 60%</th>
<th>Not Reported</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 -100%</td>
<td>60 - 79%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 60%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Reported</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

G) ANALYSIS

(Q1) Is there a sample size calculation or power calculation?

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Yes</th>
<th>Partially</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partially</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Q2) Is there a statistically significant difference between groups?

<table>
<thead>
<tr>
<th>Difference</th>
<th>Yes</th>
<th>No</th>
<th>Not Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Reported</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Q3) Are the statistical methods appropriate?

<table>
<thead>
<tr>
<th>Methods</th>
<th>Yes</th>
<th>No</th>
<th>Not Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Reported</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Q4a) Indicate the unit of allocation (circle one)

- Community
- Organization/Institution
- Group
- Provider
- Client

(Q4b) Indicate the unit of analysis (circle one)

- Community
- Organization/Institution
- Group
- Provider
- Client

(Q4c) If 4a and 4b are different, was the cluster analysis done?

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Yes</th>
<th>No</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Applicable</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Q5) Is the analysis performed by intervention allocation status (i.e. intention to treat) rather than the actual intervention received?

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Yes</th>
<th>No</th>
<th>Can’t Tell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can’t Tell</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
H) INTERVENTION INTEGRITY

(Q1) What percentage of participants received the allocated intervention or exposure of interest?

- 80 - 100%
- 60 - 79%
- Less than 60%
- Not Reported
- Not Applicable

(Q2) Was the consistency of the intervention measured?

- Yes
- No
- Not reported
- Not Applicable

SUMMARY OF COMPONENT RATINGS

Please transcribe the information from the gray boxes on pages 1-3 onto this page.

A) SELECTION BIAS

Rate this section (see dictionary) | Strong | Moderate | Weak

B) STUDY DESIGN

Rate this section (see dictionary) | Strong | Moderate | Weak

C) CONFOUNDERS

Rate this section (see dictionary) | Strong | Moderate | Weak

D) BLINDING

Rate this section (see dictionary) | Strong | Weak | Not Applicable

E) DATA COLLECTION METHODS

Rate this section (see dictionary) | Strong | Moderate | Weak

F) WITHDRAWALS AND DROPOUTS

Rate this section (see dictionary) | Strong | Moderate | Weak | Not Applicable

G) ANALYSIS

Comments

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
WITH BOTH REVIEWERS DISCUSSING THE RATINGS:

Is there a discrepancy between the two reviewers with respect to the component ratings?

No  Yes

If yes, indicate the reason for the discrepancy

1  Oversight
2  Differences in Interpretation of Criteria
3  Differences in Interpretation of Study
### Core Data Extraction Form for HWR

#### Study Identification

<table>
<thead>
<tr>
<th>Language of publication</th>
<th>English</th>
<th>French</th>
<th>Other language (specify)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Canada</th>
<th>United States</th>
<th>United Kingdom</th>
<th>Other (specify)</th>
<th>Can’t tell</th>
</tr>
</thead>
</table>

#### Design

<table>
<thead>
<tr>
<th>Years data collected</th>
<th>to</th>
<th>Can’t tell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of intervention groups</td>
<td>Can’t tell</td>
<td></td>
</tr>
<tr>
<td>Number of control groups</td>
<td>Can’t tell</td>
<td>Not appropriate</td>
</tr>
<tr>
<td>Number of subjects screened</td>
<td>Can’t tell</td>
<td></td>
</tr>
<tr>
<td>Number of eligible subjects</td>
<td>Can’t tell</td>
<td></td>
</tr>
</tbody>
</table>

#### Number of allocated subjects (total and by group)

<table>
<thead>
<tr>
<th>Group</th>
<th>Total</th>
<th>Can’t tell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention #1</td>
<td>Can’t tell</td>
<td></td>
</tr>
<tr>
<td>Intervention #2</td>
<td>Can’t tell</td>
<td>Not appropriate</td>
</tr>
<tr>
<td>Intervention #3</td>
<td>Can’t tell</td>
<td>Not appropriate</td>
</tr>
<tr>
<td>Control</td>
<td>Can’t tell</td>
<td>Not appropriate</td>
</tr>
</tbody>
</table>

#### Number of drop-outs (total and by group)

<table>
<thead>
<tr>
<th>Group</th>
<th>Total</th>
<th>Can’t tell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention #1</td>
<td>Can’t tell</td>
<td></td>
</tr>
<tr>
<td>Intervention #2</td>
<td>Can’t tell</td>
<td>Not appropriate</td>
</tr>
<tr>
<td>Intervention #3</td>
<td>Can’t tell</td>
<td>Not appropriate</td>
</tr>
<tr>
<td>Control</td>
<td>Can’t tell</td>
<td>Not appropriate</td>
</tr>
</tbody>
</table>

#### Sample

<table>
<thead>
<tr>
<th>Sex (Check one box only)</th>
<th>Male</th>
<th>Female</th>
<th>Mixed</th>
<th>Can’t tell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (specify mean and range)</td>
<td>mean</td>
<td>upper</td>
<td>lower</td>
<td>Can’t tell</td>
</tr>
<tr>
<td>Ethnicity (specify)</td>
<td></td>
<td></td>
<td></td>
<td>Can’t tell</td>
</tr>
</tbody>
</table>
Residential Setting (Check one box only)
- Urban
- Rural
- Inner City
- Can't Tell
- Mix

Social-economic status (specify) ______________________
(e.g. income, employment)
- Can't Tell

**Intervention – Describe for each intervention as applicable:**

<table>
<thead>
<tr>
<th>Intervention #1</th>
<th>Intervention #2</th>
<th>Intervention #3</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Intervention descriptors: (check all that apply)**

<table>
<thead>
<tr>
<th>Community development</th>
<th>Intervention #1</th>
<th>Intervention #2</th>
<th>Intervention #3</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

| Community-based       | 0               | 0               | 0               | 0       |
| Mass media            | 0               | 0               | 0               | 0       |
| Distribution of printed educational materials (eg. Fact sheets, posters) | 0 | 0 | 0 | 0 |
| Educational session (workshops) | 0 | 0 | 0 | 0 |
| School curriculum     | 0               | 0               | 0               | 0       |
| Counseling (one to one) | 0               | 0               | 0               | 0       |
| Computer-based learning | 0               | 0               | 0               | 0       |
| Audio-visual materials (eg. Videos) | 0 | 0 | 0 | 0 |
| Support group         | 0               | 0               | 0               | 0       |
| Other (specify)       | 0               | 0               | 0               | 0       |

**Intervention duration:**

<table>
<thead>
<tr>
<th>Specify time frame</th>
<th>Intervention #1</th>
<th>Intervention #2</th>
<th>Intervention #3</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can’t tell</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
### Intervention frequency:

<table>
<thead>
<tr>
<th>Specify time frame</th>
<th>Intervention #1</th>
<th>Intervention #2</th>
<th>Intervention #3</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can't tell</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Theoretical framework: (check all that apply for each intervention and control)

<table>
<thead>
<tr>
<th></th>
<th>Intervention #1</th>
<th>Intervention #2</th>
<th>Intervention #3</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trans theoretical</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PRECEDE</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Intention and action</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Health belief model</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Social cognitive theory</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Diffusion of innovation</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Social marketing theory</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Can't tell</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other (specify)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Intervention provider: (state who (or what) delivered the intervention. check all that apply)

<table>
<thead>
<tr>
<th></th>
<th>Intervention #1</th>
<th>Intervention #2</th>
<th>Intervention #3</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional (state profession)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Research worker (member of study team)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Para professional</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lay person</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Peer</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Volunteer</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Computer system</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Community groups</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Can't tell</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other (Specify)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Internal training provided:

<table>
<thead>
<tr>
<th></th>
<th>Intervention #1</th>
<th>Intervention #2</th>
<th>Intervention #3</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes (Specify)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Can't tell</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
### Intervention setting: (check all that apply)

<table>
<thead>
<tr>
<th></th>
<th>Intervention #1</th>
<th>Intervention #2</th>
<th>Intervention #3</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Home</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Hospital</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>School</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Telephone</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Clinic</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Can’t Tell</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Other (Specify)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

### Intervention target group: (check all that apply)

<table>
<thead>
<tr>
<th></th>
<th>Intervention #1</th>
<th>Intervention #2</th>
<th>Intervention #3</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade School Student</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>High School Student</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Class</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>School</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Community</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Other (Specify)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Can’t tell</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

### Length of post intervention follow-up period (all data collection points):

<table>
<thead>
<tr>
<th></th>
<th>Intervention #1</th>
<th>Intervention #2</th>
<th>Intervention #3</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specify in weeks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can’t tell</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
## Outcome Assessment Form

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Unit</th>
<th>Outcome measured at baseline (Y/N)</th>
<th>Outcome reached statistical significance (Y/N)</th>
<th># post-intervention assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 6: Relevant Project Accounts

5-a-Day Power Plus Program


APPLES (Active Programme Promoting Lifestyle Education in School)


Australian Heart Research Institute Project


CATCH (Child and Adolescent Trial for Cardiovascular Health)


Healthy Weights Review


**CHIC (Cardiovascular Health in Children) Study 1**


**Chicago Heart Health Curriculum**


**Children’s Television Viewing Project**


**Crete Project**


GEMS (Girls Health Enrichment Multi-site Studies) Baylor


GEMS (Girls Health Enrichment Multi-site Studies) Memphis


GEMS (Girls Health Enrichment Multi-site Studies) Minnesota


GEMS (Girls Health Enrichment Multi-site Studies) Stanford


Gimme 5 High School Program


**Gimme 5 Primary School Program**


**Go for Health**


**Heart Smart Cardiovascular School Health Promotion**


**High Five School-based Nutrition Intervention Program**


Hopper Family Participation Study 1


Kansas Lean School Intervention Project


Know Your Body Program 1


**Know Your Body Program 2**


**Minnesota Heart Health Program**


**National School Lunch Program**


**North Karelia Project**


**Nutrition for Life Program**


**Nutrition in a Changing World Project**


**PATH (Physical Activity and Teenage Health) Program**


**Pathways Obesity Prevention Study**


Planet Health


Project Active Teens


Project SPARK (Sports, Play and Active Recreation for Kids)


San Diego Family Health Project


Schools for Healthy Lifestyles


Stanford Five-City Project


TEENS (Teens Eating for Energy at School)


Trois Rivieres Project


Gauvin, L. (2003). Social disparities and involvement in physical activity: shaping the policy agenda in healthy living to successfully influence population health (Rep. No. R03-02 (May 2003)). GRIS (Groupe de recherche interdisciplinaire en sante; Secteur sante publique, Faculte de medecine, Universite de Montreal.


Interventions to Improve Nutritional Intake in Children and Youth
This is a summary statement written to condense the work of the authors of a systematic review. The reference for the full review is below. The intent of this summary is to provide an overview of the findings and implications of the full review. Implications listed in the evidence table have been developed by summary statement authors for health-evidence.ca, and may reach beyond what the authors have stated in the review. For more information on individual studies included in the review, please see the review itself.


Author Contact Info: Donna Ciliska, RN, PhD; Helen Thomas, RN, MSc Effective Public Health Practice Project 2 King Street West, 3rd Floor Dundas ON L9H 6Z1 (905) 546-2424 x1578 thomash@mcmaster.ca

Issue: In a recent study, Tremblay et al (Tremblay, Katzmarzyk, & Willms, 2002) estimated that the prevalence of childhood obesity among 7-13 year olds in Canada rose from 5% to 13.5% for boys and from 5% to 11.8% for girls between 1981 and 1996. It has been estimated that over 50% of children exceed the recommended dietary intake of salt, fat, cholesterol and sugar (Lenfant, 1995). Health consequences for youth related to obesity include risks to the cardiovascular, endocrine, pulmonary, orthopedic and gastroenterological systems and to the development of healthy lifestyles and positive self-esteem and body image (Ball & McCargar, 2003). Although the causes of obesity are multiple and complex, programs directed at healthy eating and increasing physical activity or both are relevant to obesity reduction/prevention. For instance, fruit and vegetable consumption has been shown to enhance satiety and decrease hunger, contributing to reduced caloric density and reduced total caloric intake, thus playing a role in weight management (Rolls, Ello-Martin, & Tohill, 2004).

Review Content Summary: A systematic review was conducted to determine the effectiveness of interventions to improve the nutritional intake of children and youth. Studies were divided between those targeting improved nutrition in primary school students, improved nutrition in high school students, and prevention of eating disorders. The outcomes of interest were body weight or BMI, or food intake, such as calories, or
servings per day of fruit and/or vegetables or fat intake. Measures such as body dissatisfaction and drive for thinness were also included in the assessment of eating disorder interventions.

Comments on this review’s methodology: A total of 76 articles describing 57 separate studies were included. Thirty-seven of these studies were conducted in the United States, four in Australia and Canada, three in the UK, two in each of Belgium, France, and Italy, and one in each of Denmark, Norway and Greece. Three studies were published in French, and the rest were published in English. Ten studies included girls only, one boys only, and the remainder included both genders. Approximately half the studies identified ethnicity, while less than half identified socioeconomic status. Thirty-eight percent of studies were based on social cognitive or social learning theory, two studies were based on the Theory of Planned Behaviour, PRECEDE, and the Transtheoretical Model of Change, while 33% of studies did not identify a theoretical basis. Teachers implemented the intervention in 26 studies, nurses and dieticians carried out the intervention in two studies, psychologists or psychology graduate students did so in eight studies, and peer educators did in five studies. Some studies did not identify the intervenors. Ninety percent of the interventions were carried out in schools, while three were conducted in the home, two with Scout troops, one in a community centre and one in a supermarket. Twenty-two studies were randomized controlled trials. Seventy-five percent of studies used valid and reliable outcome measures. Just over half (53%) of the studies managed withdrawals and dropouts well, while 63% managed confounders well. Selection bias was not managed well in 57% of studies. All but five studies had at least one significant outcome, however, no studies reported a sample size calculation. The analysis was appropriate in 54 studies, the remaining providing insufficient information to be able to judge adequacy. Thirty-four of the 39 studies employing differing units of allocation and analysis did not perform a cluster analysis. Only one study reported using intention-to-treat analysis. Finally, 15 studies determined the proportion of participants who actually received the intervention, while 10 measured intervention consistency.

Evidence points are not weighted or ranked

<table>
<thead>
<tr>
<th>What’s the evidence?</th>
<th>Implications for practice and policy:</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; For primary school and high school students, multifaceted interventions (school curricula, mass media, parent mailings, cafeteria changes) over at least 8 to 10 weeks show the most promise for altering food intake.</td>
<td>&gt; Multifaceted interventions require considerable planning and cooperation across many levels (teachers, cafeteria workers, parents, media).</td>
</tr>
<tr>
<td>&gt; Educational messages targeted to behaviour change (as opposed to knowledge acquisition) and to specific behaviours (increase fruit intake, reduce fat intake as opposed to general nutritional changes) are more successful in changing food behaviours.</td>
<td>&gt; Educational interventions should identify and promote specific behaviour changes versus aiming at increasing knowledge of nutrition.</td>
</tr>
</tbody>
</table>
> For prevention of eating disorders, curriculum, as currently available in content and intensity, does not significantly impact on outcomes other than knowledge.

> Single session interventions do not change food-related behavior. Interventions of greater intensity need to be developed and tested.

> Several studies found statistically significant results, however the clinical significance of some of these results is questionable (e.g.) an increase of 0.3 serving per day

> Researchers and clinicians need to attend to the level of clinical significance along with the presentation of statistical significance.

**General Implications:**
> Children’s food behavior can be altered by targeted messages of sufficient intensity.
> The conduct of research in eating disorders could be strengthened through ensuring adequate sample sizes, blinding of outcome assessors, and avoiding bias in sample selection to ensure that participants represent the target population.
> The next generation of nutrition studies should begin to assess cost-effectiveness analyses.

**Cost Benefit or Cost-Effectiveness Information:** Not included in review.

**References Used to Outline Issue:**


The format of this summary statement has been adopted from health-evidence.ca (www.health-evidence.ca).
Interventions to Improve Nutritional Intake in Children and Youth

Introduction

This review includes interventions targeted to nutrition changes. It has been estimated that over 50% of children exceed the recommended dietary intake of salt, fat, cholesterol and sugar (Lenfant, 1995). Fruit and vegetable consumption has enhanced satiety and decreased hunger, contributing to reduced caloric density and reduced total caloric intake, thus playing a role in weight management (Rolls, Ello-Martin, & Tohill, 2004). Epstein et al. (Epstein et al., 2001) showed that an intervention focused on increasing fruit and vegetables, as opposed to reducing high-fat/high sugar intake, associated increased fruit and vegetable intake and prevented increases in the percentage of overweight in high-risk children.

Nutritional interventions may involve multiple strategies, such as classroom instruction, supermarket experience and cafeteria interventions, but all are aimed at change in nutrient intake. As in other sections of this report, the purpose of the interventions is primary prevention. This section also includes a review of community-based primary prevention of eating disorders, as these interventions are also designed for the attainment and maintenance of healthy weights.

This review answers the question:

What is the effectiveness of interventions to improve nutritional intake in children and youth?

Methods

Please refer to the Methods section in the main Introduction, page 16.

Results

Description of Relevant Studies

Seventy-six articles were included regarding 57 distinct relevant studies. Three additional abstracts were received but there was insufficient information to conduct the quality assessment or data extraction. Thirty-seven studies were conducted in the United States (66%), four in Australia and Canada, three in the United Kingdom, two in each of Belgium, France and Italy, and one each in Denmark, Norway and Greece.

Eighty per cent of the studies had both male and female participants; one study had boys only and ten had girls only. Fifty-four studies were published in English and three in French; 77% of the studies were published since 1990.
About half of the studies identified the ethnicity or ethnic mix of the study samples. Less than half the studies clearly identified the socio-economic status of the participants. In terms of a theoretical basis for interventions, 38% identified social cognitive or social learning theory, two studies identified the Theory of Planned Behaviour, PRECEDE, and the Transtheoretical Model of Change, 33% of studies did not identify any theoretical basis.

Twenty-six studies (46%) used teachers to carry out the intervention. In two studies, nurses and dietitians were the interveners, in eight studies, psychologists or psychology graduate students were used, and in five studies peer educators led the intervention. The remaining studies did not identify the qualifications of the persons conducting the intervention.

Schools were the most common site of interventions (90%), followed by three studies in the home, two with Scout troops, one in a community centre and one in a supermarket.

Quality Assessment of Relevant Studies

The major criteria for assessing quality included selection bias, allocation bias, confounding, blinding of outcome assessors, reliability and validity of data collection methods, and level of withdrawals and dropouts. The quality of included studies was highly variable. The quality assessment of all studies is reported in Table 1.

Twenty-two studies (38%) were randomized trials. Most studies (75%) used valid and reliable measures for the outcomes of interest in this review. Blinding of outcome assessors was rated as not applicable when the outcome was measuring children’s self-report; however, only two studies kept the outcome assessors blind to group allocation when outcomes were measured by others. Withdrawals and dropouts were mostly well managed: 53% of the studies maintained 80% or more of the participants, 13% of studies maintained 60-79% and 34% of studies maintained less than 59% of participants. Over half of the studies (63%) managed confounders well; that is, they considered all important confounders and found no differences between groups at pretest, or managed the differences appropriately in the analysis. However, over half of the studies (57%) did not adequately manage the potential for selection bias, either having less than 80% agreement to participate in the study or participants who did not seem to be very representative of the target population. No studies reported a sample size calculation. All but five studies found statistical significance on at least one outcome measure. Three studies gave inadequate description of analysis to be able to judge the adequacy, the other 54 were judged to have appropriate analyses. For 18 studies, the unit of allocation was the same as the unit analysis. However for the remaining 39 studies, the unit of allocation was usually a school or class unit, and unit of analysis was individual student participants. No cluster analysis or other adjustment was made to correct this unit of analysis error in 34 of the 39 studies. Only one study identified that they analyzed by intention-to-treat. Fifteen studies measured the proportion of participants who actually received the intervention and 10 assessed intervention consistency.
Findings from Relevant Studies

Only the strongest studies are considered in the text. The reader is referred to Table 2 for other studies, but advised to use caution regarding the findings of studies which are not in bold, as the methodology allowed a number of potential threats to internal and external validity. Comments on the stronger studies are grouped below by age group of the target populations (primary school and secondary school age) for general nutrition interventions, then for prevention of eating disorders.

Improved Nutrition: Interventions for Primary School Students

The interventions aimed at primary school students are included in this section. Thirteen studies were assessed to be of high quality. They include those targeting outcomes of fruits and vegetables (5-a-day Power Plus Program: Project Account, 2000; TEENS (Teens Eating for Energy at School): Project Account, 2002; High Five: Project Account, 2002; Gimme 5 Primary School: Project Account, 2000; Auld, Romaniello, Heimendinger, Hambidge, & Hambidge, 1998; Foerster et al., 1998; Domel et al., 1993; Cullen, Bartholomew, & Parcel, 1997; Baranowski et al., 2002). fat intake (Frenn, Malin, & Bansal, 2003; Stewart, Seemans, McFarland, & Weinhofer, 1997; Hearty Heart and Friends: Project Account, 1989), or both (Perry, Mullis, & Maile, 1985).

Seven of the higher quality studies were focused on increasing fruit and vegetable servings to five per day. One of these, Gimme 5 Primary School, involved regular classroom teachers, who were given additional training, delivering three sessions per week for six weeks, each year for two years (Gimme 5 Primary School: Project Account, 2000). Class instruction time was accompanied by video and newsletters home to the parents, and homework assignments for the students. The result was a statistically, but not clinically, significant intervention effect on combined fruit and vegetable intake of additional 0.2 servings per day (Gimme 5 Primary School: Project Account, 2000). A very similar intervention was tested with students in grades 4 and 5. Again, there was a statistically significant increase of 0.3 servings/day in the intervention group over the control group, but it is difficult to argue for the clinical significance of this difference (Domel et al., 1993).

The High 5 trial added cafeteria changes and parent education to an intervention analogous to Gimme 5 (High Five: Project Account, 2002). There was a statistically significant impact on children’s fruit and vegetable intake (3.96 servings/day in the intervention group versus 2.28 servings/day in the control group, measured by 24-hour recall) which was maintained at two-year follow-up (High Five: Project Account, 2002). Similarly, the 5-A-Day Power Plus intervention of 16 40-minute sessions, with education package to parents, point-of-purchase promotion of fruit and vegetables and industry coalition, resulted in an intervention effect of 0.5 more fruit servings for lunch, 0.6 increased fruit servings by 24-hour recall, but no greater daily total fruit and vegetable intake measured by 24-hour recall (5-a-day Power Plus Program: Project Account, 2000). Another test of a very similar intervention, the California 5-A-Day Power Play, included close to 4000 students and compared three different interventions: school only, schools and community interventions, and community-only control (Foerster et al., 1998). Both interventions resulted in a significantly higher intake of fruits and vegetables/day than the community-only controls, by 0.4 servings per day in the school
plus community interventions, 0.2 servings increase in the school only intervention (Foerster et al., 1998). Again, these findings are of questionable clinical significance.

A 24-week classroom intervention for grades 3 to 5, taught by a special resource teacher, with six additional parent-taught lunchtime sessions, newsletters to parents and a family “fun night”, was assessed at year four of implementation (Auld et al., 1998). It had an intervention effect of increasing servings of fruit and vegetables eaten at lunchtime by 0.4 over control and 1.2 servings more total intake in 24-hour recall (Auld et al., 1998).

Lastly, another classroom intervention was targeted to grade 7 and included 10 classroom sessions, cafeteria promotion of fruits and vegetables, and home activities included in parent packs (TEENS (Teens Eating for Energy at School): Project Account, 2002). Researchers randomized classes into classroom interventions, classroom plus environmental, classroom plus environment plus peer leaders or no intervention. Environmental interventions create opportunities or remove barriers for groups of people to make healthy choices rather than individuals. Such interventions included promoting fruits and vegetables in the cafeteria, increasing availability of low-fat food and taste testing. The study found that the maximum intensity intervention had an effect on increasing mean daily fruit and vegetable consumption 0.85 servings more per day than the control group. The environment-only group experienced a reduction in fruit and vegetable consumption (TEENS (Teens Eating for Energy at School): Project Account, 2002).

Two interventions focused on Scout troops as the target population (Cullen et al., 1997; Baranowski et al., 2002). In the Girl Scout study, (Cullen et al., 1997) there were a total of four weekly sessions with behavioural interventions involving goal setting, identifying a “buddy”, preparation of recipes with taste-testing sessions, and information packages to parents. Fruit and vegetable consumption as measured by 24-hour recall found an intervention effect difference from three servings to 3.39 servings/day; a difference that was not maintained at three-month post-test (Cullen et al., 1997). Baranowski and colleagues (Baranowski et al., 2002) randomized Boy Scout troops with a more intensive intervention of eight meetings and seven home activities leading to a “badge”. The intervention was also a behavioural intervention with goal-setting, self-monitoring, problem-solving, rewards, and tasting of snacks and recipes. There was no statistically significant difference in fruit and vegetable consumption.

Three studies focused on reducing fat and salt and increasing complex carbohydrates (Stewart et al., 1997; Hearty Heart and Friends: Project Account, 1989; Frenn et al., 2003). Stewart utilized health educators and dietitians, in class, to teach four one-hour classes every six to eight weeks, which focused on decreasing dietary fat, cholesterol, sodium, and sugar, and increasing complex carbohydrates and fibre (Stewart et al., 1997). There was a statistically significant effect of the intervention in reducing high fat foods (Stewart et al., 1997).

Perry and colleagues conducted two studies regarding an intervention called Hearty Heart (Hearty Heart and Friends: Project Account, 1989; Perry et al., 1985). In Hearty Heart and Friends, grade 3 and 4 students were taught through nine 10-minute slide-tape shows using cartoon role models (Perry et al., 1985). Intervention students kept daily food and physical activity records, completed homework assignments and had an aerobic exercise routine. They were involved in weekly snack preparation, and parents
assisted these activities in the classroom. Twenty-four hour recall found a significant intervention effect on reducing added salt and fried food intake and increased fruit and vegetable consumption. This study was followed by a larger study of 2250 students in grade 3 who were randomized to one of four groups, the school-based Hearty Heart as just described, a home-based intervention which offered students and parents home correspondence activities, both in sequence or no-treatment control. The home based program showed a significant reduction in saturated fat, which was not maintained at one year follow-up. There were no other significant differences (Hearty Heart and Friends: Project Account, 1989).

Finally, one study combined a focus on reducing fat intake and increasing physical activity (Frenn et al., 2003). Only four classroom sessions of 45 minutes each were done, yet they showed a significant reduction in percent fat and higher duration of exercise in the intervention group compared with controls. Actual magnitude of change was difficult to discern from the report (Frenn et al., 2003).

**Improved Nutrition: Interventions for High School Students**

There were four high-quality studies of interventions for nutrition in secondary schools (Hassapidou, Fotiadou, & Maglara, 1997; De Bourdeaudhuji, Brug, Vandelanotte, & Van Oost, 2002; Gimme 5 High School: Project Account, 2002; De Bourdeaudhuji & Brug, 2000). Two interventions targeted reduced fat intake (De Bourdeaudhuji et al., 2002; De Bourdeaudhuji et al., 2000) and two targeted fruit and vegetable intake (Hassapidou et al., 1997; Gimme 5 High School: Project Account, 2002). The two interventions addressing fat intake were studying the effectiveness of mailed tailored interventions that went to adolescents and their families, which addressed fat intake, attitudes and self-efficacy expectations. The control group had a mailing of general nutrition education. Four weeks after the mailed intervention, there was no intervention effect on fat intake in the adolescents but their mothers had a significant reduction in per cent energy from fat (De Bourdeaudhuji et al., 2000). In a subsequent study by the same authors, three interventions of tailored messages were compared: families, adolescents only, parents only (De Bourdeaudhuji et al., 2002). Again, four weeks later, there was no intervention effect, except in a sub-analysis, those with high baseline fat intake reduced their percent energy from fat (De Bourdeaudhuji et al., 2002).

The Gimme 5 intervention was the most intensive, targeting high school students (Gimme 5 High School: Project Account, 2002). This took place over three years and involved mass media campaigns in the schools, curriculum of five workshops of 55 minutes each regarding knowledge, attitudes and skills; increased fruit and vegetable availability in the cafeterias, and mailings to parents with recipes, calendars, tips and information brochures. It resulted in a significant increase in fruit and vegetable intake at the end of three years (2.63 servings/day to 3 servings/day), with subsequent finding, one year later, of no difference as the control group increased their consumption as well. The latter increases were attributed to the 5-A-Day campaign that was also going on in the community (Gimme 5 High School: Project Account, 2002).

Further, one pilot study was conducted for high school students in Greece, targeting fruit and vegetable intake (Hassapidou et al., 1997). Ten classroom sessions of 20 minutes were taught by a dietician, then additional time was allotted for students to use workbooks, and pamphlets for both students and families were sent home. No significant effects were found on intake, but the study was underpowered (Hassapidou et al., 1997).
Prevention of Eating Disorders

There were three high-quality studies of prevention of eating disorders in primary school children (O’Dea & Abraham, 2000; Withers, Twigg, Wertheim, & Paxton, 2002; Steiner-Adair et al., 2002). All were school-based; two used curriculum of eight to nine sessions (45-90 minutes) (O’Dea et al., 2000; Steiner-Adair et al., 2002) while one was a one-time only 22-minute educational videotape (Withers et al., 2002). Content of the three interventions was similar, aimed at the media and other socio-cultural influences on body satisfaction, determinants of size and shape, changes of puberty. All considered similar outcomes. The videotape study by Withers and colleagues (Withers et al., 2002) found that an intervention effect on drive for thinness and intention to diet was limited to immediate post-test and did not last until one month follow-up; only knowledge increases lasted to one month. O’Dea and Abraham (O’Dea et al., 2000) found immediate post-intervention effect of the intervention of body dissatisfaction, drive for thinness, and reduced importance of physical appearance and of social acceptance. At 12-month follow-up, only the reduced importance of social acceptance remained significant. Steiner-Adair, with a similar intensity of intervention, found only significant knowledge differences at post-test and six-month follow-up; with no intervention effect on self-esteem, body-esteem or other attitudes toward appearance (Steiner-Adair et al., 2002).

Two Canadian studies by the same authors utilized a 10-session, peer-support process, for girls, grades 7 and 8, facilitated by public health nurses (McVey, Lieberman, Voorberg, Wardrope, & Blackmore, 2003a; McVey et al., 2003b). Both were quasi-randomized and utilized schools for the intervention, with matching of schools on demographic characteristics for controls. There was no significant impact on self-esteem; however, there was an improvement in body esteem and decreases in dieting in the intervention group versus the control group (McVey et al., 2003b). The replication of this study found no intervention effects (McVey et al., 2003a). The authors postulate a difference in the replication study was that the participants had higher disordered eating scores at baseline than the participants in the original study (McVey et al., 2003a).

Keeping with the primary school population, the studies of lesser quality found significant intervention effects on knowledge (Kater, Rohwer, & Londre, 2002; Smolak, Levine, & Schermer, 1998b), improved body esteem in boys (Smolak, Levine, & Schermer, 1998a), and reduction in weight concerns (Wade, Davidson, & O’Dea, 2003). Ayotte and colleagues (Ayotte & Laurendeau, 1998) reported on a self-esteem program that consisted of training for teachers, food service workers, parents and children in a high-income urban Montreal population. They found a significant improvement in self-concept related to physical appearance in the intervention children (Ayotte et al., 1998).

Four studies of prevention of eating disorders in high school warrant discussion based on their quality ratings (Santonastaso et al., 1999; Rocco, Ciano, & Balestrieri, 2001; Stewart, Carter, Drinkwater, Hainsworth, & Fairburn, 2001; Paxton, 1993). All involved classroom curriculum of differing intensities of about three hours (Stewart et al., 2001), eight hours (Santonastaso et al., 1999; Paxton, 1993) to 18 hours (Rocco et al., 2001). The focus was primarily on normal development associated with puberty, dangers of dieting, media influence on weight in women, although two interventions also specifically discussed eating disorders (Santonastaso et al., 1999; Stewart et al., 2001). The interventions did not have a significant effect on eating attitudes, body dissatisfaction, or drive for thinness (Rocco et al., 2001; Stewart et al., 2001; Paxton, 1993). One study
found short term (six month) reduction in restraint scores in the intervention group compared with the controls but these were not clinically important differences (Stewart et al., 2001). In one Italian study, the results were analyzed by high versus low risk (baseline score cut-off of 30 on the Eating Attitudes Test) (Santonastaso et al., 1999). There were no effects of the intervention on high-risk subjects; there was a significant intervention effect of reducing body dissatisfaction for low-risk participants.

Discussion and Implications

Improved Nutrition

While there is some evidence that a variety of interventions with different age groups can result in improved nutrition behaviours, the most consistent effect is on knowledge improvement. The outcome of interest in this review, actual intake of food, was more resistant to change, and if it did, the magnitude of change was small. The most successful interventions were of an intensity of at least 10 sessions, and were multi-pronged in involving cafeteria choices, mass media campaigns and parental involvement.

In the most rigorous studies with high school students, classroom interventions and tailored mailings had no effect on adolescent food intake. Only the most intensive intervention of five workshops per year over three years had a significant impact, and it was large, increasing fruit and vegetable servings by over 2.5 servings per day (Gimme 5 High School: Project Account, 2002).

Prevention of Eating Disorders

The studies aimed at prevention of eating disorders did not usually use a diagnostic interview for eating disorders, but used outcome measures that have been shown to be associated with the development of eating disorders such as body dissatisfaction, self-esteem, eating attitudes, drive for thinness and dieting behaviours.

Based on the best evidence, prevention programs as they have been currently tested, have not had a meaningful impact on changing body dissatisfaction, eating attitudes, drive for thinness, or restraint. Only knowledge has been statistically impacted, yet the connection between knowledge and change in attitudes and behaviours in relation to eating and body attitudes has not been made.

Implications for Practice and Policy

- For school and high school students, multi-faceted interventions (school curricula, mass media, parent mailings, cafeteria changes) over at least 8 to 10 weeks, show the most promise for altering food intake.

- Educational messages targeted to behaviour change (as opposed to knowledge acquisition) and to specific behaviours (increase fruit intake, reduce fat intake as opposed to general nutritional changes) are more successful in changing food behaviours.
Multifaceted interventions require considerable planning and co-operation across many levels (teachers, cafeteria workers, parents, media).

For prevention of eating disorders, curriculum, as currently available in content and intensity, does not significantly impact on outcomes other than knowledge. Interventions of greater intensity need to be developed and tested.

**Implications for Research**

- Researchers need to attend to the level of clinical significance along with the presentation of statistical significance.
- The conduct of research in eating disorders could be strengthened through ensuring adequate sample sizes, blinding of outcome assessors, avoiding bias in sample selection and ensuring that participants represent the target population.
- The next generation of nutrition studies should begin to assess cost-effectiveness analyses.
- Booster sessions need to be tested to find out if they can enhance the effect of the intervention, as well as improve follow-up.
- Programs geared to sub-populations need to be evaluated.

**Conclusions**

This review included 57 relevant studies, of which 38% were RCTs. The interventions focused on increasing fruit and vegetable intake, decreasing fat intake or both.

Elementary students were the focus of 13 studies with high methodological quality. The interventions included school-based curricula, both school and community strategies and community strategies alone. Although some studies reported statistically significant results, the modest changes are unlikely to be clinically significant.

There were four high quality studies with high school students. Only one that included media campaigns within the school, curriculum, cafeteria changes and mailings to parents with specific guidelines regarding diet had a significant result.

Eating disorder prevention studies were carried out with both elementary and high school students. None of these resulted in positive behaviour changes.

In spite of the number of school and community based programs to improve nutrition among school aged children and youth, their results are modest and of questionable clinical significance. The program that involved both the school and the community was intense and lasted for three years appears to have made a significant difference. This needs to be replicated to assure that it works and then adopted.
Table 1: Quality Assessment Rating of Relevant Studies
Note: Studies listed by the name of the intervention and then by author where applicable

<table>
<thead>
<tr>
<th>Author (date) Project</th>
<th>Selection Bias</th>
<th>Allocation Bias</th>
<th>Confounders</th>
<th>Blinding</th>
<th>Data Collection</th>
<th>Withdrawals and Drop-outs</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-A-Day Achievement Badge Baranowski et al. (2002)</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>Strong</td>
</tr>
<tr>
<td>5-A-Day Power Plus</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>1/1</td>
<td>Strong</td>
</tr>
<tr>
<td>All’s Well That Eats Well Perry et al. (2002)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>Strong</td>
</tr>
<tr>
<td>Borys et al. (2000)</td>
<td>Strong</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>0/7</td>
<td>Moderate</td>
</tr>
<tr>
<td>Burnett et al. (1989)</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>1/2</td>
<td>Weak</td>
</tr>
<tr>
<td>California 5-A-Day Power Play! Foerster et al. (1998)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>Moderate</td>
</tr>
<tr>
<td>Coates et al. (1985) Great Sensations</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>0/1</td>
<td>Weak</td>
</tr>
<tr>
<td>Cullen et al. (1997)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>Weak</td>
</tr>
<tr>
<td>De Broudeaudhiuj et al. (2000)</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>Strong</td>
</tr>
<tr>
<td>De Broudeaudhiuj et al. (2002)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>Moderate</td>
</tr>
<tr>
<td>Demas (1998)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>1/1</td>
<td>Weak</td>
</tr>
<tr>
<td>Ellison et al. (1989)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>1/1</td>
<td>Weak</td>
</tr>
<tr>
<td>Europe Against Cancer Hassapidou et al. (1997)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>3/3</td>
<td>Strong</td>
</tr>
<tr>
<td>Fitzgibbon et al. (1995)</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>1/1</td>
<td>Strong</td>
</tr>
<tr>
<td>Frenn et al. (2003)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong/Not Applicable</td>
<td>2/2</td>
<td>Weak</td>
</tr>
<tr>
<td>Gimme 5 Domel et al. (1993)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>Strong</td>
</tr>
<tr>
<td>Gimme 5 – Primary School</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>Weak</td>
</tr>
<tr>
<td>Gimme 5 –High School</td>
<td>Strong</td>
<td>Strong</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>0/1</td>
<td>Strong</td>
</tr>
<tr>
<td>Author (date) Project</td>
<td>Selection Bias</td>
<td>Allocation Bias</td>
<td>Confounders</td>
<td>Blinding</td>
<td>Data Collection Valid</td>
<td>Reliable</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------</td>
<td>----------------</td>
<td>-------------</td>
<td>----------</td>
<td>-----------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Hearty Heart and Friends Perry et al. (1985)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>1/1</td>
</tr>
<tr>
<td>Hearty Heart and Friends</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>1/1</td>
</tr>
<tr>
<td>High 5</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>2/2</td>
<td>2/2</td>
</tr>
<tr>
<td>Integrated Nutrition Program Auld et al. (1998)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>2/2</td>
<td>2/2</td>
</tr>
<tr>
<td>Integrated Nutrition Program Auld et al. (1999)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>1/2</td>
<td>1/2</td>
</tr>
<tr>
<td>King et al. (1988)</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Strong/NA</td>
<td>1/2</td>
<td>1/2</td>
</tr>
<tr>
<td>Klepp et al. (1993)</td>
<td>Strong</td>
<td>Moderate</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>0/1</td>
<td>0/1</td>
</tr>
<tr>
<td>Know Your Body Stewart et al. (1997)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>1/2</td>
<td>1/2</td>
</tr>
<tr>
<td>La Porte et al. (1989)</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>0/1</td>
<td>0/1</td>
</tr>
<tr>
<td>Learning by Teaching Hölund (1989, 1990a, 1990b)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>1/1</td>
<td>1/1</td>
</tr>
<tr>
<td>Lewis et al. (1988)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>1/1</td>
</tr>
<tr>
<td>Michel et al. (1994)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>0/3</td>
<td>0/3</td>
</tr>
<tr>
<td>National School Lunch Program</td>
<td>Moderate</td>
<td>Weak</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>1/1</td>
</tr>
<tr>
<td>Nutrition Education and Training (NET) Gillespie (1984)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak (gr. 3)/Not Applicable(gr. 5-6)</td>
<td>0/1</td>
<td>0/1</td>
</tr>
<tr>
<td>Nutrition Education at Primary School (NEAPS) Friel et al. (1999)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>1/2</td>
<td>1/2</td>
</tr>
<tr>
<td>Nutrition for a Lifetime System Wagner et al. (1992)</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Weak</td>
<td>0/1</td>
<td>0/1</td>
</tr>
<tr>
<td>Nutrition for Life</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>0/1</td>
<td>1/1</td>
</tr>
<tr>
<td>Nutrition in a Changing World Byrd-Bredbenner et al. (1988)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>0/1</td>
<td>0/1</td>
</tr>
<tr>
<td>Author (date) Project</td>
<td>Selection Bias</td>
<td>Allocation Bias</td>
<td>Confounders</td>
<td>Blinding</td>
<td>Data Collection Valid</td>
<td>Reliable</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------</td>
<td>----------------</td>
<td>-------------</td>
<td>----------</td>
<td>-----------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Nutrition in a Changing World</td>
<td>Weak</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>1/1</td>
<td>1/1</td>
</tr>
<tr>
<td>TEENS</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>1/1</td>
</tr>
<tr>
<td>Turnin et al. (2001)</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Weak</td>
<td>1/1</td>
<td>0/1</td>
</tr>
<tr>
<td>Wardle et al. (2003)</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>1/1</td>
<td>1/1</td>
</tr>
<tr>
<td>Washington Heights-Inwood Healthy Heart Program</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>2/2</td>
<td>2/2</td>
</tr>
<tr>
<td>Whitaker et al. (1994)</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Weak</td>
<td>1/1</td>
<td>1/1</td>
</tr>
<tr>
<td>Eating Disorder Prevention</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>1/5</td>
<td>1/5</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>----------</td>
<td>----------</td>
<td>--------</td>
<td>--------</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Ayotte et al. (1998)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body Image and Eating Behaviour Intervention</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paxton (1993)</td>
<td>Strong</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eating Smart, Eating for Me (grade 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smolak et al. (1998b)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>2/2</td>
<td>2/2</td>
</tr>
<tr>
<td>Eating Smart, Eating for Me (grade 5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smolak et al. (1998a)</td>
<td>Strong</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>2/2</td>
<td>2/2</td>
</tr>
<tr>
<td>Everybody's Different</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>2/3</td>
<td>2/3</td>
</tr>
<tr>
<td>O'Dea (2000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full of Ourselves: Advancing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girl Power, Health and Leadership</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girl Talk McVey et al. (2003a)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>3/3</td>
<td>3/3</td>
</tr>
<tr>
<td>Girl Talk McVey et al. (2003b)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>3/3</td>
<td>3/3</td>
</tr>
<tr>
<td>Healthy Body Image Kater et al. (2002)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>1/1</td>
</tr>
<tr>
<td>Rocco (2001)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>2/2</td>
<td>2/2</td>
</tr>
<tr>
<td>Santonastaso et al. (1999)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>3/3</td>
<td>3/3</td>
</tr>
<tr>
<td>Wade et al. (2003)</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>4/5</td>
<td>4/5</td>
</tr>
<tr>
<td>Withers (2002)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>3/6</td>
<td>4/6</td>
</tr>
</tbody>
</table>
Table 2: Results of Relevant Studies

Note: Studies of better quality indicated by bold font; Studies listed by name of intervention and then by author where applicable

<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-A-Day Power Plus Perry, Bishop et al. (1998); Story (2000) United States</td>
<td>• Randomized trial • 20 schools; 536 grade 4 students</td>
<td>Intervention: School Curriculum • 16-40 min classroom sessions (2/week X 8 weeks) • Snack preparation and taste-testing • Comic books about nutrition • Team competitions • Education package to parents; 5 packages sent at intervals; Parents signed they received them • Snack packs Food Service • Point-of-purchase promotion of fruits and vegetables • Increased variety and attractiveness of fruits and vegetables • Provided 2 hour training of food service staff Industry • Coalition of producers • 30 minute presentation to classes • Additional educational material Control: • Usual health curriculum Theory: • Social Learning Theory</td>
<td>• 1 year after intervention: • 24 hour recall: no significant difference in total fruit and vegetable intake; saturated fats; • Difference between groups in fruit servings/day (0.62 servings) (p&lt;.02); in total fat (-1.81) (p&lt;.02) • Lunch intake 1.53 servings of fruits and vegetables/day for intervention group vs. 1.06 for control group (p&lt;.001) and increased consumption of fruits (p&lt;.001)</td>
<td>• Intervention increased fruit intake but not vegetables or total intake of fruits and vegetables • Significant intervention effect on asking for fruits and vegetables, and knowledge • No effect on preference or on family consumption</td>
</tr>
<tr>
<td>Author (date)</td>
<td>Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------</td>
<td>--------------------------</td>
<td>------------------</td>
<td>-----------------------</td>
</tr>
</tbody>
</table>
| 5-A-Day Achievement Badge for Boy Scouts Baranowski et al. (2002) United States | • Randomized trial  
• 14 Boy Scout Troops (186 Scouts)  
• 6 urban  
• 8 church-based | • Designed to increase fruit, juice and vegetable intake  
• 8 troop meetings, and 7 home badge activities;  
• Comic book  
• “Tasting” of snacks and recipes  
• Self-control  
• Goal-setting  
• Self-monitoring  
• Problem-solving  
• Rewards  
Theory:  
• Social Cognitive Theory | • No statistically significant differences in consumption | • Pilot study, sample size small |
| All’s Well That Eat’s Well Perry et al. (2002) United States | • 2 randomly assigned sequential intervention-control groups, where post-test of first group was compared with the pretest of 2nd group  
• 20 schools with 4,093 students, grades 1 to 6 | • 45 minute professional theatre production aimed at:  
• increasing fruit and vegetable consumption  
• increased knowledge, self-efficacy, perceived benefits and barriers, motivation to change  
• benefits of eating healthy diet  
• reinforced with classroom messages and home assignments  
• materials to classroom teachers to use after play; take-home materials for parents  
Theory:  
• Social Cognitive Theory | • Intervention effect on food choices for grades 1 to 3 (mean difference 1.65) and for grades 4 to 6 (mean difference 1.94) (p<.001) | • Schools agreed to participate only if they received the theatre production  
• Intervention effect on knowledge scales (p<.05) |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| Borys et al. (2000) France    | • Quasi-experimental    | • School-based nutrition education program (“Fleurbaix Laventie Ville Sante Study”)  
• Classes taught for four years  
Theory:  
• Can’t tell | Only reported results were:  
• Family butter consumption (less than 125 g/week/family) 13% in 1992 and 27.8% in 1997 with intervention families  
• In control families butter consumption also dropped i.e. 2 times less than Intervention group  
• Heavy butter eaters (families) had decrease as well: 50% reduction in intervention vs. 9% in control  
• BMI (adult females) 23 (p<.007) for intervention vs. 24.1 with control female adults when controlled for smoking  
• Total kcals/day consumed by girls: 1768 kcals (p=.03) intervention vs. 1888 kcals control group | • Nutrition knowledge not reported for children and their families although mentioned in abstract  
• Results only reported after 4 year intervention  
• High participation rate (children 79%; parents 95%)  
• Follow up started in 1999 (10 year follow up planned) |
| Burnett et al. (1989) United States | • Randomized trial  
• High school students:  
• 45 students in computer intervention  
• 17 students in health tips intervention  
• 15 students in assessment-only control | Intervention:  
• Computer-assisted behavioural counselling  
• Baseline assessment, then generation of individualized feedback letters with specific health tips associated with their feedback (3 different occasions)  
• After baseline survey, complete package of 14 health tips distributed to participants  
Control:  
• Assessment only  
Theory:  
• Can’t tell | 12 week post-test:  
• Significant intervention effect (computer-assisted) on reduction in saturated fat and cholesterol consumption (p<.05)  
• Increase in fibre and complex carbohydrates (p<.006) | • Overweight participants in computer-assisted group lost a mean of 2.95 kg compared with weight loss of 0.57 kg in assessment-only group and mean weight gain of 1.25 kg for those in health tips condition; not a statistically significant difference (p=.071) |
<table>
<thead>
<tr>
<th>Author (date)</th>
<th>Country</th>
<th>Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>California 5-a-Day Power Play! Foerster et al. (1998) United States</td>
<td>• Quasi-experimental • 49 schools, 151 classrooms; 3,966 students in grades 4 and 5 • 1st community conducted interventions in the schools • 2nd community conducted activities in the schools and community channels • 3rd community served as control</td>
<td>• School curriculum taught by regular classroom teachers; at least 10 out of 14 core activities • Community activities included development of a coalition, supermarket, farmer's markets, media, youth organizations, school recipes; radio and local TV stations promoted advertisements</td>
<td>• Both intervention groups showed significant increase in fruit and vegetable intake/day over control group (p&lt;.05) • 0.4 serving increase in school and community intervention • 0.2 serving increase in school only intervention • 0.3 serving decrease in control group</td>
<td>• Results may not be clinically meaningful</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| Cullen et al. (1997) United States | • Randomized trial • 22 Girl Scout troops • 259 girls (grades 4 and 5) | Intervention: • 1 session/week X 4 weeks • Buddy • Self-monitoring • Goal setting • Problem-solving • Eat 5 badge • Preparation and taste-testing • Info package to parents Control: • No intervention | • 1 week post test: increased 24 hour recall fruit and vegetable consumption in intervention group (p&lt;.01) • Not maintained at 3 month posttest | • 19% dropped out at 1 week • 38% dropped out at 3 month follow-up • Significant intervention effects for fruit and vegetable knowledge and preferences |</p>
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| De Broudeaudhiuj et al. (2000) Belgium | • Randomized trial  
• Families (both parents, two adolescents)  
• 18 experimental families (n=72)  
• 17 control families (n=68) | Tailored Intervention:  
• Letters to home, tailored to fat intake, attitudes and self-efficacy expectations  
Control:  
• General nutrition education newsletters mailed to them personally  
Theory:  
• Social Learning Theory  
• Theory of Planned Behaviour | • 4 weeks after mailed intervention only mothers benefited more from tailored intervention (p<.05), with reduction in total % energy from fat | • Fathers and adolescents for both interventions had reduced fat scores |
| De Broudeaudhiuj et al. (2002) Belgium | • Quasi-experimental  
• 52 classes of adolescents 15 to 18 years  
• 3 groups:  
• 1 group recruited families (44 adolescents)  
• 1 group adolescents only (n=50)  
• 1 group for parents only (n=40) | Tailored Intervention:  
• Letters to home tailored to fat intake, attitudes and self-efficacy expectations  
Control:  
• General nutrition education newsletters mailed to them personally  
Theory:  
• Social Learning Theory  
• Theory of Planned Behaviour | • 4 weeks after mailed intervention no difference in fat intake across conditions | • Tailored fat feedback resulted in significant decrease in % energy from fat in respondents with high fat intake |
| Demas (1998) United States | • Quasi-experimental  
• 560 students from 1 elementary school; half as intervention, half as controls | Intervention:  
• Classroom experience with low-fat foods  
• Introduced every 2 weeks over 9 months  
Control:  
• No exposure to new foods  
Theory:  
• Can’t tell | • Lunch-time consumption of target foods increased in the intervention group (3-20 times for specific foods than the control group) | • Report states effect on food choices was statistically significant, but actual p value or CIs not given |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ellison et al. (1989) United States</td>
<td>• Quasi-experimental • Food services at 2 boarding schools</td>
<td>Environmental intervention: • Planning sessions and education to food services personnel; review and revision of menus with nutritionist; product substitution Theory: • Can’t tell</td>
<td>• 20% less saturated fat intake increase in polyunsaturated/ saturated fat ratio from 0.46 to 0.84 (Note: No level of statistical significance given with these results)</td>
<td>• 20% reduction in added salt (p&lt;.001) • Intervention effect on blood pressure: 1.7 mmHg for systolic; 95%CI -0.6 to -2.9 1.5 for diastolic; 95% CI -0.6 to -2.5</td>
</tr>
<tr>
<td>Fitzgibbon et al. (1995) United States</td>
<td>• Randomized trial • 24 Low income, African-American mother/daughter dyads • Mothers’ mean age=31 • Daughters’ mean age=11 (8-12 years)</td>
<td>6 week intervention aimed at obesity prevention based on “Know your Body”: • problem-solving • decision-making • goal-setting • how to read food labels • tastings • menu planning with low fat foods • how to lower fat in choices at fast food restaurants Theory: • Social Learning</td>
<td>No significant intervention effect on daily caloric, fat gram or fat% intake (24 hour recall) or on nutrition knowledge or attitudes</td>
<td>Daughters in group normal weight; 67% of mothers obese Participants recruited from a neighbourhood tutoring program</td>
</tr>
<tr>
<td>Frenn et al. (2003) United States</td>
<td>• Quasi-experimental • Urban middle school • Low income, culturally diverse • Intervention group (n=60) • Control group (n=57); usual classroom education</td>
<td>Four classroom interventions(45 min) to reduce fat in diet and increase physical activity. • Taught by nurses Theory: • Transtheoretical Model of Change</td>
<td>Intervention groups showed significant decrease in % fat in food compared with control (p&lt;.05)</td>
<td>41% of participants available at follow-up Post-intervention duration of exercise higher in intervention than control (p&lt;.04)</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| Gimme 5 Domel et al. (1993) United States | • Randomized trial  
• 16 classes (grades 4 and 5) in 2 similar schools  
• 10 classes in experimental group, 6 classes in control group | • Taught by regular classroom teachers 3 times/wk for 6 weeks (18 sessions); teachers received 6 hours of training  
• Focus on student’s ability to ask for and to prepare fruits and vegetables  
• Includes: recipe preparation  
• taste testing  
• goal setting  
• self-monitoring  
• problem solving  
• use of goal buddies (social support)  
• weekly newsletter to parents  
Theory:  
• Social Cognitive Theory | • 2 weeks post-test  
• Food diaries: fruit intake significantly improved in intervention group (increase of 0.3 servings/day versus 0.06 servings in the control group) (p<.001)  
• No difference in total fruit and vegetable servings/day or in vegetables servings/day | • Results may not be clinically meaningful  
• Significant intervention effect on fruit preferences, fruit and vegetable snack preferences, vegetable preferences and knowledge  
• Predominately lower to middle class; about half in each group eligible for free or reduced-price lunches |
<table>
<thead>
<tr>
<th>Author (date)</th>
<th>Country</th>
<th>Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gimme 5 High School</strong> Nicklas et al. (1997, 1998, 2000); O’Neil et al. (2002)</td>
<td>United States</td>
<td></td>
<td>• Randomized trial&lt;br&gt;• 12 schools (matched pairs, then randomised)&lt;br&gt;• Grade 9 students randomized to Gimme 5 or control&lt;br&gt;• Followed to grade 12</td>
<td>• Intervention over 3 years&lt;br&gt;• Mass media campaign in school&lt;br&gt;• Curriculum of 5 workshops of 55 minutes each re: knowledge, attitudes and skills&lt;br&gt;• Teachers trained&lt;br&gt;• Cafeteria increased availability, variety, appeal of F &amp; V&lt;br&gt;• Brochures to parents, taste-testing, recipes, calendar with food tips</td>
<td>• Significant increase in fruit and vegetable intake in intervention group (p&lt;.05) reported at 1 year and maintained at 2 years; not maintained at 3 years</td>
<td>• Significant increase in knowledge in intervention group (p&lt;.05)&lt;br&gt;• Increased fruit and vegetable consumption maintained in the intervention group at follow-up; increased intake by control group resulted in no significant differences&lt;br&gt;• Control group increase attributed to 5-A-Day campaign&lt;br&gt;• Stages of Change: fewer intervention students in pre- and contemplation and more in preparation stage at posttest</td>
</tr>
<tr>
<td><strong>Gimme 5 Primary School</strong> Baranowski et al. (2000); Davis et al. (2000)</td>
<td>United States</td>
<td></td>
<td>• Randomized trial&lt;br&gt;• 32 elementary schools; 16 intervention and 16 matched control schools</td>
<td>• Aim to increase fruit, juice and vegetable intake&lt;br&gt;• Taught by classroom teachers&lt;br&gt;• 6 weeks (12) sessions (45-55 mins each), each for 2 years&lt;br&gt;• Teachers had additional training (6 hours) in intervention&lt;br&gt;• newsletters and videotapes to parents, and home assignment Theory: • Social Cognitive Theory</td>
<td>• 7 day food record&lt;br&gt;• Significant effect of intervention on combined fruit, juice and vegetables (0.2 servings/day; p&lt;.05) and vegetables alone (0.2 servings/day; p=.005)&lt;br&gt;• No effect for fruit alone</td>
<td>• Randomization by schools&lt;br&gt;• Questionable clinical significance of increased intake&lt;br&gt;• Significant intervention effect on knowledge and asking for fruit and vegetables</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Great Sensations Coates et al. (1985) United States | • Quasi-experimental  
• High school students  
• 154 students in experimental school  
• 130 students in control school | • Aim to reduce consumption of salty snacks and increasing fresh fruits  
• 6 lessons during regular health education classes  
• Classroom activities and instruction included personal goal-setting and feedback and reinforcement  
• Within intervention school, some parents received mailed material and telephone calls to encourage student food changes  
• Intervention school received school-wide media program to support changes  
Control:  
• No intervention  
Theory:  
• Social Learning Theory | • School wide media program produced decrease in consumption of salty snack food (p<.01) and increase in target fruits (p<.05)  
• Only those students who also received class instruction maintained those changes to end of school year (p<.05)  
• No changes were maintained across summer vacation. | |
| Hassapidou et al. (1997) Greece | • Randomized trial  
• Two secondary schools (13-14 year old students)  
• Intervention group (n=73)  
• Control group (n=53) usual classroom education | • Focus on nutrition for prevention of cancer (increasing fruit and vegetable consumption)  
• 10 classroom interventions (20 min) taught by dieticians  
• Workbooks for students 20-30 min per week  
• Pamphlets for students and parents  
Theory:  
• Can’t tell | • No significant changes in intake | • Pilot test of the intervention |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearty Heart and Friends Perry et al. (1985) United States</td>
<td>• Quasi-experimental 8 classes (3rd and 4th grade) in intervention schools 8 classes (3rd and 4th grade) in control schools</td>
<td>• Aim to reduce fat and salt and increase complex carbohydrates  Taught through 9 10-min slide-tape shows of cartoon role models  Reinforced by daily food and physical activity records, curriculum worksheets, homework assignments and aerobic exercise routine  Recipes and weekly preparation of snacks  Parents assisted classroom activities</td>
<td>24 hour recalls  Significant effect of intervention on less added salt (p&lt;.05), reduced fried food intake (p&lt;.005), and increased consumption of vegetables and fruit (p&lt;.05)</td>
<td>Pilot test  1 day teacher training  No effect on potato chips, candy, soft drinks, meat, legumes, fish, or chicken</td>
</tr>
<tr>
<td>Hearty Heart and Friends Perry et al. (1988, 1989); Crockett et al. (1989) United States</td>
<td>• Randomized trial 2,250 3rd grade students from 31 schools randomized to one of 4 groups: School-based Hearty Heart Home-based Home Team  Both in sequence  No-treatment control</td>
<td>• Aim to reduce fat and salt and increase complex carbohydrates Hearty Heart Taught by teachers in class; 15 session over 5 weeks (see Perry et al, 1985) Home Team 5 week correspondence course with 3rd grade students and parent involvement to complete activities Equivalent content to Hearty Heart Theory: Social Cognitive Theory</td>
<td>24 hour recall  At end of program, significant effect of home-based program on reduced saturated fat (p&lt;.05)  No effect remained at one year follow-up</td>
<td>When school was the unit of analysis (as it was the unit of allocation), there were no significant differences between the groups</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>High 5 Reynolds, Franklin, Leviton et al. (2000); Reynolds, Franklin, Binkley et al. (2000); Reynolds (2002) United States</td>
<td>• Randomized trial • 28 schools with 1,698 grade 4 students</td>
<td>• Multiple level intervention • Classroom taught by usual teachers • 14 lessons (3 consecutive days/week; 30-45 min) • 3 booster sessions delivered year following the intervention • Cafeteria-food service involved • Parents - 7 homework assignments Theory: • Social Cognitive Theory</td>
<td>• 24 hour diet recall • Mean daily fruit and vegetable serving consumption higher in intervention than controls; 1 year measurement: 3.96 vs. 2.28 servings/day (p&lt;.001); 2 year measurement: 3.2 vs. 2.21 servings/day (p&lt;.001) • Mean % energy from fat; 1 year measurement: 30.93 vs. 33.37 (p&lt;.003); 2 year measurement: 31.56 vs. 33.23 (p&lt;.001)</td>
<td>• Mean daily consumption of fruit and vegetables higher for intervention parents at one year; not at 2 year follow-up • Significant effect on fibre intake, knowledge, fruit and vegetable self-efficacy and asking skills in students; knowledge and health benefits outcome expectancy in parents</td>
</tr>
<tr>
<td>Integrated Nutrition Program Auld et al. (1998) United States</td>
<td>• Quasi-experimental • 456 intervention students (grades 3-5) • Data available for 226 students • 219 comparison students</td>
<td>• 24 weekly classroom activities with a Special Resource Teacher • 6 parent-taught lunchroom lessons • Newsletters to parents • Family “fun night” Theory: • Social Cognitive Theory</td>
<td>• 0.4 more servings of fruits and vegetables eaten at lunchtime by intervention group than control (p&lt;.001) • 1.2 more servings of fruit eaten by intervention group, than control measured by 24 hr recall</td>
<td>• Report of year 4 of the intervention • Teacher training provided</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Integrated Nutrition Program Auld et al. (1999) United States</td>
<td>• Quasi-experimental • 760 intervention students (grades 3-5) • 19 classes in intervention • 19 classes in comparison</td>
<td>Intervention: • 16 weekly classroom sessions, alternating Special Resource Teacher with regular classroom teacher • 6 parent-taught lunchroom lessons • Comparison: • 24 classroom sessions by Special Resource Teacher only • All lessons (both interventions) involved preparing and eating food</td>
<td>• 0.35 more servings of fruits and vegetables eaten at lunchtime, by intervention group than control (p&lt;.001)</td>
<td>• Difference in groups attributed to decreased intake in comparison group</td>
</tr>
<tr>
<td>King et al. (1988) United States</td>
<td>• Randomized trial • Grade 10 students in 2 different schools • Classes randomized within schools • 5 classes to intervention, 7 classes to control</td>
<td>Intervention was a curriculum taught by research staff with teachers present • 3 weeks, 5 sessions (50 min each) to improve knowledge • Used cognitive-behavioural interventions to modify dietary practices • Goal setting, homework, games, food-tasting</td>
<td>• Significant intervention effect on reported healthful eating behaviour (p&lt;.0001), availability of healthful food at home (p&lt;.01), and knowledge (p&lt;.005)</td>
<td>• Both schools in middle class areas, but different ethnic groups represented in each school • Mean attendance at intervention was 3.5 of 5 sessions • Complete pre-posttest data for 50% of participants</td>
</tr>
<tr>
<td>Klepp et al. (1993) Norway</td>
<td>• Quasi-experimental • 4 junior high schools; 2 intervention, 2 controls • 447 students in grade 7</td>
<td>Integrated into home economics course • Goal to increase fruit, vegetable, whole-wheat bread and low-fat dairy product consumption, and to reduce high-sugar and high-fat snack consumption • Focus on own eating habits • Selected and prepared snacks • Preparation of favourite foods with healthier recipes • Preparation of dinners for families</td>
<td>• 5 month post-intervention: intervention effect for both males and females for eating behaviour (healthy eating score) • No intervention effect maintained at 12 months post-intervention</td>
<td>• Intervention effect for knowledge in males, but not females</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| **Know Your Body** Stewart et al. (1997) United States | • Randomized trial  
• One class from each of grades 3 to 5 (30 classes) from 10 schools; 742 children  
• 319 in intervention group (social learning)  
• 273 in control (traditional approach) | • Taught by health educator and dietician brought into regular classes  
• Four 1-hour classes taught every 6-8 weeks  
• Content re: decreasing dietary fat, cholesterol, sodium, and sugar, and increasing complex carbohydrates and fibre  
• Lessons used role models, skill building, rewards, environmental component (food shopping experience) and involved setting a series of goals  

Theory:  
• Social Cognitive Theory | • Both groups reduced their use of high-fat foods, but there was a significantly greater reduction in the intervention group (23% vs. 18%) (p<.05) | • Randomization by school  
• Both groups reduced use of high-sodium foods by 12% and high sugar foods by 15%; no differences between groups  
• No change in use of heart healthy foods |
| **La Porte et al. (1989) United States** | • Randomized trial  
• 50 11-12 year olds  
• Group 1- children with materials sent to parents (n=20)  
• Group 2 - children with out materials to parents (n=17)  
• Group 3 - control (n=13) | • Cancer nutrition education based on Planning Meals that Lower Cancer Risk re lowering fat in diet, increasing fibre  
• Once a week for 5 weeks  
• Parent involvement via handouts, pamphlets packages of information and activities to involve them and their children in food preparation  

Theory:  
• Can’t tell | • 10 week post-test  
• Children in group without parents had greater increase in frequency of consumption of carrots, decreased butter, margarine, whole milk and cheeses (p<.05)  
• Group that included parent material involvement had no impact on outcomes | • Children in group without parents increased knowledge (p<.05)  
• Authors postulate that adolescents’ need for independence and parental control might have had an influence on lack of change in education group that included information sent to parents |
<table>
<thead>
<tr>
<th>Author (date) Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning by Teaching (1990) Hölund (1989, 1990a, 1990b) Denmark</td>
<td>• Quasi-experimental • 14 year olds; • 64 in peer training intervention • 63 controls</td>
<td>• Goal to reduce sugar consumption • Conducted dietary interviews of 10 year olds, analyzed commercials related to body image and sex roles, developed curriculum; posters over 5 sessions; • Different classes of 10 year old students were then taught for 20 sessions Theory: • Social Learning Theory</td>
<td>• Immediate post-test reduction in frequency of overall and between-meal sugar consumption (p&lt;.05) • Maintained at 2 month follow-up • No effect on fat consumption</td>
<td>No results presented for 10 year olds</td>
</tr>
<tr>
<td>Lewis et al. (1988) United States</td>
<td>• Quasi-experimental • High school students • Intervention conducted through 23 teachers (any student who took one course with these teachers); n=1,476 • 223 control students from same schools who had not had a course with the 23 teachers</td>
<td>• 3 year intervention of nutrition education (National Dairy Council’s Food…your Choice) • 17- 22 different teaching plans were available for 4 curriculum areas (integrated into home economics, health, science and social studies) • Teachers taught an average of 6 activities per year. Theory: • Can’t tell</td>
<td>• 3-day food record showed no statistically significant intervention effect on food intake</td>
<td>Significant intervention effects: knowledge improved, attitudes became more positive, intentions to include more high-nutrient food increased • Teacher experience and commitment were important factors influencing teenagers to change food consumption patterns</td>
</tr>
<tr>
<td>Author (date)</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| Michel et al. (1994) Canada | • Quasi-experimental  
• Students in grades 4-6  
• One intervention school cafeteria  
• One control cafeteria (traditional school food service that includes fast foods and higher prices than Intervention) | • Non-profit school food service with parent and community involvement  
• Served hot healthy meals at low price  
• Can’t tell | • Significant differences in protein and cholesterol consumption (22.6 g vs. 27.4g, p<.01; 54.6mg vs. 72.7mg, p<.02) | • Limitations: meals were analyzed and compared to daily Nutrition Recommendations (NR) yet outcomes were based on only one lunchtime meal, and the macronutrient composition of the 2 schools’ menus did not differ according to NR, however children’s consumption did |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| National School Lunch Program Gordon et al. (1995); Gleason (1995); Burghardt, Gordon and Fraker (1995); Burghardt, Devaney and Gordon (1995); Hardy (2002) United States | • Cross-sectional  • Nationally representative sample of 3350 students in grades 1-12  • Compared participants versus non participants | • Provision of lunch and breakfast programs – available in US to 92% of all students  
Theory:  • Can't tell | • 24 hour recall  • Lunch program participation is associated with higher lunch and 24 hour intake of fat (37% vs. 33% of total energy) and saturated fat (14 vs. 11) (p<.01) | • Among schools offering the program lunch participation was 56% and breakfast participation 19%  • Availability of breakfast did not affect likelihood of students eating breakfast  • Participation in lunch program associated with higher lunch intake of vitamin A, calcium and magnesium and lower intake of vitamin C |
| Nutrition Education and Training (NET) Gillespie (1984) United States | • Quasi-experimental  • 6 elementary schools: 3 schools with program (530 children); 3 control schools (627 children)  • Schools matched on size, SES, staff interest in nutrition and type of food service | • Purpose of program is to provide positive lunchroom experience, appropriate classroom reinforcement for the value of nutritionally balanced diet  • Teachers and food service personnel received training  
Theory:  • Can't tell | • Significant intervention effect on snacking practices of children when at home, and in “food-like” score (p<.01) | • Children with most intensive NET program had greatest improvements |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nutrition Education at Primary Schools (NEAPS)</strong> Friel et al. (1999) Ireland</td>
<td>• Quasi-experimental 8 schools chosen by Education inspectors 8-10 year old children in grades 3 and 4 3 comparison schools randomly chosen by research staff</td>
<td>• Content based on US Hearty Heart program  • Purpose: build awareness of healthy eating, increase knowledge, and induce positive eating behaviour change • 20 sessions over 10 weeks: curriculum, homework, aerobic exercise</td>
<td>• At 3 month follow-up, food diaries indicated that the intervention had an effect on increasing consumption of fruit and vegetables and reducing salty snacks (p&lt;.01)</td>
<td>• Pilot program  • Pretest knowledge was high and did not significantly increase  • Rural children benefited more; children living in disadvantaged areas benefited less (p&lt;.01)</td>
</tr>
<tr>
<td><strong>Nutrition for a Lifetime System</strong> Wagner et al. (1992) United States</td>
<td>• Randomized trial 77 families with children 10-13 years of age 24 in intervention 53 in control</td>
<td>• Goal to reduce fat intake, increase fibre intake  • Intervention families received 1 educational video per week for 6 weeks, and feedback (on fat and fibre) from supermarket purchases</td>
<td>• No statistically significant differences in behaviour for children or parents</td>
<td>• Significant intervention effect for children on stated snack preferences</td>
</tr>
<tr>
<td><strong>Nutrition for Life</strong> Devine et al. (1992); Olson et al. (1993) United States</td>
<td>• Quasi-experimental 1,863 students from 103 randomly selected grades 7 and 8 classes 3 three groups compared in analysis: 1. No teaching of nutrition (26 classes) 2. Nutrition taught but not Nutrition for Life 3. Nutrition for Life curriculum used</td>
<td>• Integrated into regular curricula of home economics and health classes  • Focus on eating for health and well-being  • Food choices, nutritional needs across the lifespan, nutrition and fitness  • Distributed state-wide (New York)</td>
<td>• No intervention effect on attitude, knowledge or behaviour scores across home economics and health classes</td>
<td>• Outcome measurement tool re: changes in reported nutrition behaviour had reliability co-efficient of .60  • Changes in outcomes associated with amount of exposure (hours) to the curriculum</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td><strong>Nutrition in a Changing World</strong> Byrd-Bredbenner et al. (1988) United States</td>
<td>• Quasi-experimental • Home economics students in grades 10, 11 and 12 • 55 classrooms, 21 teachers, 600 students • One experimental group was pre and post-tested (n not reported) • One control group was pre and post-tested (n not reported) • Two other groups (pretest only and posttest only)</td>
<td>• Teachers trained and given curriculum guides to be done over a 5-6 week period Theory: • Can’t tell</td>
<td>• No intervention effects on food behaviour</td>
<td>• Significant intervention effects for knowledge and attitudes</td>
</tr>
<tr>
<td><strong>Nutrition in a Changing World</strong> Shannon et al. (1988) United States</td>
<td>• Quasi-experimental • 12 school districts; • Within districts, schools assigned to intervention or control • Started with grade 3 and followed until grade 6</td>
<td>• 3 year intervention • Each year was 9-12 week nutrition education intervention taught by classroom teachers • Focused on increasing variety of foods • Posters, table tents for cafeterias Theory: • Can’t tell</td>
<td>• No significant intervention effect</td>
<td>• Improvement in attitudes in both groups over time.</td>
</tr>
<tr>
<td>Author (date)</td>
<td>Country</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
</tr>
<tr>
<td>--------------</td>
<td>---------</td>
<td>--------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
</tr>
</tbody>
</table>
| TEENS (Teens Eating for Energy at School) | United States | • Randomized trial  
• 20 schools, grade 7 classes  
• School environment interventions only  
• Class-room plus environment interventions  
• Class-room plus environment interventions plus peer leaders  
• No intervention control | • Intervention delivered across 2 years to grade 7 students followed into grade 8  
• Classroom - 10 curriculum sessions  
• Peer leaders helped classroom teachers  
• Environment: Promoting fruits and vegetables in the cafeteria; taste testing; increasing availability of lower fat food; appealing fruits and vegetables; table tents and posters  
• Parent packs: Home activities to be done with parents  
Theory:  
• Social Cognitive Theory | • Mean daily fruit and vegetable serving consumption higher in classroom + environment + peer than any of the other groups (p<.05): 5.8 vs. 4.95 for classroom + environment  
• No improvement control decrease in consumption for environment only group | • Questionable clinical significance of increased intake |
| Story et al. (2002); Lytle et al. (2001); Birnbaum et al. (2002) | | | | | |
| Tumin et al. (2001) | France | • Randomized trial  
• 1,876 students aged 7 to 12 years  
• 16 schools randomized to computer games group or control group | • Computer nutrition games  
• 4 games on CD-ROM developed with nutritionists, dieticians and pediatricians  
• Time available for students to play was 1 hour twice a week for 5 weeks  
• Consisted of games to classify food into categories, find out what food contains, and choosing foods for snacks and balanced meals  
• During the same time allotment, control students had regular nutrition curriculum  
Theory:  
• Can’t tell | • Significant intervention effect for:  
• more balanced diet  
• more carbohydrate (46.4% vs. 45.7%)  
• less fat (37.1 vs. 37.6%)  
• less protein (16.5% vs. 16.7%)  
• less sucrose (11.5% vs. 12.2%)  
• more calcium and fibre, ate fruits and vegetables every day (p<.05) | • Significant intervention effect on knowledge (p<.01)  
• Question clinical significance of these dietary differences |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| Wardle et al. (2003) United Kingdom | • Randomized trial  
• 156 parents of 2-6 year old children  
• Randomized to exposure, information, or control | • Home-based exposure training for preschoolers to increase children’s liking for previously disliked vegetable  
• Taste test each day for 14 days of a “target” vegetable  
• Information given to parents as leaflet Control:  
• No intervention Theory:  
• Can’t tell | • Significant effect of exposure training of increase in consumption of “target” vegetable (p<.001); increased from 47% pre-intervention to 77% post-intervention for voluntarily eating target vegetable  
• No effect of information only | • Significant effect of Exposure training of increase in liking, ranking of “target” vegetable  
• Control group voluntary intake of target vegetable decreased |
| Washington Heights – Inwood Healthy Heart Program Wechsler et al. (1998) United States | • Randomized trial  
• Randomization of 6 schools paired according to base-line low-fat milk consumption  
• 3 schools each in intervention and control conditions  
• Primarily Latino sample | • Social marketing intervention to increase consumption of low-fat white milk at school lunchtime  
• Posters, auditorium educational information sessions, and tasting sessions Theory:  
• PRECEDE | • Immediate post-intervention test  
• Low-fat milk choices increased from 25% to 75% in intervention schools as measured by observed discarded milk cartons  
• Intervention effect remained at 3-4 month follow-up | • School was unit of assignment and unit of analysis |
| Whitaker et al. (1994) United States | • Randomized trial  
• 16 elementary schools randomized to intervention (n=8) and control (n=8)  
• Participants were students eating lunch at school (average of 2,445 students/day) | • Both sets of schools had one low-fat entrée every day  
• 4 month intervention with the goal to increase selection of low-fat food at school lunch  
• Labelled low-fat foods in the menu  
• Parents notified of low-fat food choices and availability, and asked to encourage children to select low fat foods Theory:  
• Can’t tell | • Intervention schools increased in proportion of students who chose low fat selections compared to control schools (31.5% vs. 30.7%, p=.03) | • Unit of randomisation and analysis was school  
• 221 parents surveyed; 71% remembered receiving mailing; 53% remembered that there were low fat entrées on the menu; 10% reported requesting their child to choose low-fat selection |
<table>
<thead>
<tr>
<th>Eating Disorder Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ayotte et al. (1998)</strong></td>
</tr>
<tr>
<td><strong>Canada</strong></td>
</tr>
<tr>
<td>• Quasi-experimental</td>
</tr>
<tr>
<td>• Students grades 2-6</td>
</tr>
<tr>
<td>• One intervention school and one control</td>
</tr>
<tr>
<td>• 10 month intervention (Sept 1992-June 1993)</td>
</tr>
<tr>
<td>• Self-esteem training of school staff (teachers, food service, helpers), parents, children grades 2-6</td>
</tr>
<tr>
<td>• Teacher training: 16.5 hrs group and 4 30 min minimum individual teacher training</td>
</tr>
<tr>
<td>• School personnel training: 6 hrs</td>
</tr>
<tr>
<td>• Parent training: 5 sessions 2 hrs each (unclear if parent goes to one or all 5)</td>
</tr>
<tr>
<td>• Student training: 45 minutes minimum each lesson (grade 2 14.3 hrs; grades 3-6 27.8 hrs)</td>
</tr>
<tr>
<td>Theory:</td>
</tr>
<tr>
<td>• Can’t tell</td>
</tr>
<tr>
<td>• Children’s rating of overall self concept by Self-Description Questionnaire reported to be validated in French (reference given)</td>
</tr>
<tr>
<td>• Multiple regression analyses showed important adjusted gains for self-concepts related to physical appearance, mathematics and relationships with parents</td>
</tr>
<tr>
<td>• Students with largest deficit benefited most from the intervention</td>
</tr>
<tr>
<td>• Low drop out rate (3.4%)</td>
</tr>
<tr>
<td>• Other tools used not reported re: validity and reliability</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Body Image and Eating Behaviour Intervention Program</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Paxton (1993)</strong></td>
</tr>
<tr>
<td><strong>Australia</strong></td>
</tr>
<tr>
<td>• Quasi-experimental</td>
</tr>
<tr>
<td>• 136 grade 9 girls in 3 different private schools</td>
</tr>
<tr>
<td>• 125 in intervention</td>
</tr>
<tr>
<td>• 34 in control</td>
</tr>
<tr>
<td>• Curriculum once a week (1.5 hours) for 5 weeks; included:</td>
</tr>
<tr>
<td>• media influence</td>
</tr>
<tr>
<td>• determinants of size and shape</td>
</tr>
<tr>
<td>• nutrition</td>
</tr>
<tr>
<td>• dangers of weight loss attempts</td>
</tr>
<tr>
<td>• emotional eating</td>
</tr>
<tr>
<td>Theory:</td>
</tr>
<tr>
<td>• Can’t tell</td>
</tr>
<tr>
<td>• Follow-up at 11 months</td>
</tr>
<tr>
<td>• No significant intervention effect for restraint, bulimia, drive for thinness, weight control behaviour, ideal figure or body dissatisfaction</td>
</tr>
<tr>
<td>• Pilot study</td>
</tr>
<tr>
<td>• Trend toward increase in body dissatisfaction in both groups</td>
</tr>
<tr>
<td>Study</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
</tbody>
</table>
| Eating Smart, Eating for Me | Smolak et al. (1998a) | United States | - Quasi-experimental  
- 222 school children in grade 5 classes (boys and girls)  
- 167 in intervention  
- 55 in control | - 10 lessons total, taught by teachers after 2 hour training session  
- Curriculum:  
  - healthy eating, Food Pyramid  
  - exercise  
  - body shape and body image issues  
  - reduce calorie restriction  
  - development of body dissatisfaction  
  - 9 newsletters home to parents | Theory:  
- Social Cognitive Theory | - 4 months post-intervention  
- Significant intervention effect of knowledge (importance of breakfast, effect of puberty on body fat, heritability of body shape, dieting ineffectiveness)  
- No significant intervention effect on fruit and vegetable consumption, body esteem, weight loss attempts, need for a variety of food or for exercise  
- Teachers unsupervised and not required to do all lessons  
- Possible contamination of control and intervention classes as in same school  
- Children in both interventions increased teasing of others about weight and shape  
- Control group had less negative attitudes toward overweight people  
- Girls in control group decreased vegetable consumption; boys in control group increased consumption |
| Eating Smart, Eating for Me | Smolak et al. (1998b) | United States | - Quasi-experimental  
- 11 grade 4 classes (boys and girls)  
- 194 children in intervention  
- 105 in control | - 10 lessons total taught by teachers as they saw fit to implement  
- Curriculum:  
  - healthy eating, Food Pyramid  
  - exercise  
  - body shape and body image issues  
  - reduce dieting behaviour  
  - critical evaluation of media messages | Theory:  
- Social Cognitive Theory | - Immediate Post-test:  
- Boys in intervention and girls in control classes showed increase in body esteem  
- No effect on total consumption of fruit and vegetables | - No measure of how many of the 10 sessions taught by teachers  
- Intervention group improved scores on knowledge of need for variety in food intake  
- No effect on exercise, teasing others about weight and shape, or weight loss attempts |
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Participants</th>
<th>Intervention Details</th>
<th>Theory</th>
<th>Post-intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everybody’s Different O’Dea (2000) Australia</td>
<td>Quasi-randomized trial</td>
<td>470 children (173 males, 297 females) in two schools enrolled in years 7 and 8, 275 in intervention, 195 in control</td>
<td>Play, drama, group work to promote positive self-esteem, positive environment, dealing with stress, resisting stereotypes, communication and relationships. Taught by teachers 9 sessions once/week for 50 - 80 minutes</td>
<td>Can’t tell</td>
<td>Intervention group improved over control group in body dissatisfaction, drive for thinness, importance of physical appearance, and reduced importance of social acceptance 12 month follow-up: No effect of intervention on drive for thinness, body dissatisfaction, anxiety, depression, and proportion currently trying to lose weight Significant effect on reduced importance of social acceptance (peer group acceptability and popularity; intervention group improved and control group worsened)</td>
</tr>
<tr>
<td>Full of Ourselves: Advancing Girl Power, Health and Leadership Steiner-Adair (2002) United States</td>
<td>Quasi-experimental</td>
<td>499 girls (12-14 year old), 260 intervention, 198 control</td>
<td>Taught by teachers, nurses and guidance counselors 8 topic units (45-90 min each) delivered over 8-15 weeks Discussion, art activities, role play and guided meditation Strategies to resist media messages</td>
<td>Can’t tell</td>
<td>Immediate post-test and 6 month follow-up: Significant difference in intervention group compared with control on knowledge No effect on eating-related behaviour, self-esteem, or attitude toward appearance</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Participants</td>
<td>Intervention</td>
<td>Theory</td>
<td>Outcomes</td>
</tr>
<tr>
<td>-------</td>
<td>--------</td>
<td>--------------</td>
<td>--------------</td>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>Girl Talk</strong> McVey et al. (2003a) Canada</td>
<td>Quasi-experimental</td>
<td>214 girls in grades 7 and 8</td>
<td>10 weekly one-hour sessions</td>
<td>Peer support group, facilitated by Public health nurse</td>
<td>Significant intervention effect on improved body esteem scores related to appearance and weight, and on reduction in dieting scores</td>
</tr>
<tr>
<td></td>
<td>99 in intervention</td>
<td>Focused on prevention of eating disorders</td>
<td></td>
<td>Media literacy, promotion of life skills, self-esteem and body image enhancement, stress management and peer relational skills</td>
<td>Maintained at 3 month follow-up</td>
</tr>
<tr>
<td></td>
<td>115 in control (schools matched for size, socioeconomic status and geographic location)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Girl Talk</strong> McVey et al. (2003b) Canada</td>
<td>Quasi-experimental</td>
<td>283 girls in grades 7 and 8</td>
<td>10 weekly one-hour sessions</td>
<td>Peer support group, facilitated by Public health nurse</td>
<td>Post-intervention and 3 month follow-up;</td>
</tr>
<tr>
<td></td>
<td>87 in intervention</td>
<td>Focused on prevention of eating disorders</td>
<td></td>
<td>Media literacy, promotion of life skills, self-esteem and body image enhancement, stress management and peer relational skills</td>
<td></td>
</tr>
<tr>
<td></td>
<td>196 in control (schools matched for size, socioeconomic status and geographic location)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Healthy Body Image: Teaching kids to eat and love their bodies too!</strong> Kater et al. (2002) United States</td>
<td>Quasi-experimental</td>
<td>415 students, 9-13 years of age in 5 schools</td>
<td>11 lesson curriculum taught by classroom teachers; includes:</td>
<td>body image</td>
<td>Significant intervention effect on knowledge and media scales (p&lt;.01)</td>
</tr>
<tr>
<td></td>
<td>Classes randomly assigned; 357 students received intervention (in intact classes)</td>
<td>body size prejudice</td>
<td>No effect on body image, body size prejudice, lifestyle behaviours, or self-image</td>
<td>biological factors affecting body size</td>
<td>For girls:</td>
</tr>
<tr>
<td></td>
<td>2 classes in control group (58 students)</td>
<td>normal development</td>
<td>Significant intervention effect on knowledge, body image, body size prejudice, lifestyles behaviours, self-image and media scales (p&lt;.05)</td>
<td>risks of dieting</td>
<td>For boys:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>activity/sedentary behaviour balance</td>
<td></td>
<td>self-image/self-esteem</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>media awareness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Sample</td>
<td>Intervention Details</td>
<td>Outcomes</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Rocco (2001)</td>
<td>Quasi-experimental</td>
<td>99 girls in five classes (mean age 16 years)</td>
<td>Psycho-education re: targeted risk factors for eating disorders:</td>
<td>Between group difference at post-test on maturity fears (p&lt;.05)</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td></td>
<td>63 in intervention group</td>
<td>normal development at puberty</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>33 in control group</td>
<td>nature of eating disorders</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>body image concerns</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>self-esteem problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Each session was 2 hours once/month over 9 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Santonastao et al. (1999)</td>
<td>Quasi-randomized trial</td>
<td>408 16-year old girls</td>
<td>Four group sessions (2 hours each) took place during school hours once a week for one month</td>
<td>Follow-up at 12 months</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td></td>
<td>154 in intervention (randomly selected classes)</td>
<td>Taught by psychiatrist and psychologist</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>154 in control (from classes not participating)</td>
<td>Topics included normal weight gain with puberty, body image concerns, desire for thinness, self-esteem,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>inter-personal relationships, socio-cultural pressures for thinness, nature and prevalence of dieting</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>induced disorders, anorexia and bulimia</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Theory:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Can’t tell</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Healthy Weights Review – Nutritional Interventions 102
<table>
<thead>
<tr>
<th>Stewart (2001) United Kingdom</th>
<th>Designed to promote behaviour and attitude change; focused on adjustment to puberty, development of eating disorders, dealing with socio-cultural pressures to be thin, body image dissatisfaction, low self-esteem and dieting</th>
</tr>
</thead>
</table>
|                                | Once a week for 6 weeks, 45 min each  
|                                | Conducted by the research team (clinical psych.) |
| Theory:                       | Developmental framework somewhat based on cognitive-behavioural interventions for treating eating disorders |
|                                | Follow-up at 6 months:  
|                                | Restraint lower in intervention group than control,  
|                                | Higher knowledge scores in intervention  
|                                | No statistical difference between groups in weight and eating concerns, self-concept, total scores on Eating Disorder Examination, and Eating Attitudes test or eating disorder behaviours |
| In the intervention group, restraint, shape concerns, eating concerns, eating disorder examination scores went down immediately following the intervention, but back up at 6 months |
| Differences in restraint scores may not be clinically significant, even though statistically significant |
| Greater impact on dieters in the intervention than in the control group on reducing dietary restraint |
| Wade et al. (2003) | Randomized trial  
4 classes of 86 grade 8 students (boys and girls)  
Mean age of 13 years  
1. Intervention - Media literacy  
2. Intervention - self-esteem program designed to reduce general and specific risk factors for eating disorders  
3. Control group who had normal religious education curriculum | Both interventions were 5 classes of 50 minutes each  
Media literacy program adapted from Go Girls!  
- Becoming critical media viewer  
- Media impact on negative body image  
- Media awareness presentation  
Self-esteem based on Everybody’s Different:  
- Coping with stress  
- Relaxation exercises  
- Observe and communicate positive aspects in others  
- Challenging societal stereotypes  
- How others affect our self-concept  
Theory:  
- Can’t tell | Intervention effect of media literacy group on weight concern compared with control group (p<.007)  
No significant effect of self esteem group  
No effect of group on body dissatisfaction or dietary restriction  
Lack of power in sample size |
| Withers (2002) | Quasi-experimental  
242 girls in grade 7 aged 12-13 years  
115 in intervention  
127 in control | 22 minute videotape included information on:  
- Determinants of body size and shape  
- Weight gain with puberty  
- Variations on “normal” female bodies  
- Socio-cultural influences on ideal appearance  
- Negative effects of extreme dieting  
- Healthy eating habits  
- Suggestions for creating healthy body image  
Control:  
- No intervention  
Theory:  
- Elaboration Model of Persuasion | Immediate post-test:  
- Intervention group made significantly greater changes in drive for thinness (p<.01) and intention to diet (p<.005)  
At 1 month follow-up, no significant effect of intervention  
Intervention group had significantly greater increases in knowledge (p<.002); maintained at 1 month follow-up |
Reference List


Interventions to Reduce Physical Inactivity in Children and Youth
This is a summary statement written to condense the work of the authors of a systematic review. The reference for the full review is below. The intent of this summary is to provide an overview of the findings and implications of the full review. Implications listed in the evidence table have been developed by summary statement authors for health-evidence.ca, and may reach beyond what the authors have stated in the review. For more information on individual studies included in the review, please see the review itself.


Author Contact Info: Donna Ciliska, RN, PhD; Helen Thomas, RN, MSc Effective Public Health Practice Project 2 King Street West, 3rd Floor Dundas ON L9H 6Z1 (905) 546-2424 x1578 thomash@mcmaster.ca

Issue: Juvenile obesity has reached epidemic proportions (Strauss & Pollack, 2001; Reilly & McDowell, 2003). Numerous studies indicate a positive association between obesity and physical inactivity, such as television viewing, video or computer game use (Reilly et al., 2003; Gordon-Larsen, Adair, & Popkin, 2002; Tremblay, Katzmarzyk, & Willms, 2002; Hussey, Gormley, & Bell, 2001; Faith et al., 2001). As Gortmaker et al. observed, individuals that watch more than five hours of television a day were 4.6 times more likely to be overweight (Gortmaker, Must, Sobol, et al, 1996). Evidence also supports inactivity as a stimulus for over-consumption and sedentary behaviour (Hussey et al., 2001). Routine inactivity at a young age has been suggested to predict behaviour in adulthood, which can lead to coronary artery disease, stoke, hypertension, colon and breast cancer, type 2 diabetes and osteoporosis, all of which constituted 25.5% of total health care costs in Canada in 2001 (Katzmarzyk, Gledhill, & Shephard, 2000). The degree to which physical inactivity contributes to obesity has yet to be clarified, though with such a strong association, the pursuit of effective interventions to decrease the amount of physical inactivity could prevent obesity, reduce health care costs and promote long term healthy lifestyles (Campbell, Waters, O'Meara, Kelly, & Summerbell, 2002).
**Review Content Summary:** A systematic review was completed to determine the effectiveness of interventions to reduce physical inactivity in children and youth. Studies focused on reducing television, video and video game use in elementary school children. The outcome of interest was reducing the amount of time engaged in sedentary activities by measuring the number of hours per week the child was engaged in this behaviour as well as nutritional intake to assess the intervention.

**Comments on this review’s methodology:** Six projects were found to be relevant. All projects were conducted in the United States, except one from the United Kingdom. All but one were randomized trials, and outcome assessors typically were not blinded to group allocation. The majority of the studies failed to avoid selection bias, handle confounders appropriately, had high rates of retention and variable reliability with respect to data collection instruments. All interventions were school-based, apart from a community after-school dance program. Three interventions were based on social cognitive theory while two did not state the theoretical framework. All studies implemented appropriate statistical methods and accounted for potential error created by differences between the unit of analysis and the unit of allocation. Five studies had at least one statistically significant outcome; however, only two included sample size or power calculations. Finally, half of the studies employed intention to treat analysis, two measured the proportion of participants actually receiving the intervention, and no measures of intervention consistency were taken.

**Evidence points are not weighted or ranked**

<table>
<thead>
<tr>
<th>What’s the evidence?</th>
<th>Implications for practice and policy:</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Teachers given additional training to promote less video game and television use as well as better nutrition in some cases, resulted in a statistically and clinically significant decrease in those activities.</td>
<td>&gt; School-based interventions appear to be highly effective in reducing physical inactivity and reducing obesity and should be replicated.</td>
</tr>
<tr>
<td>&gt; Also resulted in decreased BMI, triceps skin folds, waist-to-hip ratio and the frequency of eating meals in front of the television.</td>
<td></td>
</tr>
<tr>
<td>&gt; Educational interventions designed to decrease sedentary behaviour appear to be more effective than increasing physical activity in obese children.</td>
<td>&gt; Replicate the study.</td>
</tr>
<tr>
<td>&gt; Exercise-contingent television viewing statistically and significantly reduced the amount of television viewing of obese children.</td>
<td>&gt; Replicate the study.</td>
</tr>
<tr>
<td>&gt; After-school recreation programs had no effect on television, video or videogame use, however, there was a statistically significant decrease in the total household television use including fewer meals with the television on.</td>
<td>&gt; Sample size needs to be calculated and the study replicated.</td>
</tr>
</tbody>
</table>
General Implications:
> Research in this field is in its infancy.
> Successful studies focused on decreasing television and video viewing time as well as video game use need to be replicated in other samples.

Cost Benefit or Cost-Effectiveness Information: Not included in review.

References Used to Outline Issue:


The format of this summary statement has been adopted from health-evidence.ca (www.health-evidence.ca).
Interventions to Reduce Physical Inactivity in Children and Youth

Introduction

This review answers the question:

What is the effectiveness of interventions to reduce physical inactivity in children and youth?

Methods

Please refer to the Methods section in the main Introduction, page 16.

Results

Description of Relevant Studies

Focusing on reducing inactivity, as opposed to increasing activity, is a relatively new area of research. Reports of six projects (10 unique articles) were found to be relevant. All projects were conducted in the United States except one, which was done in the United Kingdom (Apples: Project Account, 2004). All were published between 1999 and 2003. All have outcome measures that include reducing sedentary behaviors, namely, television, video, and videogame use.

Quality Assessment of Relevant Studies

The quality assessment results are found in Table 1. On the whole, the literature was found to be of variable quality. All but one (Gortmaker et al., 1999a) were randomized trials, and for the most part, there were fairly high rates of retention (Chomitz, Collins, Kim, Kramer, & McGowan, 2003; Planet Health: Project Account, 2000; Children's Television Viewing: Project Account, 2001; GEMS Stanford: Project Account, 2003; Apples: Project Account, 2004). However, selection bias was not avoided in most studies, nor were confounders handled well. For the outcome of interest for this review (decreasing sedentary behavior) the outcome assessors were most often not blinded to group allocation. Data collection instruments also varied from reliable and valid to unknown psychometric properties. All were school-based interventions except a community, after-school dance program (GEMS Stanford: Project Account, 2003). Social cognitive theory was the theoretical basis for the intervention in three of the projects (Children's Television Viewing: Project Account, 2001; GEMS Stanford: Project Account, 2003; Planet Health: Project Account, 2000). In one project health promotion concepts were used (Apples: Project Account, 2004). The other two projects had no stated theoretical framework (Chomitz et al., 2003; Gortmaker et al., 1999a).
Only two of the six included studies indicated either sample size or power calculations; five of the six showed statistically significant differences on at least one outcome. All studies were judged to have appropriate statistical methods; in all studies where the unit of analysis (individual) differed from the unit of allocation (school or classroom), the methods of analysis accounted for this potential error. Half of the studies used intention-to-treat analysis. Two of the six studies measured the proportion of participants who actually received the intervention and none measured the consistency of intervention that was delivered.

Findings from Relevant Studies

Descriptions of all relevant studies can be found in Table 2. Four projects involved curriculum taught in the usual classroom situation, by regular classroom teachers given additional training (Gortmaker et al., 1999a; Planet Health: Project Account, 2000; Children's Television Viewing: Project Account, 2001; Apples: Project Account, 2004). The methodologically strongest of these studies was the Children's Television Viewing Program by Robinson (Children's Television Viewing: Project Account, 2001). The 18-lesson intervention, delivered over a seven-month period, focused on reducing media use by limiting access to TV sets, budgeting watching and videogame playing time, and increasing playtime. It was effective (statistically and clinically significant) in reducing TV viewing by over five hours/week and video game use by 2.5 hours per week compared to the control group. Children in the intervention group also had decreases in BMI, triceps skin folds, waist-to-hip ratio, and frequency of eating meals in front of the TV. This study provides the most convincing evidence of possible effects of a school-based intervention.

In contrast, the other studies not only had other methodological weaknesses (see Table 3.2), but two found no differences in TV viewing time or physical activity compared to the control group (Apples: Project Account, 2004; Gortmaker et al., 1999a). Only the Planet Health Program, with a more intense, but more inclusive, intervention of 32 lessons over a two-year period, had much more modest results finding a mean difference of about a half-hour per week of TV viewing time for both boys and girls (Planet Health: Project Account, 2000). However, they did realize a lower prevalence of obesity for girls in the intervention schools after the intervention compared to the controls (OR 0.47, 95% CI, 0.24 to 0.93) but no difference for boys (Planet Health: Project Account, 2000). This was explained by the significant increase in servings of fruits and vegetables and decrease in total calories consumed by the girls in the intervention group.

Robinson and colleagues also conducted a feasibility study of an after-school dance program for African-American girls, aged 8-10 attempting to prevent weight gain. The GEMS Program compared the 12-week dance, plus home lessons, encouraging reduced TV and video use, with a control group who received newsletters and health education lectures. No difference was found in TV, video or videogame use, although a statistically significant finding of lower total household TV use and fewer dinners with the TV on, were found in the intervention group. As a feasibility study, the sample size was small (n=61) and likely underpowered to show a difference in primary outcomes (GEMS Stanford: Project Account, 2003).
A written report card mailed to parents, regarding the child’s weight, height, weight status, fitness test results and interpretation, and referral if overweight, had no effect on hours of TV viewed, level of physical activity or fruit and vegetable intake in participants compared to a general information group who were mailed general information about those behaviors, or a control group who received no mailed information. In a sub-group analysis, the intervention had an impact on parents of obese children in that they reported planning to seek medical help, and planning to begin dieting and physical activities for their children (Chomitz et al., 2003).

Three other studies are worth considering as promising for further investigation in primary prevention (Epstein et al., 1995), (Faith et al., 2001), (Ford, McDonald, Owens, & Robinson, 2002). They did not meet inclusion criteria as they were interventions for children already obese (Epstein et al., 1995; Faith et al., 2001), or they were clinically, not community-based (Ford et al., 2002). Epstein randomized obese children to interventions focused on increased exercise, decreased sedentary activity or both. At one-year follow-up, the group that focused on decreasing sedentary behavior had greater decrease in percent overweight and in percent body fat compared to the other two groups (Epstein et al., 1995). A small pilot study of an electronic time manager attached to the TV, in addition to counseling, showed, even with a small sample size of 28 families, a statistically significant increase in weekly hours of organized physical activity, compared to the control group who just received counseling (Ford et al., 2002). Similarly, a pilot study of making TV viewing time dependent on pedaling a cycle ergometer at a minimum level of intensity for one minute for two minutes of TV viewing, resulted in a statistically significant reduction in TV viewing time to 1.6 hours versus 21 hours/week in the control group (Faith et al., 2001). These strategies could be more widely tested.

Discussion and Implications

This small collection of studies gives support to the relevance and importance of developing and evaluating community-based strategies to reduce sedentary behaviour. The intervention in the methodologically strongest study was highly focused on decreasing TV and video viewing time and video game use. Certainly, the research needs to be replicated on other samples.

Implications for Research

- Replication of Robinson’s study of decreasing sedentary behavior (Children's Television Viewing: Project Account, 2001).

- Direct comparison of interventions comparing decreasing sedentary behavior versus increasing physical activity in non-obese samples.

- Testing of TV locking devices or exercise-contingent devices in non-obese samples.

- Further rigorous assessment of interventions to reduce video terminal use compared to multi-targeted approaches of decreasing video use, increasing activity, and improving nutrition, such as the intervention in the Gortmaker study (Gortmaker et al., 1999b).
• Evaluation of environmental changes to reduce sedentary behavior.

Conclusions

Work in this area is just beginning. The review included six primary studies that focused on reducing physical inactivity with or without interventions to reduce fat intake and increase fruit and vegetable intake. Of these, five were RCTs. The methodological rigour of several of the studies was weak. Four were school-based, one was community-based, and one involved parents only. One program with 18 lessons over seven months demonstrated both statistically and clinically significant gains for the experimental group of students. Several clinic-based programs for obese children have had positive results. These could be tested among community populations of children and youth.
Table 1: Quality Assessment Rating of Relevant Studies
Note: Studies listed by the name of the intervention and then by author where applicable

<table>
<thead>
<tr>
<th>Author (date) Project</th>
<th>Selection Bias</th>
<th>Allocation Bias</th>
<th>Confounders</th>
<th>Blinding</th>
<th>Data Collection Valid</th>
<th>Data Collection Reliable</th>
<th>Withdrawals and Drop-outs</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPLES Sahota et al. (2001)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>1/2</td>
<td>1/2</td>
<td>Moderate</td>
</tr>
<tr>
<td>Chomitz et al. (2003)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>Not Reported/Not Applicable</td>
<td>1/3</td>
<td>1/3</td>
<td>Weak</td>
</tr>
<tr>
<td>Eat Well and Keep Moving Gortmaker, Cheung et al. (1999)</td>
<td>Strong</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>2/3</td>
<td>3/3</td>
<td>Moderate</td>
</tr>
<tr>
<td>GEMS - Stanford Robinson et al. (2003)</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Strong</td>
<td>2/5</td>
<td>2/5</td>
<td>Strong</td>
</tr>
<tr>
<td>Planet Health Gortmaker, Peterson et al. (1999)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>2/3</td>
<td>2/3</td>
<td>Strong</td>
</tr>
</tbody>
</table>
Table 2: Results of Relevant Studies

Note: Studies of better quality indicated by bold font; Studies listed by name of intervention and then by author where applicable

<table>
<thead>
<tr>
<th>Author (date)</th>
<th>Country</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| APPLES Sahota (2001) United Kingdom | • Randomized trial  
• 636 children in 4th and 5th grade (7-11 years) in 10 schools divided equally between intervention and control | • Intervention implemented over one academic year  
• Program aims to link the school with family and community; program focused on parents, teachers, catering staff, students and the school environment  
• Intervention taught by classroom teachers included:  
  • Teacher training  
  • Modification of school meals  
  • Development and implementation of school action plans designed to promote healthy eating and physical activity  
Theory:  
• Health Promoting Schools concept | Follow-up data collected at the end of the intervention:  
• Intervention children had significantly higher vegetable intake (weighted mean difference 0.3; 95% CI 0.2 to 0.4)  
• No significant difference in BMI  
• No significant difference in physical activity and sedentary behaviour | • Intensity of the intervention is unknown and may be a contributing factor to the lack of effect for the intervention  
• Although there is a statistically significant difference in fruit and vegetable intake, .3 servings per day may not be clinically significant |
| Children’s Television Viewing Robinson (1999) United States | • Randomized trial  
• 227 children in grades 3 and 4  
• 2 schools matched on socio-demographic and scholastic variables  
• 1 school intervention; n=106 children  
• 1 control; n=121 children | • Training for teachers  
• 18 lessons taught by classroom teachers over 7 month period  
• Content on reducing media use by limiting access to TV sets, budgeting watching or playing time, increasing play time  
Theory:  
• Social Cognitive Theory | Compared to the usual school curriculum, the intervention group significantly reduced TV viewing; 5.53 hr/week (95% CI -8.64 vs -2.42) and video game use -2.54 hr/week (95% CI -4.48 to -0.60)  
• Children in the intervention group had statistically significant changes relative to control group in BMI (-0.45 kg/m), triceps skin folds (-1.47 mm), waist-to-hip ratio (-0.02), and frequency of eating meals in front of TV (-0.54) | • Intention-to-treat analysis |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| Chomitz et al. (2003) United States | • Quasi-randomized trial  
• Randomised to report card intervention, general information, control group, or post-test only  
• 4 elementary schools  
• 793 families | • Mailed materials  
1. Personalized health and fitness report card intervention  
• Child’s weight, height and weight status  
• Fitness test results with interpretive information  
• Referral of children outside of health weight range to follow up with primary care provider or school nurse  
2. General information intervention (2-1-5):  
• <2 hours TV or video  
• 1 hour physical activity  
• 5 servings fruit and vegetables  
3. Control group  
Theory:  
• Can’t tell | Assessed 1-6 weeks after materials mailed:  
• No effect of the intervention shown on improvement in “2-1-5”health behaviours  
• Among parents who had overweight children, those who received the report care were more likely to plan for medical help (p<.005), dieting (p=.02), and physical activities (p=.02) | • Outcomes assessed by telephone interview; 50% response rate  
• Potential confounder not controlled; control group mothers had less education than in other 2 groups |
| Eat Well and Keep Moving Gortmaker, Cheung et al. (1999) United States | • Quasi-experimental  
• 479 children in grades 4 and 5  
• 6 intervention schools  
• 8 matched control schools | • Taught by classroom teachers over a 2 year period  
• Training for teachers  
• Links to school food services  
• 21 lessons  
• Content on reducing TV time, total fat, saturated fat and increasing activity level and fruit and vegetable intake  
Theory:  
• Can’t tell |  
• Minutes in physical activity or in TV viewing did not differ significantly  
• Statistically significant improvements were found in the intervention group for total energy from fat (p=.004) and saturated fats (p=.05), fruit and vegetable intake (0.36 servings p=.01), vitamin C intake (p=.01) and fibre consumption (p=.05) |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEMS – Stanford Robinson (2003) United States</td>
<td>• Randomized trial • 61 8-10 year old mostly African-American girls from low-income neighbourhoods in California • Recruited from the community • Randomized into the treatment group or the ‘Active Control’ intervention</td>
<td>• Implemented over 12 wks by female African-American college students and dance troupe grads <strong>Treatment Group</strong> 1. GEMS Jewels dance class • 5 days/wk at 3 community centres • Healthy snack; 1 hr homework, 1 hr dance class, 30 min discussion • Developed to produce sustained moderate to vigorous activity 2. START (Sisters Taking Action to Reduce Television) • 5 lessons during home visits with family; specialist as behaviour change partner/role model • Encouraged non-selective reduction in total hrs and/or access to TV • Newsletters to reinforce lessons and update dance class activities <strong>Control Group</strong> • Info-based health education to promote healthful diet and physical activity delivered by African-American volunteers from American Heart and Diabetes Associations • Included monthly community health lectures and newsletters focused on reducing CVD risk</td>
<td>Final data collection at the end of the intervention: • No difference between groups on BMI, waist circumference, video game playing, and TV watching • Families in the treatment group had significant reduction in total household TV viewing (p&lt;.007) • No difference between groups in TV watching while eating breakfast • Intervention girls had a significant reduction in TV viewing while eating dinner by (p&lt;.03) • No difference between groups on total dietary calorie intake per day, % calories from fat • No difference between groups on physical activity between noon – 6 PM, previous day self-reported moderate to vigorous physical activity, physical activity liking, number of physical activities ever tried • Significant difference in over-concern with weight and body shape by intervention girls (p&lt;.03) • No difference in body shape dissatisfaction</td>
<td>• Number of girls in the treatment unable to attend the dance class more often due to lack of transportation to the centre • Girls attending dance class reported practising dance 3.9 days outside of class • Likely inadequate power to observe significant differences on most outcomes • Likely insufficient duration to produce significant physical activity changes and likely insufficient intensity to produce significant changes in TV viewing</td>
</tr>
</tbody>
</table>

Theory: • Social Cognitive Model
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| Planet Health Gortmaker, Peterson et al. (1999) United States | • Randomized trial  
• 1, 295 children grades 6 and 7  
• 5 intervention schools  
• 8 control schools | • Training for teachers  
• 32 lessons taught by classroom teachers over 2 year period  
• Content on reducing TV time, total fat, saturated fat and increasing activity level and fruit and vegetable intake  
Theory:  
• Behavioural-Choice Theory  
• Social-Cognitive Theory | • TV viewing in the intervention group was reduced for boys, 0.4 hours/day (p<.0001) and girls, 0.58 hours (p=.001)  
• Minutes in physical activity did not differ significantly  
• Prevalence of obesity for girls reduced in the intervention schools (OR 0.47, CI 0.24 to 0.93, p=.03); not for boys  
• Girls in the intervention ate 0.32 more servings of fruit and vegetables each day (p=.003) and consumed 575kJ/day less total energy | • Intention-to-treat analysis  
• Clinical significance of changes is unknown |
Reference List


Interventions to Increase Physical Activity in Children and Youth
This is a summary statement written to condense the work of the authors of a systematic review. The reference for the full review is below. The intent of this summary is to provide an overview of the findings and implications of the full review. Implications listed in the evidence table have been developed by summary statement authors for health-evidence.ca, and may reach beyond what the authors have stated in the review. For more information on individual studies included in the review, please see the review itself.


**Author Contact Info:**
Helen Thomas, RN, MSc
Effective Public Health Practice Project
2 King Street West, 3rd Floor
Dundas ON L9H 6Z1
(905) 546-2424 x1578
thomash@mcmaster.ca

**Issue:** In a recent study, Tremblay et al (Tremblay, Katzmarzyk, & Willms, 2002) estimated that the prevalence of childhood obesity among 7-13 year olds in Canada rose from 5% to 13.5% for boys and from 5% to 11.8% for girls between 1981 and 1996. Two-thirds of Canadian children ages 5-17 are not active enough to promote health benefits (Canadian Fitness and Lifestyle Research Institute, 1997). Health consequences for youth related to obesity include risks to the cardiovascular, endocrine, pulmonary, orthopedic and gastroenterological systems and to the development of healthy lifestyles and positive self-esteem and body image (Ball & McCargar, 2003). Physical activity patterns track from childhood into adulthood (Harvard Family Research Project, 2003). 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.

**Review Content Summary:** A systematic review was conducted to determine the effectiveness of interventions to increase physical activity in children and youth. The outcomes of interest included changes in physical activity measures,
changes in BMI, changes in total caloric intake and in percent fat intake, as well as several psychological measures. Only studies without serious methodological threats to internal or external validity are discussed.

Comments on this review’s methodology: A total of 21 relevant studies were included. Thirteen of these studies were conducted in the United States, three in the UK, and one in each of Canada, Australia, Denmark and France. All studies but one included boys and girls. Socioeconomic status was mentioned in only seven studies (four middle-class, two lower- and middle-class, one lower-class). Classroom and/or physical education teachers carried out the intervention in every study except two. Most of the studies employed samples that were either somewhat likely or unlikely to be representative of the target population. Nine of the studies employed randomized controlled trials, while the remainder were cohort studies with matched control groups. The cohort studies in general did not report controlling for confounders. Blinding of outcome assessors was rare; however, as a number of the outcomes were self-reported or used standardized measures such as weight, blinding may not be an important criterion for this type of study. Most of the outcome measures used were valid and reliable. Greater than half of the studies reported withdrawal and dropout rates of less than 20%, although nine studies had rates less than 40% or did not report withdrawals and dropouts. A sample size calculation was not reported for any of the studies, making it impossible to determine if a lack of significant results in some studies was due to a lack of statistical power. In over half of the studies assigning groups by classroom or school, analysis was conducted by individual without cluster analysis. Intervention consistency was not often reported. The proportion of intervention participants actually receiving the intended intervention was reported by approximately half of the studies. Only eight of the 21 studies did not have any serious methodological threats to their validity.

Evidence points are not weighted or ranked:

<table>
<thead>
<tr>
<th>What’s the evidence?</th>
<th>Implications for practice and policy:</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Several studies evaluated the effectiveness of additional physical activity classes versus skill development classes. Results were mixed, but three studies found improved outcomes among students engaging in physical activity classes.</td>
<td>&gt; School physical education classes should consider implementing more programs focused on exercise rather than on skill development. This will increase the amount of physical activity that students received during class time. In addition, the number of physical activity classes in which students can enroll could be increased.</td>
</tr>
<tr>
<td>&gt; One study found that the withdrawal</td>
<td>&gt; Although this study should be</td>
</tr>
</tbody>
</table>
of physical education specialists led to a decrease in student activity in physical education class. replicated, the use of physical education specialists appears to be one way to ensure that more vigorous physical activity occurs during classes.

> One study revealed that teacher expertise impacted the amount of vigorous activity students received; classroom teachers were often the intervention implementers in the included studies.
> Teachers need to receive adequate training and to be provided with sufficient motivation to carry out the intervention as planned.

> Positive, statistically significant changes were found for some studies (e.g. increases in minutes per week spent being active), but their clinical significance is not known
> The difference between clinical and statistical significance of outcomes needs to be clearly delineated.

> Interventions may have resulted in modest effects as a result of being carried out over a relatively short period of time. Interventions that did produce significant differences were those in schools that implemented the intervention in addition to regular physical education classes.
> The length and intensity of interventions need to be expanded.

**Ge**

> Methodological weaknesses need to be addressed in future research. The method of subject allocation to groups and appropriate analysis are issues that particularly need to be addressed.

Cost Benefit or Cost-Effectiveness Information: Not included in review.

References Used to Outline Issue:


The format of this summary statement has been adopted from health-evidence.ca (www.health-evidence.ca).
Interventions to Increase Physical Activity in Children and Youth

Introduction

This review includes interventions to improve physical activity. The outcomes may include changes in physical activity measures, changes in BMI, changes in total caloric intake as well as changes in percent of fat intake and several psychological measures. There are 21 relevant studies included in this review.

This review answers the question:

What is the effectiveness of interventions to increase physical activity in children and youth?

Methods

Please refer to the Methods section in the main Introduction, page 16.

Results

Description of Relevant Studies

There were 21 relevant studies. Table 2 displays the description of the relevant studies in detail.

Most of the studies were carried out in the United States (n=14). Three were completed in the United Kingdom. Investigators in Australia, Canada, Denmark and France reported one study each.

The ages of the participants varied from study to study. Two studies included grade two students, five included students aged 8-10 years, seven included students 10-12 years old, eight included adolescents, and one study included students of mixed ages. All but one of the studies included both males and females.

Socio-economic status of the participants was rarely reported. Four studies included students from middle-class backgrounds, one from lower-class and two were from mixed-lower and middle-class backgrounds. The remainder did not report the socio-economic status of the participants.

Although all of the interventions targeted increasing physical activity, their strategies varied. Twelve studies actually increased physical activity among the intervention group participants. Classroom/physical education teachers were the interveners in all but two studies. In one study the impact of different interveners (e.g. classroom teachers versus classroom teachers with additional training versus physical education specialists) on physical activity outcomes was reported. In another study, medical students provided
the intervention. Six studies implemented an intervention focused on increasing physical activity plus a health education component directed toward healthy lifestyles. One study focused on information related to the importance of physical activity and maintaining normal body weight. Another focused on physical activity only. Strategies to change the school environment were the focus of one study. Two studies included parental involvement and one involved the community as well.

Quality Assessment of Relevant Studies

The details of the quality assessment of the relevant studies can be found in Table 1.

Most samples were somewhat likely or unlikely to be representative of the target population. In some situations, whole classes were included, however, there was no data regarding how well they represented the student population in general. There were nine RCTs. The others were cohort studies where intervention groups were selected and then control groups were identified that matched the intervention group on a variety of variables.

Controlling for confounders in the cohort studies was generally not reported and therefore classified as weak. Blinding of outcome assessors to participant group was rarely done. Given that most of the outcomes were either self-report questionnaires or diaries or standardized measurements (e.g. height, weight, sit-ups) blinding may not be as important in these studies as in some others. The majority of outcome measurements were both reliable and valid. Over half of the studies reported withdrawal/drop-out rates of less than 20%, however nine studies either did not report these rates or the rates were less than 40%.

In more than half the studies where groups were assigned by classroom or by school, the analyses were carried out on individual outcomes, without any cluster analysis. This means that the similarities in students in a school/classroom were not taken into account in the results. No studies included a sample size calculation, so one cannot determine whether the lack of results in some studies is related to the lack of statistical power to find a difference or to the intervention not being effective.

There are two other issues that could influence the results that are related to program integrity. First is the consistency of the intervention. When many groups receive the intervention it is important to be sure that results are not affected by the fact that the groups may have received different interventions. Few studies reported on the consistency of the intervention. Second, the proportion of participants that indeed received the intervention is important for the same reason. This was reported about half the time among the reviewed studies.

Findings From Relevant Studies

Table 2 includes the findings for all the relevant studies. Only those without serious methodological threats to internal or external validity are discussed in this section (n=8 studies). The results of those studies are presented below.
In Ernst and Pangrazi's Promoting Lifetime Activity for Youth, both groups of students had a 15-minute activity break each day for four weeks (Ernst & Pangrazi, 1999). The intervention group teachers took an active role in teaching and participating in activities. In the control group, teachers did not participate in the activity breaks. For the subsequent eight weeks, students recorded their daily physical activity, but there were no additional activity breaks. Statistically significant (p<.05) increases in physical activity were reported for intervention boys and girls at the end of the activity intervention and at 12-weeks post-test. Students in the intervention group maintained their levels of activity after the actual program ended. There was no change in physical activity between pretest, four-week test and 12-week post-test among students in the control group. Authors suggested that recording physical activities helped to maintain the level of activity.

Numerous outcomes have been reported for the SPARK project (SPARK: Project Account, 1999). McKenzie et al. (McKenzie, Sallis, Faucette, Roby, & Kolody, 1993) compared the effectiveness of teachers with different levels of expertise in physical education on length of lessons, amount of very active, moderately vigorous activity and amount of energy expended by each group of students over a two-year period (grades 4 and 5 students). The lessons were statistically significantly longer (38 minutes/week vs. 64.4 minutes/week vs. 79.7 minutes/week for traditional teachers vs. trained teachers vs. physical education specialists). As well, the students spent more time being very active as the expertise of the teacher increased (17.8 minutes/week vs. 32.7 minutes/week vs. 40.2 minutes/week). This increased activity is probably of little clinical significance. Groups did not differ on the amount of time spent doing moderate to vigorous activity outside of school. Sallis et al. (Sallis et al., 1997) reported that the program resulted in increasing abdominal strength and endurance among girls, but no difference for boys. Although there were differences at measurement points throughout the two years among the three groups, there were no statistically significant differences for boys or girls in BMI or skin fold thickness at the end of the program. The program improved some outcomes for girls. A follow-up study 1.5 years after the program ended indicated that withdrawing the physical education specialists led to a decrease in student activity in the classes.

Herman-Tofler & Tuckman (Herman-Tofler & Tuckman, 1998) described an intervention for children in grade 3. The intervention group received three exercise sessions (stretching followed by low to medium impact aerobics and then cooling down) per week for eight weeks. The control group continued with regular physical activity classes three times per week where students were taught racquet sports. There were no statistically significant differences found between the two groups on physical fitness or self-perception. Differences were noted between the two groups on creativity (p< .05) and fluency (p< .04).

Stephens & Wentz (Stephens & Wentz, 1998) had medical students provide classes to eight to 10 year olds with a 15-week intervention of 35 minutes of stretching (5 minutes), aerobic activity (20 minutes) and cooling down (10 minutes). Some health promotion information related to nutrition and heart health was discussed during the cool down time. The control group received regular physical education classes once per week. The intervention group had significantly smaller skin fold thicknesses (p< .01), significantly greater improvement on sit and reach (p< .001), and less weight gain than the control group (p< .001).
Hansen et al. (Hansen, Froberg, Hyldebrandt, & Nielsen, 1991) reported on the outcomes of a study of nine to 11 year old Danish students where the intervention group received three extra classes of regular physical activity per week for eight months. The control group received two classes per week during the study. Fitness as measured by mlO2/kg/min., was significantly increased (p< .05) in the intervention group post-intervention.

The intervention initiated by Tuckman & Hinkle (Tuckman & Hinkle, 1986) consisted of a running program of 30-minute sessions per week for 12 weeks in place of the regular physical activity class among students in grades 4 to 6. There was a gradual increase in distance interval workouts and relay runs as the children got older. The control group received the regular physical activity class for their grade. Post-test results indicated that intervention group boys had less body fat (p< .05). Both genders in the intervention group reported faster 800-metre runs (p< .01) than controls. The 800-metre run results persisted over eight months post-intervention for boys, but not for girls. Creativity for both genders post-intervention was significantly better (p< .001) among the intervention students.

Two studies reported on interventions with adolescents. Sadowsky et al. (Sadowsky, Sawdon, Scheiner, & Sticklin, 1999) tested an eight-week intervention with male and female 14 and 15 year olds. Students in the intervention group received moderate activity exercise for 40 minutes four times per week while control students participated in regular physical activity classes (number per week not stated). A small, but statistically significant decrease was noted in percent body fat in intervention females. There was no between group difference in BMI.

Eliakim et al. (Eliakim, Burke, & Cooper, 1997) conducted a study with 15-17 year old female high school students. The five-week intervention involved daily endurance type training. Outcomes were changes in skin fold thickness and percent thigh and abdominal fat. Both groups had significantly reduced overall percent body fat post-intervention. Control group students had a significantly greater (p< .05) percent fat in the distal thigh. No other significant differences were found.

**Discussion and Implications**

Eight of the 21 included studies did not have any serious methodological threats to their validity. Most of these studies involved interventions with children in grades 3 to 6. Although they all increased physical activity during the intervention, only two measured and demonstrated any lasting significant change. None of the studies found between group differences in BMI. Although positive, statistically significant changes were found in before/after comparisons among the intervention group students for several of the studies, their clinical significance is unknown. The interventions appeared to be more effective for boys than for girls. This may indicate that different interventions are required for males and females.

Several factors may account for the modest effects of the interventions. First, most of the interventions took place over a relatively short period of time. Six were between 8 and 15 week’s duration. SPARK and the study by Hansen et al. (Hansen et al., 1991)
were eight months long. Second, intensity of the intervention varied from daily to weekly.

Third, most students in the control groups received regular physical education classes. Some of the interventions took place during regular class time. Others involved additional classes. Those interventions that resulted in significant differences for the intervention groups were in addition to regular physical education classes.

Fourth, although the SPARK project did not demonstrate any increase in physical activity outcomes, it did show that the expertise of the teacher had an effect on the amount of vigorous exercise students received. Since classroom teachers implemented many of the interventions, it may be that they need additional training and motivation to implement the intervention to maximize the intervention outcomes.

**Implications for Practice and Policy**

- School physical education classes should consider implementing more programs focused on exercise rather than on skill development. This will increase the amount of physical activity that students receive during class time.

- The number of physical activity classes in which students can enroll could be increased.

- The use of physical education specialists is one way to ensure that more vigorous physical activity occurs during classes.

- Teachers need to receive adequate training and be provided with sufficient motivation to carry out the intervention as planned.

**Implications for Research**

- The difference between clinical and statistical significance of outcomes needs to be clearly delineated.

- Those studies with clinically significant outcomes need to be replicated.

- Methodological weaknesses need to be addressed in future research. The method of subject allocation to groups and appropriate analysis are issues that particularly need to be addressed.

- Length and intensity of the intervention needs to be expanded.

**Conclusions**

This review included 21 studies of interventions to increase physical activity. Of these studies, nine were RCTs. The methodologically strong ones (n=8) were included in the discussion. However, it is important to note that neither the consistency of the intervention between student groups, nor the proportion of students that actually received the intervention were reported. This makes it difficult to interpret the results,
because the lack of impact may be due either to the integrity of the intervention implementation or to the intervention itself.

Of the eight studies two reported statistically significant differences that are unlikely to be clinically significant, one study improved fitness within the experimental group and one impacted on boys but not girls. The remainder reported no between group differences. Intervention implementation must be monitored in future work. As well, it is possible that different interventions may be needed for boys and girls. All analysis should be gender specific.
Table 1: Quality Assessment Rating of Relevant Studies

Note: Studies listed by the name of the intervention and then by author where applicable

<table>
<thead>
<tr>
<th>Author (date) Project</th>
<th>Selection Bias</th>
<th>Allocation Bias</th>
<th>Confounders</th>
<th>Blinding</th>
<th>Data Collection Valid</th>
<th>Reliable</th>
<th>Withdrawals and Drop-outs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Winners</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>1/1</td>
<td>Strong</td>
</tr>
<tr>
<td>Pate et al. (2003)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baquet et al. (2001)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>2/2</td>
<td>2/2</td>
<td>Weak</td>
</tr>
<tr>
<td>Boyd and Hrycaiko (1997)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>1/1</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Eliakim et al. (1997)</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>2/3</td>
<td>3/3</td>
<td>Strong</td>
</tr>
<tr>
<td>Future Fit Connor et al. (1986)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>0/1</td>
<td>0/1</td>
<td>Weak</td>
</tr>
<tr>
<td>Goldfine and Nahas (1993)</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>0/1</td>
<td>Strong</td>
</tr>
<tr>
<td>Hansen et al. (1991)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>Weak</td>
<td>1/1</td>
<td>1/1</td>
<td>Strong</td>
</tr>
<tr>
<td>Herman-Tofler and Tuckman (1998)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>2/3</td>
<td>2/3</td>
<td>Strong</td>
</tr>
<tr>
<td>Jones (1990)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Mixed</td>
<td>2/3</td>
<td>2/3</td>
<td>Moderate</td>
</tr>
<tr>
<td>Mahon et al. (1993)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>1/5</td>
<td>1/5</td>
<td>Weak</td>
</tr>
<tr>
<td>Move It Groove It van Beurden et al. (2003)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>1/1</td>
<td>1/1</td>
<td>Weak</td>
</tr>
<tr>
<td>Phillip et al. (1989)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>2/2</td>
<td>2/2</td>
<td>Strong</td>
</tr>
<tr>
<td>Project Active Teens</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>1/1</td>
<td>Moderate</td>
</tr>
<tr>
<td>Promoting Lifetime Activity for Youth Ernst and Pangrazi (1999)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>1/1</td>
<td>Strong</td>
</tr>
<tr>
<td>Sadowsky et al. (1999)</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>4 Weak/1 Not Applicable</td>
<td>5/5</td>
<td>5/5</td>
<td>Strong</td>
</tr>
<tr>
<td>SPARK</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>3/3</td>
<td>3/3</td>
<td>Moderate</td>
</tr>
<tr>
<td>Staying WELL Abbott and Farrell (1989)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Not Applicable</td>
<td>0/1</td>
<td>0/1</td>
<td>Weak</td>
</tr>
<tr>
<td>Stratton (2000)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>2/2</td>
<td>2/2</td>
<td>Moderate</td>
</tr>
<tr>
<td>Tuckman and Hinkle (1986)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>3 Weak/3 Not Applicable</td>
<td>5/6</td>
<td>5/6</td>
<td>Strong</td>
</tr>
<tr>
<td>Werner and Durham (1988)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>1/4</td>
<td>1/4</td>
<td>Strong</td>
</tr>
</tbody>
</table>

Healthy Weights Review – Physical Activity Interventions 134
Table 2: Results of Relevant Studies

Note: Studies of better quality indicated by bold font; Studies listed by name of intervention and then by author where applicable

<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active Winners</strong> United States</td>
<td>Quasi-experimental 5th grade students (6 schools; 23 classrooms) in two rural communities in South Carolina  At least 65% of eligible participants were eligible for free or reduced-price school lunch program  175 intervention students: 49% male and 51% female; mean age 10.9 yrs; 87% African American  261 control students: 49% male and 51% female; mean age 10.8 yrs; 59% African American</td>
<td>Intervention: 18-months; four components: 1. Active Kids (after-school and summer physical activity program); focused on non-competitive physical activity; emphasized fitness activities and physical activity, social, and academic skills -Summer 1 program: three 2-wk sessions (5 hrs/day, 4 days/wk); After-school program: 2 hrs at end of school day, 5 days/wk (11 weeks for Fall 1 and 15 weeks for spring 2); 4-wk day camp in summer 2 (5 hrs/day for 4 days/wk); Fall program (students met 8 times for 2 hrs) 2. Active Home included a regular newsletter, take-home assignments for family physical activity, and family activity nights 3. Active School included activities to make physical activity more accessible and appealing 4. Active Community included physical activity featured in newspapers and incorporated into community events; a wellness committee of teachers and staff formed Theory: Social cognitive theory &amp; Pender’s health promotion model</td>
<td>Students recalled their physical activity for the previous day  No significant differences in mean daily number of 30-min blocks of moderate to vigorous physical activity (MVPA) or vigorous physical activity (VPA) during after-school hrs between intervention and control</td>
<td></td>
</tr>
<tr>
<td>Author (date)</td>
<td>Country</td>
<td>Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------</td>
<td>---------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Baquet et al. (2001)</td>
<td>France</td>
<td></td>
<td>• Quasi-experimental&lt;br&gt;• 551 secondary-school adolescents, aged 11-16 yrs&lt;br&gt;• Intervention Group: 503 students; 263 boys, mean age of 12.8 yrs; 240 girls, mean age of 12.7 yrs&lt;br&gt;• Control Group: 48 students; 21 boys, mean age of 13.5 yrs; 27 girls, mean age of 13.0 yrs</td>
<td>10-week intervention:&lt;br&gt;• 2 sessions of 3 physical education hrs per week; 2 normal physical education hrs; 1 hr short high-intensity intermittent running exercises (10 seconds) at 100-120% of maximal aerobic speed&lt;br&gt;Control:&lt;br&gt;• 2 sessions of 3 physical education hrs (spent in games such as handball &amp; badminton) per week&lt;br&gt;Theory:&lt;br&gt;• Can’t tell</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| Boyd and Hrycaiko (1997) Canada | • Quasi-experimental  
• 181 female students aged 9 to 16 years in grades 4 and 5 (pre-adolescent), 7 and 8 (early adolescent) and 9 and 10 (middle adolescent) from an independent school  
• Students were categorized as either high or low self-esteem; students from both categories were assigned to both the intervention and control groups | Intervention:  
• Conducted by the principal investigator over 6 weeks in regular PE class time (45 min)  
• Junior students received 9 classes; middle and upper school students received 12 classes  
• Physical activity focused on strength training, cardiovascular endurance, agility, and flexibility  
• Education to create positive self-image through awareness of physical activity benefits; early and middle adolescents received information on weight management/body image  
• Log books used to reinforce accomplishments and intervention Control:  
• Regular physical education classes taught by their instructor  
Theory:  
• Theories of the connection between physical activity and self-esteem found in psychology, education, sports psychology, etc. | • In the pre-adolescent group, the lower self-esteem students scored better than the high self-esteem students on total self concept (p<.05), and the intervention group scored better than the control on the Physical Appearance Scale (p<.01)  
• The intervention had an effect on early adolescents’ physical abilities self-concept (p<.01)  
• Younger participants appeared to find the program more beneficial and enjoyable than older participants  
• Most participants were interested in continuing with physical activity training  
• Teacher reaction to the intervention was mixed  
• Lack of significant differences may be a result of the scales used to separate the students into high and low self-esteem groups (e.g., the division between these two groups was not as clear as initially thought) |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| Eliakim et al. (1997) United States | • Randomized trial  
• 44 healthy female students, aged 15-17, in a high school in California  
• 61% Asian, 20% White, & 18% Hispanic  
• 22 intervention and 22 control students | Intervention:  
• 5 weeks of endurance-type training consisting of running, aerobic dance, competitive sports and occasional weightlifting  
• About 90% of time was spent in endurance-type activities  
• Activities varied in duration and intensity throughout the week  
Control:  
• Participation in a computer workshop  
| • Sum of skinfold thicknesses decreased in both intervention (from 74.6 to 64.3 mm, $p<.05$) and control students (from 60.6 to 54.3, $p<.005$)  
• % body fat (skinfold thickness) decreased among control students only (from 28.7 to 27.0, $p<.005$)  
• No significant change in % fat in distal thigh among intervention students, but significantly increased among control students at the end of the study  
• No significant differences in % abdominal fat in either group  
• No between group differences reported  
| No between group differences reported  
Small sample size (inadequate statistical power) may have influenced lack of between group differences  
Authors speculate the intervention prevented an increase in distal thigh fat |
| Future Fit  
Connor et al. (1986) United States | • Quasi-experimental  
• 3rd and 4th grade students enrolled in after-school programs at 4 centers; 40% male, 60% female  
• Students were 44% black, 44% Hispanic, 7% white, & 5% other ethnic origins  
• 26 intervention and 29 control students | Intervention:  
• Ran for 12 weeks and had two components:  
  1. Heart health education  
  • Curriculum included content such as cardiovascular system, attitude & decision making skills, risk factors & prevention of heart disease, & exercise physiology  
  2. Aerobic exercise  
  • Three 45 min exercise sessions per week, including warm-up, exercise, and cool-down  
  • Tried to keep heart rates between 60-80% of max heart rate for 20-25 min each session after first 3 or 4 weeks  
Theory:  
• Can’t tell  
| Post intervention, 62% of parents reported noticing changes in their children’s behaviour at home which they attributed to the intervention  
Changes included exercising more, better eating habits, more outgoing, and more active  
Intervention group did not maintain heart rate in target heart rate zone for the time needed to produce a training effect  
<p>| Only parents of intervention students completed a survey |</p>
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goldfine and Nahas (1993) United States</td>
<td>• Randomized trial • Male and female students aged 14-16 (grades 9 and 10) enrolled in required physical education in a suburban secondary school in Los Angeles • Students were mainly white and middle and upper class • 23 intervention 1 students (lectures) • 21 intervention 2 students (lectures and labs) • 46 control students</td>
<td>Intervention 1: • Lectures 1 day per week for 12 weeks and assigned readings • Topics included health-related fitness, cardiovascular fitness, flexibility and strength, muscular endurance, body composition, etc Intervention 2: • Lectures 1 day per week for 12 weeks and assigned readings (same as intervention 1 students) • Additional labs 1 day per week for 12 weeks to reinforce lectures (e.g., students design a personal exercise program) Control: • Participation in skill activities daily for 12 weeks Theory: • Can't tell</td>
<td>• No significant differences in adjusted posttest means (controlling for pretest differences) for self-reported level of voluntary physical activity during the previous four weeks among Intervention 1, Intervention 2, and control students</td>
<td>• Physical activity level calculated as sum of products from reported frequency, duration, and intensity of different activities that students participated in (other than physical education classes) during the previous four weeks • Small sample size may have reduced power to find a between group difference</td>
</tr>
<tr>
<td>Herman-Tofler and Tuckman (1998) United States</td>
<td>• Randomized trial • 52 third-grade students in a university-affiliated “research” school</td>
<td>Intervention: • Physical education teacher led three aerobics exercise sessions per week for eight weeks • Each session consisted of 5 min stretching to warm up, 25 min low- to medium-impact aerobics, and stretching to cool down Control: • Physical education teacher led traditional physical education classes three days per week • Each session consisted of 5 min stretching to warm up and instruction, practice, and games in racquet sports Theory: • Can’t tell</td>
<td>• Intervention and control groups did not significantly differ on posttest scores for: a) Perceptions of athletic competence, social acceptance, behavioural conduct, physical appearance, and global self-worth b) Time on 800-meter run c) Three out of five scales on the Torrence Test d) Intervention group scored higher on the creativity index and fluency subscales of the Torrence Test (p&lt;.05)</td>
<td>• Authors suggest that changing only one aspect of children’s lives for a short time may make it difficult to improve self-esteem • Authors question the value of the 800 meter run as an outcome for this group</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Jones (1990) England</td>
<td>• Quasi-experimental</td>
<td>Intervention:</td>
<td>• Intervention girls showed a significant decrease in physical activity participation (p&lt;.001)</td>
<td>• Participation in physical activity for 1 week was measured by an exercise diary</td>
</tr>
<tr>
<td></td>
<td>• 442 3rd yr secondary students (13 and 14 yr old boys &amp; girls) in 9 comprehensive schools</td>
<td>• 10-week health-related fitness course during a school term</td>
<td>• No significant change in 20-meter shuttle run performance among intervention group compared to control group</td>
<td>• Scoring system was based on points for amount of time spent doing specific physical activities</td>
</tr>
<tr>
<td></td>
<td>• Mix of inner-city, suburban, and rural schools in England</td>
<td>• Practical and theoretical components each week</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Practical component included 20-meter shuttle run, running activities, and circuit activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Theoretical component included a video, pulse counting, target rates, exercise &amp; muscles, etc</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Control:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Usual physical education course during a school term</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Theory:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A sociocognitive model of attitudes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mahon et al. (1993) United States</td>
<td>• Quasi-experimental</td>
<td>Intervention:</td>
<td>• Intervention group scored better than the control group on the one-mile run, timed sit-ups, and sit and reach, although the statistical significance of these findings were not reported</td>
<td>• Authors suggest the results may indicate this type of intervention is not enough to produce physiological changes in body fat or cardio-respiratory fitness</td>
</tr>
<tr>
<td></td>
<td>• 24 first grade children;</td>
<td>• Daily physical education classes (30 min each)</td>
<td>• No between group differences in body fat or cardio-respiratory fitness</td>
<td>• Methodological limitations means these results should be viewed with caution</td>
</tr>
<tr>
<td></td>
<td>• 10 intervention students attending a school with daily physical education</td>
<td>• Included aerobic activities 3 times per week and sport and motor skills twice a week</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 14 control students attending a school with twice weekly physical education</td>
<td>Control:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Twice weekly physical education classes (30 min each)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Motor and sport skill development</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Theory:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Can’t tell</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td><strong>Move It Groove</strong>&lt;br&gt;van Beurden et al. (2003) Australia</td>
<td>Quasi-experimental&lt;br&gt;1,045 Year 3 and Year 4 students in rural primary schools in Australia; 53% boys and 47% girls aged 7-10 yrs&lt;br&gt;9 intervention schools and 9 control schools</td>
<td>Intervention:&lt;br&gt;• 1 year; consisted of 5 strategies:&lt;br&gt;1. Establishment of school project teams (coordinated project; selected and tailored policy and environmental strategies for school)&lt;br&gt;2. Teacher “buddy” system: 3rd yr education teachers (buddies) matched with generalist teachers; buddies shared updated strategies and resources with teachers; generalist teachers shared teaching experience with buddies&lt;br&gt;3. Project web site which included resources for teachers&lt;br&gt;4. Funding to buy equipment&lt;br&gt;5. Four teacher training workshops&lt;br&gt;<strong>Theory:</strong>&lt;br&gt;• Can’t tell</td>
<td>• No significant differences in percent moderate to vigorous physical activity (MVPA)&lt;br&gt;• 3.3% increase in percent vigorous physical activity in intervention schools compared to control (p=.008)&lt;br&gt;• For boys and girls, there was significant improvement in most of the 8 fundamental movement skills (i.e., static balance, sprint run, vertical jump, kick, hop, catch, overhand throw, and side gallop) among the intervention group compared to the control group (p&lt;.05)&lt;br&gt;• Changes in girls sprint run, boys hop, and boys &amp; girls balance were not significant</td>
<td>• Withdrawal/drop-out rates were not reported</td>
</tr>
<tr>
<td><strong>Phillipp et al. (1989)</strong> United States</td>
<td>Quasi-experimental&lt;br&gt;6 physical fitness classes of 9th to 12th graders from 3 high schools in Albuquerque, New Mexico&lt;br&gt;Intervention students from 1 class at each school; 70 students in 1st yr cohort; 76 students in 2nd yr cohort&lt;br&gt;Control students from 1 class at each school; 66 students in 1st yr cohort; 69 students in 2nd yr cohort</td>
<td>Intervention:&lt;br&gt;• 6-wk summer physical education course (2 consecutive yrs)&lt;br&gt;• Course integrated physical fitness and health promotion in daily 4 hr sessions&lt;br&gt;• Curriculum topics included fitness and wellness issues and activities&lt;br&gt;• Course emphasized involvement in physical fitness activities via field experiences (e.g., hiking)&lt;br&gt;<strong>Control:</strong>&lt;br&gt;• Traditional summer school physical education curriculum that was oriented to team sports and had limited classroom instruction&lt;br&gt;• Daily 4 hr sessions for 6 weeks&lt;br&gt;<strong>Theory:</strong>&lt;br&gt;• Can’t tell</td>
<td>• In both the 1st and 2nd cohorts, intervention and control students did not show a significant change on skinfold thickness, weight, exercising regularly, or failing to exercise regularly&lt;br&gt;• In 1st and 2nd cohorts, intervention group showed significantly greater improvement on 1.5 mile run than control group (p&lt;.05)&lt;br&gt;• Intervention and control groups in both cohorts did not significantly differ on changes in weight, sit and reach, and sit ups</td>
<td>• Unit of measurement for weight (i.e., kg or lb) was not specified</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| Project Active Teens Dale (2000) United States | • Quasi-experimental and longitudinal  
• Participants began as 9th grade students, and were 1995 and 1996 high school graduates  
• 1995 cohort: 99 intervention subjects and 39 control subjects  
• 1996 cohort: 151 intervention subjects and 44 control subjects | Intervention:  
• Conceptual Physical Education (CPE)  
• 1 day of CPE in the classroom and 1 day in the gym per week for one full academic year  
• The remainder of the week included sports-based activities (traditional)  
Control:  
• Traditional Physical Education (TPE)  
• Classified as physical education received at a school other than the Project Active Teens school (ie) students who transferred from another school to the Project Active Teens school  
Theory:  
• Can't tell | • Outcomes measured in grades 11 and 12 and post graduation  
• Moderate Activity:  
  1995 cohort: CPE men more active than TPE men in grade 12 (p<.04); no difference remained post graduation; no differences for women  
  1996 cohort: no differences for men or women  
• Vigorous Activity:  
  1995 cohort: no differences for men or women  
  1996 cohort: CPE men significantly more active than TPE men post graduation (p<.01); no differences for women  
• Strength Activity:  
  1995 cohort: CPE women more active than TPE women in grade 11; no difference remained in grade 12 or post graduation; no differences for men  
  1996 cohort: no differences in females or males  
• Sedentary Behaviour:  
  1995 & 1996 cohorts: No differences for any of the groups at any time period | • Results should be viewed with caution because of the low response rate to the questionnaires  
• 1995 cohort: 30%  
• 1996 cohort: 38% |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| Promoting Lifetime Activity for Youth | • Randomized trial  
• Students from 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade elementary school classes  
• 5 schools from a suburban metropolitan district in the southwestern United States  
• Students had low-middle socioeconomic status; there were approximately equal number of boys and girls, mainly Caucasian and Hispanic  
• 14 intervention classes  
• 14 control classes | Intervention:  
• 12-weeks; complement to physical education classes:  
  1. Step 1 (4 weeks): students and classroom teachers took a 15 min activity break each day  
     Week 1: Teachers prompted students to be active at their own pace and intensity  
     Weeks 2-4: Teachers taught and participated in games and activities during activity breaks  
  2. Step 2 (8 weeks): students asked to record daily physical activity; no activity breaks  
Control:  
• 12-weeks:  
  1. Step 1 (4 weeks): 15 min activity break daily; teachers did not encourage student participation, teach games and activities, or participate  
  2. Step 2 (8 weeks): students asked to record how much TV they watched the previous day  
Theory:  
• Can’t tell | • Reported level of physical activity was significantly higher among intervention boys and girls at 4 weeks (after activity intervention) (p<.05)  
• There was no change at 12 weeks posttest  
• For control girls and boys there was no difference from pretest to 12 weeks posttest  
• Girls in the intervention group reported significantly higher scores on attraction to physical activity (p<.05); no difference for boys | • Authors suggested that recording daily physical activity helped maintain physical activity level gains |
<table>
<thead>
<tr>
<th>Author (date)</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sadowsky et al. (1999) United States</td>
<td>• Randomized trial • High school students; 92% of males and 80% of females were Asian • 39 intervention students; 13 males, mean age 15.1 yrs; 26 females, mean age 14.7 yrs • 22 control students; 3 males, mean age 15.3 yrs; 19 females, mean age 15.0 yrs</td>
<td>Intervention: • Moderate intensity exercise sessions 4 times per week for 8 weeks • Included warm-up before each session and 40-min sessions (5 min walking; 30 min aerobic activity; 5 min cool-down) • Led by physical education instructor and investigators Control: • Regularly scheduled physical education classes Theory: • Can’t tell</td>
<td>• % body fat measured by skinfold thickness at chest, midaxillary, subscapular, triceps, abdomen, suprailiac, and thigh • Significant decrease in % body fat in intervention females (p&lt;.05), but no significant differences among control females or either of intervention or control males • No significant differences in body mass index (p&lt;.05)</td>
<td>• All participants had a BMI of &lt;21 kg/m² at pretest • This study successfully employed the Ventilatory Response Index (VRI) for self-monitoring of exercise intensity • One limitation is that there was no information on sexual maturity to correlate with body fat or BMI</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| SPARK Sallis (1999) United States | • Randomized trial  
• 955 4th and 5th grade children from 7 elementary schools  
• Schools were randomized to two intervention groups (specialist-led and teacher-led) and a control group | • 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  
**Physical Education Specialists**  
• 3 30 min session/wk focused on high levels of physical activity; 15 min health-fitness activity, 15 min skill-fitness activity  
• 10 health-related activity units; intensity, duration and complexity was increased during intervention; 9 skill-related fitness units  
• Students recorded fitness level  
**Physical Education Teachers**  
• Taught behaviour change skills to generalize activity outside school  
• Weekly 30 min classroom sessions included goal setting, self-monitoring, stimulus control, and self-reinforcement  
• Homework and monthly newsletters to promote parent-child activity  
**Control:**  
• Usual physical education program  
**Theory:**  
• Health Belief Model  
• Social Learning Theory | • Final data collection at the end of the intervention  
• Significant difference between interventions and control for moderate to vigorous physical activity (min/wk) (p<.001)  
• Specialist-led group more active than teacher-led  
• All intervention students expended significantly more kcal/kg/wk than controls (p<.001); specialist-led significantly better than teacher-led  
• All intervention students spent significantly more time in PE class/wk than controls (p<.001); specialist-led group significantly higher than teacher-led  
• No differences on physical activity outside of school  
• No difference between groups for boys on all fitness measures  
• Girls in specialist-led group had significantly shorter mile runs (p<.03) and did significantly more sit-ups/min (p<.03) than girls in the teacher-led or control groups  
• No difference on other fitness outcomes | • Evidence of strong impact with this intervention when increased minutes of physical activity is the goal  
• Draws into question to some degree whether various fitness level measures are good indicators of program effectiveness  
• Physical education specialists maximized activity versus teacher led |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staying WELL Abbott and Farrell (1989) England</td>
<td>• Quasi-experimental • Students aged 10-11 yrs in two primary schools in a middle-class area • 55 intervention students from two schools; 32 boys and 23 girls • 56 control students from same two schools; 29 boys and 27 girls</td>
<td>Intervention: • From January to July • Teachers received a pack with information they could include in projects • Packs included teaching notes on exercise, how the body works, healthy eating and nutrition, smoking, alcohol, sleep and relaxation, and first aid • Packs included booklets, research reports, and case studies of health-related exercise projects in secondary schools • Parental involvement</td>
<td>• Change in percent of students who reported belonging to a sports group or class at school or outside school was not significantly different between intervention and control students • More intervention than control students reported increased use of sports facilities (p&lt;.01) • Change in percentage of students who reported visiting sports facilities with family members was not significantly different between intervention and control students • Fewer intervention girls reported visiting sports facilities with friends post-intervention (p&lt;.001)</td>
<td>• Outcome measures obtained via student daily records of physical activity for the previous day</td>
</tr>
<tr>
<td>Stephens and Wentz (1998) Unites States</td>
<td>• Randomized trial • 99 4th grade students 8 to 10 yrs old from two urban public schools in Cleveland • Student body was mainly Black and from low-income families • 45 intervention students from one school • 44 control students from the other school</td>
<td>Intervention: • 15-weeks; in addition to regularly scheduled 45 min physical education class held once per week: • Pairs of medical student volunteers met with students for 3 physical activity sessions per week • Sessions consisted of a 5 min warm-up, 20 min aerobic activity, and 5-10 min cool down • Medical students provided information about exercise, nutrition, and disease prevention during cool-down Control: • Regularly scheduled 45 min physical education class held once per week</td>
<td>• Intervention group showed a significant decrease in skinfold thickness compared to control group (p&lt;.01) • Compared to control group, intervention group had significantly greater improvement on sit and reach (p&lt;.001) and significantly lower heart rate during submaximal exercise and recovery (p&lt;.05) • Control group gained significantly more weight than intervention group (p&lt;.001)</td>
<td>• Although weight gain in control versus intervention group was statistically significant, it is very moderate and may be of little clinical significance, particularly given changes in height</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Stratton (2000) England</td>
<td>• Quasi-experimental • 5-7 yr old boys and girls in two urban primary schools in England • 27 intervention students from one school • 20 control students from the other school</td>
<td>Intervention: • Included a phase where students designed the tarmac playground area; markings were a castle, dragon, pirate ship, clock face, flower maze, fun trail and dens, hopscotch, letter squares, snakes and ladders, and circular maze • Except for a single football, play equipment was not allowed Control: • No playground markings • Limited equipment allowed</td>
<td>• Body mass (kg) changed little • Percent of playtime spent in moderate to vigorous physical activity (MVPA) and vigorous physical activity was stable among control students compared to an increase among intervention students (p&lt;.01) • Before intervention, intervention and control students spent 27 and 29 minutes of playtime respectively in MVPA per school day; post-intervention, this increased to 45 and 36 minutes (p&lt;.01)</td>
<td>• Percent of playtime spent in MVPA and vigorous physical activity and number of min of playtime in MVPA measured by recording time on a heart rate radio telemeter (time spent in heart rate zones) • Small sample size • Needs replication</td>
</tr>
<tr>
<td>The Odense Schoolchild Study Hansen et al. (1991) Denmark</td>
<td>• Randomized trial • 132 children 9 to 11 years old; 64 hypertensive and 68 normotensive • Randomized into: -Hypertensive training subgroup (32) -Normotensive training subgroup (35) -Hypertensive control subgroup (32) -Normotensive control group (33)</td>
<td>Intervention: • 3 extra lessons per week of regular physical education for 8 months • Lessons were 50 min long, including 10 min warm-up • Content of lessons the same as regular classes, which included organized games, gymnastics and exercises; regular exercise schedule of 2 weekly lessons was continued Control: • Regular schedule of physical education classes</td>
<td>• 51 of the 67 training children complied with the intervention throughout the intervention period; 48 took part in over half the lessons • Fitness as measured by ml O₂/kg/min in the training subgroups increased post-intervention (after 8 months) (p&lt;.05) • No significant between group differences in height, weight or triceps skinfold thickness</td>
<td>• Fitness was greater in the hypertensive training group than in the hypertensive control group • Only results for normotensive groups are reported here</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Tuckman and Hinkle (1986) United States</td>
<td>• Randomized trial • 154 students in a university-affiliated &quot;research&quot; school • 48 4th graders, 53 5th graders, and 53 6th graders (average age of 9.3, 10.3, &amp; 11.3 yrs, respectively) • Percent of non-white students in each grade ranged from 27-29%</td>
<td>Intervention: • Three 30-minute running sessions per week for 12 weeks • Gradual increase in distance, interval workouts, and relay runs • For 6th graders, 3 sessions were their only physical education activities • For 4th and 5th graders, remaining two periods during the week were regular physical education classes Control: • Regular physical education three times per week for 6th graders and 5 times per week for 4th and 5th graders for 12 weeks Theory: • Can't tell</td>
<td>• When posttest scores were adjusted for pretest scores, intervention boys had less body fat than control boys (p&lt;.05), and there was no significant difference in body fat between intervention and control girls • Intervention group performed significantly better on 800-meter run (p&lt;.001) and had significantly lower pulse rates (p&lt;.01) • No significant between group differences in 800 meter run at 5 months posttest follow-up (boys maintained their rate, but not girls) • Intervention and control groups did not significantly differ on 50-meter run, self-concept, perceptual-motor ability, planning ability, or visual-motor coordination • Treatment group had higher scores on creativity (p&lt;.001)</td>
<td>• The relationship between increased physical activity and increased creativity is a unique one that requires further examination</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Werner and Durham (1988) United States</td>
<td>• Quasi-experimental • 130 students from a rural public school in South Carolina • 66 intervention students (21 4th graders, 23 5th graders, and 22 6th graders); 1 class from each grade • 64 control students (16 4th graders, 24 5th graders, and 24 6th graders); 1 class from each grade</td>
<td>Intervention: 1. Physical education instruction in softball for 30 min twice a week for 9 weeks 2. Extra physical education for 20 min (included 3-5 min warm-up and 15 min cardio-respiratory endurance activity) 3 days per week • Nutrition information provided; classroom teachers had supplemental readings and resource information; physical education specialist available to assist teachers Control: • Physical education instruction in softball for 30 min twice a week for 9 weeks Theory: • Can’t tell</td>
<td>• Skinfold measurement decreased among intervention students and increased among control students (p&lt;.01) • Intervention group showed significantly greater improvement on timed mile run, sit ups, and sit and reach test than control group (p&lt;.01)</td>
<td>• A variety of factors including teacher and student motivation and onset of puberty among grade 6 students may account for the statistically significant intervention effect of grade and intervention (p&lt;.01)</td>
</tr>
</tbody>
</table>
Reference List


Interventions to Increase Physical Activity and Nutritional Intake in Children and Youth
Effective Public Health Practice Project
Summary Statement

December 2004

This is a summary statement written to condense the work of the authors of a systematic review. The reference for the full review is below. The intent of this summary is to provide an overview of the findings and implications of the full review. Implications listed in the evidence table have been developed by summary statement authors for health-evidence.ca, and may reach beyond what the authors have stated in the review. For more information on individual studies included in the review, please see the review itself.


Author Contact Info: Helen Thomas, RN, MSc
Effective Public Health Practice Project
2 King Street West, 3rd Floor
Dundas ON L9H 6Z1
(905) 546-2424 x1578
thomash@mcmaster.ca

Issue: In a recent study, Tremblay et al. (Tremblay, Katzmarzyk, & Willms, 2002) estimated that the prevalence of childhood obesity among 7-13 year olds in Canada rose from 5% to 13.5% for boys and from 5% to 11.8% for girls between 1981 and 1996. It has been estimated that over 50% of children exceed the recommended dietary intake of salt, fat, cholesterol and sugar (Lenfant, 1995). In addition, two-thirds of Canadian children ages 5-17 are not active enough to promote health benefits (Canadian Fitness and Lifestyle Research Institute, 1997). Health consequences for youth related to obesity include risks to the cardiovascular, endocrine, pulmonary, orthopedic and gastroenterological systems and to the development of healthy lifestyles and positive self-esteem and body image (Ball & McCargar, 2003). Although the causes of obesity are multiple and complex, programs directed at healthy eating and increasing physical activity or both are relevant to obesity reduction/prevention.

Review Content Summary: A systematic review was conducted to determine the effectiveness of interventions targeting children and youth aimed at improving nutritional intake, increasing physical activity, and/or preventing obesity. The outcomes of interest included body weight or BMI, percent kCalories from fat, servings of fruit and vegetables, moderate to vigorous physical activity, sit-ups per minute, mile run time, pO₂ levels,
sedentary activity, self-concept, self-efficacy, creativity, self-acceptance, and perception of physical appearance.

Comments on this review’s methodology: A total of 241 articles describing 51 separate studies were included. Thirty-nine of these studies were conducted in the United States, four in the UK, two in each of Australia and Greece, and one in each of Canada, Israel and Finland. Six studies included girls only, while the remainder included both males and females. One study’s participants were from high-income families, two studies included children from middle-class families, and 10 had participants from low-income families. Only 10 studies were reportedly based on a theory. Of these, social cognitive theory was the most frequently mentioned framework, followed by social learning theory and ecological theory. Twenty-seven of the studies employed randomized controlled trials, while the remainders were cohort studies with matched control groups. The limitations of the cohort studies included lack of control of confounders, high withdrawal and dropout rates, and lack of reporting blinding assessors of outcome measures. Of the RCTs, 23 rated as weak or moderate for selection bias, usually as a result of not reporting the percentage of selected individuals that agreed to participate. Eleven either did not blind outcome assessors or did not report on this criterion, while 15 studies blinded assessors for only some of the outcome measures. Data collection tools were reliable and valid in all studies except for three. Eighteen studies had withdrawal/dropouts rates of less than 20 percent, in five studies 60% to 79% completed the study, and fewer than 60% of respondents completed the study in four studies. A sample size calculation was reported for three studies. Nineteen studies resulted in no between group differences after the intervention. In the studies that did find differences, the findings were inconsistent and often minimal without any discussion of clinical significance. Eighteen studies had differing units of allocation and analysis; of these, only two conducted cluster analysis. The number of participants receiving the intended intervention and the consistency of intervention implementation were both reported in only six studies.

Evidence points are not weighted or ranked.

<table>
<thead>
<tr>
<th>What's the evidence?</th>
<th>Implications for practice and policy:</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Shifting the balance from skill development to aerobic activity in physical education classes results in increased physical activity among students.</td>
<td>&gt; Schools should consider changing the focus of physical education classes to aerobic activity. In addition, the frequency of physical education classes in secondary schools should be increased.</td>
</tr>
<tr>
<td>&gt; Several studies demonstrated that the amount of physical activity students engaged in during class was dependent on the qualifications of the teachers involved. Groups taught by physical education specialists experienced more physical activity than those led by regular teachers.</td>
<td>&gt; Increase the use and/or on-going supervision by physical education specialists of regular teachers in physical education classes.</td>
</tr>
<tr>
<td>&gt; The only study that measured the impact of student goal setting on</td>
<td>&gt; Introduce individual student goal setting in the areas of nutrition and</td>
</tr>
</tbody>
</table>

Healthy Weights Review – Multifaceted Interventions 153
<table>
<thead>
<tr>
<th>Physical activity and improved nutrition found that goal setting improved outcomes.</th>
<th>Physical education in elementary and secondary schools.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; None of the RCTs included a sample size calculation, making it impossible to determine if any of the studies lacked the statistical power to detect between group differences.</td>
<td>&gt; Successful interventions (effectiveness determined by RCT) should be replicated with sample size calculations to ensure there is an adequate sample to have the power to detect any between group differences.</td>
</tr>
<tr>
<td>&gt; Several studies reported significant results, however the clinical significance of some of the findings is questionable.</td>
<td>&gt; Experts in the field need to arrive at a consensus about what constitutes a clinically important difference.</td>
</tr>
<tr>
<td>&gt; Data analysis was rarely based on unit of allocation and cluster analysis was rarely reported. School-based programs often did not report the amount of exposure students had to the intervention, making it impossible to determine if implementation challenges affected the results. In addition, few studies conducted follow-up testing.</td>
<td>&gt; Conduct analysis at the same level as the unit of allocation and include cluster analysis. As well, intention to treat analysis should be conducted, and studies should be expanded to include longer term follow-up.</td>
</tr>
<tr>
<td>&gt; Many studies did not make the theoretical basis of their work explicit.</td>
<td>&gt; Future studies should clearly state their theoretical basis and demonstrate the connection between the intervention and the theory.</td>
</tr>
<tr>
<td>&gt; Few studies used the ecological model. Although it is more comprehensive, it raises other challenges.</td>
<td>&gt; Future studies based on the ecological model should address the challenges outlined by the investigators in this review before proceeding.</td>
</tr>
<tr>
<td>&gt; There is a paucity of work focusing on children that includes outcomes such as increased attention to body image leading to more body dissatisfaction for those who are overweight.</td>
<td>&gt; More thorough investigation of possible negative outcomes from interventions targeting children and aimed at preventing overweight and obesity is needed.</td>
</tr>
<tr>
<td>&gt; Some studies reported that interventions were effective for some subgroups, but not others (e.g. effective for girls, but not for boys).</td>
<td>&gt; Quantitatively and qualitatively investigate the reasons for the differences in outcomes for some subgroups (e.g. gender, family income level, culture, race).</td>
</tr>
</tbody>
</table>

**General Implications:**

| > |

**Cost Benefit or Cost-Effectiveness Information:** Not included in review.
References Used to Outline Issue:


The format of this summary statement has been adopted from health-evidence.ca (www.health-evidence.ca).
Interventions to Increase Physical Activity and Nutritional Intake in Children and Youth

Introduction

This review includes studies that have implemented primary prevention intervention strategies targeted at both increasing physical activity and improving nutrition/preventing obesity among children and adolescents. The outcomes may include one or more of BMI, percent kCalories from fat, servings of fruit and vegetables eaten daily, moderate to vigorous physical activity (MVPA), sit-ups per minute, mile run time, VO$_2$ levels, sedentary activity, self-concept, self-efficacy, creativity, self-acceptance and perception of physical appearance. There are 241 papers representing 51 relevant studies included in the review.

This review answers the question:

What is the effectiveness of interventions that focus on both improving nutritional intake and increasing physical activity in children and youth?

Methods

Please refer to the Methods section in the main Introduction, page 16.

Results

Description of Relevant Studies

Table 1 displays the description of relevant studies in detail. Most of the studies were conducted in the US (n=39). Four took place in the United Kingdom and two each in Australia and Greece. Authors in Canada, Israel and Finland each reported one relevant study. Six studies included females only, the remainder involved both males and females. Twenty-six studies targeted children up to and including grade five (up to age 10 years). Other studies targeted those in grades six to eight or adolescents. One study included all elementary school children. Many studies did not report on the income of the children's families (n=33). Ten studies included children from low-income families, two from middle-income families and one from families with high incomes. Children in four studies came from families with mixed incomes. Only 10 studies reported basing the intervention on a particular theory. The most frequently cited theories were social cognitive theory followed by social learning theory and the ecological theory.

Interventions varied in intensity, in duration and in the number of strategies employed. Many of these projects fell under the rubric of improving heart health and included strategies to prevent smoking, decrease blood pressure and decrease lipids in the blood as well as increasing physical activity and promoting healthy nutrition. Other heart health outcomes (e.g. cholesterol levels, blood pressure) are not reported in this review.

Healthy Weights Review – Multifaceted Interventions 156
Ten studies used what may be identified as an ecological approach within the school. These interventions were usually of two to five years duration. They included strategies directed at the students, the school environment and parents. Interventions such as educating children and/or parents regarding the value of healthy nutrition, improving the nutritional value in foods available in school lunch programs, encouraging children and parents to improve the nutritional value of lunches brought to school, encouraging physical activity throughout the day, and increasing aerobic physical activity during physical education classes were included in these projects. Other projects included actually increasing physical activity during the school day and providing education about the importance of increasing activity and of good nutrition.

Quality Assessment of Relevant Studies

The details of how studies rated on the six quality assessment criteria are displayed in Table 1. There were 27 RCTs and the rest were cohort studies with control groups matched on a number of variables. The cohort studies had some methodological weaknesses. Some did not control for confounders. Some had high withdrawal/drop-out rates and many either did not report blinding of assessors, or did not blind them. These flaws to validity mean that the results of the cohort studies should be viewed with caution.

Among the RCTs there were also some methodological limitations. Twenty-three of the RCTs rated either moderate or weak on selection bias. This was usually because the percent of selected individuals who agreed to participate was not reported. In 11 of the studies blinding of outcome assessors was either not reported or not done. In an additional 15 studies blinding rated as mixed because assessors were blinded for some outcome measurements but not for others. Data collection instruments were both reliable and valid for all but three of the studies. Four studies reported that less than 60% of participants completed the study. An additional five studies reported that between 60-79% of participants completed the study. The remaining 18 studies reported withdrawal/drop-out rates of less than 20%.

Only three studies reported a sample size calculation. Nineteen studies reported no between group differences in outcomes post-intervention. Although many studies reported some statistically significant between group differences following the intervention, these findings were inconsistent in that some studies reported changes in nutrition, others in physical activity, and only three reported changes in both. The reported differences were often small and no investigators discussed their clinical significance.

Many studies (n=18) used one group (e.g. schools) as the unit of allocation and another (e.g. students) as the unit of analysis. Of these studies, only two used cluster analysis in calculating the between group differences.

Only six studies reported the number of participants that received the intervention as planned. The consistency of implementation of the intervention across groups was reported in only six studies as well.
Findings from Relevant Studies

Table 2 outlines all the relevant studies. Because of methodological threats in the cohort studies (outlined above), only the findings from the RCTs are reported here.

Four studies involving the Girls Health Enrichment Multi-site Studies (GEMS) program in four different cities were found (GEMS Baylor: Project Account, 2003; GEMS Memphis: Project Account, 2003; GEMS Minnesota: Project Account, 2003; GEMS Stanford: Project Account, 2003). This intervention targeted 8-10 year old African-American girls from low-income neighbourhoods. In all settings, African-American females implemented the program. Although the interventions varied slightly from site to site, they all consisted of a 12-week program including interactive exercise such as dancing and games and snack preparation to improve nutrition. The participants set goals for these behaviours. As well, weekly behavioural/environmental assignments were sent to the girls and their parents. None of the studies found any significant differences in BMI, fruit juice and vegetable servings per day, percent calories from fat, minutes of MVPA, physical activity, self-efficacy, sedentary activity or home environment. One study found a difference (p<.01) in low-fat food consumption and percent energy from fat (p<.03) favouring the treatment group. The sample sizes in all the studies were small and may have resulted in inadequate statistical power to detect a between group difference in the other outcomes. As well, the intervention was quite short and not very intensive, which may account for the lack of changes in physical activity or sedentary behaviour.

Two of five studies reporting on the Know Your Body program were RCTs (Know Your Body I: Project Account, 1994; Know Your Body II: Project Account, 1994). Study participants were grade four males and females from families with mixed incomes. The program was delivered over three academic years in one study and over five years in the second. Classroom teachers who had received extra training delivered the program. They were provided with a variety of educational aids. The program had three components. The classroom curriculum consisted of two hours per week during the school year to promote a healthy diet and to engage students in endurance physical activities. Parent education included self-scoring on a chronic disease behavioural risk status instrument, newsletters, participation in the student curriculum, and evening seminars. The third component was risk factor screening of the students and explanation of optimal scores and strategies for changing the scores. In one study the results were given to both the intervention group students and their parents. In the other, both parents and students in one intervention group received the results, while only parents received them in the other group. The programs were based on a combination of the PRECEDE model, the Health Belief Model and Social Learning Theory. There were two statistically significant differences found. In the five-year study (Know Your Body I: Project Account, 1994) the intervention group from higher-income families reported a reduction (p<.05) in total fat intake, which was not found among the students from lower-income families. In the second study (Know Your Body II: Project Account, 1994), intervention girls had a significantly improved (p<.01) exercise recovery rate compared to the control group.

Stolley and Fitzgibbon (Stolley & Fitzgibbon, 1997) conducted an RCT with African-American mother and daughter dyads from low-income families. The mean age of the daughters was 10 years. The program consisted of one-hour weekly programs with 7 to 10 dyads. The intervention was based on the nutrition and fitness units from Know Your Body that were adapted for cultural relevance. The program had a greater impact on
mothers than on daughters. The intervention group daughters reported reduced percent fat calories compared to the control group (<.05).

The Cardiovascular Health in Children (CHIC) studies (CHIC 1: Project Account, 2003; McMurray et al., 2002) used a similar intervention but with different age groups of students. In CHIC 1 (CHIC 1: Project Account, 2003) grades 3 and 4 students from urban and rural settings were included. In the second study reported by McMurray et al. (McMurray et al., 2002) the age group was 11-14 year old students. In this study students came from rural settings with mixed incomes. Almost half of the families had annual incomes of less than $30,000. Following one day of training and with on-going support, classroom teachers implemented the intervention. The first study included two intervention groups. During the eight-week program, the classroom based intervention included two sessions per week focusing on selecting heart healthy foods and getting regular exercise. As well, students spent 30-minute sessions three times per week in aerobically oriented physical activity. In CHIC II, there were three intervention groups. The Exercise Only (ExO) group received 30 minutes of aerobic exercise three times a week for eight weeks taught by Physical Education teachers. The Education Only (EdO) group received information from the regular classroom teacher on smoking, exercise and nutrition for two classes per week for eight weeks. The third group (EE) received half of the two interventions over eight weeks. There were three significant differences between the EdO and EE groups: skin folds increased less in the EE group (0.9mm vs. 1.9mm, p=.0001); small increase in $\text{VO}_2\text{max}$ in EE group (p=.001); and, aerobic power increased in EE group (p=.001). Because there were no differences between the ExO and the EE groups, the authors concluded that although both education and exercise had a positive impact, exercise seemed to be the most important determinant. The short length of the intervention may have led to the small increases in the outcomes.

Hopper conducted two studies using the same six-week intervention among two different age groups. One study involved students in grades 2 to 4 (Hopper Family Participation Study 2: Project Account, 1996). The second study included students in grades 5 and 6 (Hopper Family Participation Study 1: Project Account, 1996). There were two intervention groups and a control group. The first intervention group, school only, received three 40-minute sessions of physical activity focused on non-competitive games plus two half-hour per week interactive sessions focused on healthy eating. The classroom teachers who delivered the programs received assistance from a physical education specialist and a nutritionist. The second intervention group received the same school-based intervention plus a family intervention including packets to read with their children, points for completing activities as a family and students received stickers and a balloon if the goal was achieved. Among the grades 2 to 4 students, the intervention groups consumed significantly more fruits and vegetables per day than the controls (p<.05). Among the grades 5 and 6 students both intervention groups reported less percent calories from fat (p<.05). The school and home group differed significantly (p<.05) from the control group for sit and reach flexibility. The duration of the intervention may account for the small between group differences found at the end of the intervention.

Sallis et al. (SPARK: Project Account, 1999; Sallis et al., 1999) reported on two studies to increase physical activity. Fourth and fifth grade students were included in Sports Play Active Recreation for Kids (SPARK) (SPARK: Project Account, 1999). There were two intervention groups in this two-year program. Both groups received the same intervention, but one was led by certified physical education specialists and the other by
trained classroom teachers. Regular classroom teachers led the control group. There were two components to the intervention. The first component included three 30-minute sessions per week focused on high levels of physical activity, ten health related activity units, and nine skill-related fitness units. The second component consisted of a weekly 30-minute self-management program that taught behaviour change skills to help generalize physical activity outside of school. The specialist led group was significantly more active than the teacher led group (p<.001) Both intervention group students expended significantly more kcal/kg/week than control students (p<.001). Girls in the specialist led group had significantly shorter mile runs and more sit-ups per minute (p<.003) than those in the teacher led group or the control group. There was no difference for boys. There were no between group differences in physical activity level outside of school.

Using a structural ecological model, the Middle-School Physical Activity and Nutrition (M-SPAN) study (Sallis et al., 1999) focused on slightly older students (grades 6 to 8). It was a two-year project with a much broader focus than SPARK. The interventions were aimed at increasing physical activity in physical education classes and throughout the rest of the school day, reducing fat intake by altering cafeteria choices and lunches brought from home, and promoting school policy changes to enhance these activities. Student health committees were formed in eight of the twelve intervention schools to promote project-related activities. Parents received education through a newsletter and presentations. Physical activity at school increased overall for the intervention students (p<.009) however there were insignificant changes for girls. Boys increased activity both inside and outside of school whereas girls increased activity only within school time. There was a significant reduction in BMI among intervention group boys only (p<.04). This study demonstrates the challenges of implementing a program based on ecological theory. The post-intervention response rate was 60%. The success of enablers to increase activity at other times than physical education classes varied from school to school. Altering food products in the cafeteria appeared to have been minimally implemented. There are many financial as well as other barriers in this area. The effectiveness of school policy change committees varied widely. Communication with parents may not have been sufficient to compete with other media. Finally, the program appears to be successful for boys, but not for girls.

In a similar project, the Australian Heart Research Institute (Australian Heart Research Institute: Project Account, 1996) conducted a study over one academic year with five intervention groups and a control group among children 10-12 years of age. Following two half-day training sessions classroom teachers provided all of the interventions. They were also provided with resource packages. The physical fitness group received six 30-minute classroom sessions of aerobic activity. The school-based nutrition program was comprised of 10 one-hour sessions to improve knowledge, attitudes and eating habits. The third group received the physical fitness and school nutrition program. The fourth group received the school nutrition program plus a home nutrition intervention. The home nutrition intervention included five nutrition messages. Parents were encouraged to assist in the homework and students received awards for returning completed homework. The fifth group received the home nutrition intervention only. Girls and boys in both fitness groups increased endurance (p<.05). Triceps skin fold thickness decreased in boys and girls in the fitness/school nutrition group (p<.05). Girls in the home nutrition group had a greater decrease in fat intake (p<.05). Girls in the school/home nutrition and home nutrition groups significantly decreased their saturated fat intake (p.05). Boys in the two fitness and school/home nutrition groups had
decreased sugar intake (p<.05). Although the differences were not large, there was some evidence that parental involvement produces more positive results for both physical activity and improved nutrition.

In the Active Programme Promoting Lifestyle Education in School (APPLES) project, Sahota et al. (Apples: Project Account, 2004) implemented a one academic year study with 7 to 11 year-olds. They do not describe the intervention in detail, but it included teacher training, modification of school meals and development and implementation of school action plans designed to promote physical activity and healthy eating. The only post-intervention difference was that intervention group children reported eating more servings of vegetables per day (0.3 servings) than the control group. The intensity of the intervention was not reported, which may account for the lack of between group differences. The other question raised by this study is regarding the clinical significance of such a small difference.

The Child and Adolescent Trial for Cardiovascular Health (CATCH) program was implemented among grade 3 students in 96 schools (CATCH (Child and Adolescent Trial for Cardiovascular Health): Project Account, 2003). The intervention lasted 2.5 years. Physical education teachers and food service staff implemented the intervention after receiving training. One intervention group received the school-based intervention including three sessions a week for 15 weeks focused on exercise and eating, followed by 24 sessions in 12 weeks to teach skill development through monitoring behaviour and goal setting. School environment interventions included for this group were directed at modification of lunch menus and food purchasing practices and increasing moderate to vigorous physical activity during physical education classes. The other intervention group received the school-based intervention plus a family intervention. The family intervention included four to six activity packs for home-based skill development and Family Fun Nights. Post-intervention results indicated that the intervention groups significantly improved on several outcomes compared to the control group: increased intensity of moderate to vigorous physical activity (MVPA) (p<.02); self reported vigorous activity (p<.003); decreased total fat intake and total fat in lunches (p<.001); decreased percent of calories from saturated fat and decreased intake of saturated fat (p<.01). There were no changes in BMI or skin fold thickness among the groups. There were no statistically significant differences in outcomes between the two intervention groups.

Pathways was a project implemented by Hunsberger et al. among third grade American Indian children (Pathways: Project Account, 2002) taking place over three academic years. There were four components to the project. The physical activity component included three 30-minute sessions per week during school time, as well as guided play during recess and encouraging after-school physical activity by teaching traditional American Indian games. Nutritionists assisted in training food service staff to plan and serve more nutritious meals. In two 45-minute sessions per week each academic year children tasted new foods and beverages and practiced behavior related to healthy eating and physical activity. Families were involved by receiving family packs (including snack packs) to promote healthy eating and physical activity in the home. Families were invited to family events at school. There were no statistically significant between group differences on percent body fat, BMI or physical activity. There were differences in fat intake and reduction in percent calories from fat and saturated fat (p<.05).

Warren et al. conducted the Be Smart Program (Warren, Henry, Lightowler, Bradshaw, & Perwaiz, 2003) with grade 1 and 2 students from high income, predominately
Caucasian families. Families were randomized into three intervention groups and a control group. The intervention took place over 14 months. It was based on the Social Learning Theory. The first intervention group received the Be Smart Program that was a series of 25 minute interactive and behavioural sessions focused on nutrition. The second group received the Play Smart curriculum over the same number of sessions as the Eat Smart program. These sessions focused on promoting physical activity in daily life. The third group received half of the first two interventions plus homework to be shared with parents and a regular newsletter. The control group received information about food, but not about nutrition. There were no statistically significant differences on fat content in diet, BMI or skin fold measures, or physical activity levels among the four groups. The Be Smart and Eat Smart groups increased fruit intake (p<.05), although this was not a clinically significant difference. One explanation regarding the lack of change in diet was that the groups were eating diets with low/moderate fat and medium to high fibre content at baseline.

The San Diego Family Health Project (San Diego Family Health Project: Project Account, 1993) was a family intervention of low- to middle-income Anglo-American and Mexican-American students in grades 5 and 6 and their families. The one year intervention consisted of three months of weekly sessions for 1.5 hours plus monthly or bimonthly maintenance sessions for nine months. Two graduate students led the activities. They included games and discussion with gradually increasing vigorous physical activity and diet education activities. The maintenance sessions were designed to teach skills to enhance ability to continue new skills. At 12-month post-intervention follow-up, there were no between group differences in physical activity or BMI. Anglo-American students, but not Mexican American students, had a decrease in fat intake (p<.0005). The intensity and frequency of the intervention may have been insufficient to alter physical activity.

Body Power, Chicago Health focused on sixth grade students (Chicago Heart Health: Project Account, 1998). Trained classroom teachers taught the intervention over one academic year. There were five modules consisting of two 20-minute sessions. The modules were entitled Special You, Foodwise, Keeping it Together, and Movin. Although there were significant differences in health knowledge and in attitude toward nutrition, there were no behavioural outcome differences. The intervention intensity was likely insufficient to alter behaviour.

Planet Health was an intervention directed at students in grades 6 and 7 (Planet Health: Project Account, 2000). Trained teachers taught 32 lessons over two school years focusing on reducing TV watching time, total fat and saturated fat intake and increasing activity level and fruit and vegetable intake. TV viewing was significantly reduced for boys (p<.0001) and girls (p<.001). However these results are probably not clinically significant. The prevalence of obesity in the intervention schools was reduced for girls (p=.03), but not for boys. Girls in the intervention group reported eating more fruits and vegetables (p=.003). These results (.32 servings per day) are not clinically significant.

Everhart et al. (Everhart, Harshaw, Everhart, Kermodie, & Stubblefield, 2002) provided an intervention group of high school students with an opportunity to interact with a media software program four times during the school year. The students recorded their physical activity and eating habits during the program and then the program provided guidance on physical activity and nutrition. There were no significant differences post-
intervention. The authors suggested that more frequent interaction with the program might have led to different results.

The Physical Activity and Teenage Health (PATH) program enrolled ninth and tenth grade students in inner city high schools (PATH: Project Account, 2002). This 11-week program included daily physical activity and health lectures by physical education teachers. As well, a 30-minute health promotion class was delivered five times per week. The physical activity consisted of 20-25 minutes of aerobic exercise (circuit training) and five minutes of lecture discussion regarding exercise, nutrition, stress management, heart disease, cancer and motivation. Twenty-four month post-intervention outcomes indicated that there was a significant increase in VO$_2$Max for females ($p<.001$). Females also reported significantly less consumption of high fat foods ($p<.04$) There were no differences in skin fold thickness or physical activity level. Again the intervention may be too short to actually change levels of physical activity.

The Stanford Adolescent Heart Health program targeted students in grade 10 at four high schools (Stanford Adolescent Heart Health Program: Project Account, 1996). Regular classroom teachers who had received specialized training delivered this seven-week program. It consisted of 20 50-minute sessions. Sessions included an introduction to cardiovascular risk factors (one session). Students were given handouts, worksheets and homework assignments. The next 12 sessions were divided into four modules: physical activity; nutrition; smoking; and, stress. Students were encouraged to set goals in each module. The next two sessions quizzed students on their knowledge regarding the modules. The final five sessions focused on problem-solving and developing action plans to change behaviour. A number of statistically significant differences were found between the intervention and control groups when measured two months post-intervention. These should be interpreted with caution because many of the outcome measures were not reliable or valid. Among non-regular exercisers at baseline, students in the intervention group reported a significant increase in physical activity ($p<.003$) The intervention group also reported significant increase in choosing heart healthy snacks ($p<.0010$). There was also a significant decrease in BMI ($p<.05$) and a decrease in triceps skin folds ($p<.004$). All of the outcomes favoured the intervention group.

New Moves, reported by Neumark-Sztainer et al. (Neumark-Sztainer, Story, Hannan, & Rex, 2003), randomly assigned female students in grades 9 to 12 to either an intervention or control group. The students were of mixed ethnicity: white, African-American, and Asian-American. The 16-week intervention consisted of four classes a week of physical activity and nutritional guidance and social support for one class every other week. No statistically significant differences were found either at post-program data collection or at eight-months post-program. Again, the short duration of the program is suggested to account for the lack of differences.

Wilson et al. (Wilson et al., 2002) targeted 11-15 year old African-American males and females from low-income families in a pilot study. The first intervention group had nine weekly two-hour sessions based on social cognitive theory related to eating and physical activity. The second intervention group received intervention number one plus strategic self-preservation videos and motivational interviewing. The control group spent 12 weekly sessions learning about health related issues. All three groups participated in a weekly after-school intramural sports program. There were no between group differences at post-intervention testing.
Discussion and Implications

Outcomes of the 27 RCTs indicate that their ability to impact on improving nutrition, increasing physical activity/fitness and reducing obesity are mixed. Although a variety of measures were used in data collection, most were reliable and valid. Thirteen studies significantly changed some nutritional outcomes. However the impact was observed on select groups in some cases. In one study, Anglo-American students positively benefited while there was no change for Mexican-American students. In two others, those participants from high-income families showed significant improvement while those from low-income families did not. In a fourth study, only girls were positively affected by the intervention. The question about why the intervention worked for some subgroups and not for others needs to be addressed.

Another question from these results is whether or not a statistically significant difference is clinically significant. For example, does increasing fruit and vegetable intake by 0.32 servings per day make any difference in nutritional health?

Significant reduction or small decreases in BMI or skin fold thickness were only reported in four studies. Again the question of statistical versus clinical significance needs to be addressed. Twelve studies reported significant increases in physical activity and/or fitness. Few studies did any follow-up testing so whether or not these post-intervention changes were maintained is unknown.

Several factors may account for these mixed and modest results. The fact that control groups received the usual physical education program in the school means that these studies are looking for changes above what might be expected through the regular program. In other words, they are not comparing an intervention with no intervention, but an intervention with usual practice. This may have diminished the impact of the programs.

When the differences were statistically insignificant but in the right direction, many investigators suggested that the duration and/or frequency of the program were inadequate to see significant changes. This may or may not be true. Another explanation is that some studies lacked statistical power to detect a difference because the small sample sizes. However, some studies with large samples did not detect a difference. No investigators presented a sample size calculation upon which to make this determination. In some studies, where interventions were successful in some areas and not others, it is possible that factors such as teacher skill and motivation, program implementation, family income and different ethnic mixes in the sample affected the outcomes. One study found a statistically significant difference in the amount of physical activity in the group led by physical education specialists, compared to the trained teachers’ group, compared to regular classroom teachers’ group. Regular classroom teachers, who received varying amounts of special training, implemented most of the interventions. In multi-site studies it is possible that the standardized program had mixed levels of success because it did not consider the social or cultural context within which the students live their lives. This may also account for how well teachers followed the program. The enthusiasm and commitment of the school and teachers was important to implementing the program as designed. In one study that reported it, only 38% of the
teachers used the materials consistently (Plotnikoff, Williams, & Fein, 1999). This is an implementation challenge for school-based programs.

School-based programs did not often report the amount of exposure students had to the program. If the exposure varied and was low for a lot of students, then the results may be explained by implementation challenges as opposed to ineffective programs.

Although many studies did not make their theoretical basis explicit, most had attributes that would suggest they were based on the social cognitive theory, or the ecological theory (treating the school as a community). Some studies based on the social cognitive theory included actually increasing aerobic physical activity at school. Others focused on engaging students in an interactive learning process related to setting personal goals after understanding the health benefits of increasing activity and improving nutrition. Those following the ecological theory emphasized change at many levels; school cafeteria food choices, bag lunch food choices, and increasing physical activity throughout the day as well as during class time. All programs that increased physical activity during class time used aerobic exercises versus skill development programs in an effort to maximize the effects on fitness, BMI and skin fold thickness. It is possible that programs based on some combination of the two theories might be more successful.

There are a number of study design issues that may have affected the outcomes. Although the students or schools were randomly allocated to intervention and control groups, the data analysis was rarely based on the unit of allocation. Cluster analysis that would have taken this into account was rarely reported. In many of the studies whose objective was to improve a variety of behaviours beyond physical activity, obesity and nutritional intake (i.e. Heart Health Studies), there was little information about which changes (if any) were emphasized in the teacher training.

In summary, the mixed results of these RCTs and the potential rationale for the findings mean that further work needs to be undertaken.

**Implications for Policy and Practice**

- Since shifting the balance from skill development to aerobic activity in physical education classes results in increased physical activity among students, schools should consider making these changes.

- Increase the frequency of physical education classes in secondary schools.

- Increase the use and/or on-going supervision by physical education specialists of regular teachers in physical education classes.

- Increase the emphasis on the connection between healthy nutrition, regular exercise and obesity/improved health in health education classes.

- Introduce individual student goal setting in the areas of nutrition and physical education in elementary and secondary schools.
Implications for Research

- Successful interventions (effectiveness determined by RCT) should be replicated with sample size calculations to ensure there is an adequate sample to have the power to detect a between group difference if there is one.

- Although several studies reported statistically significant results, the clinical significance of some of the findings is questionable. Experts in the field need to arrive at a consensus about what constitutes a clinically important difference.

- Conduct analysis at same level as unit of allocation and include cluster analysis.

- Conduct intention to treat analysis.

- Expand studies to include longer term follow-up.

- Future studies should clearly state their theoretical basis and demonstrate the connection between the intervention and the theory. Some studies may be based on more than one theory.

- Future studies based on the ecological model should address the challenges outlined by the investigators in this review before proceeding.

- More thorough investigation of possible negative outcomes from such interventions (e.g., increased attention to body image leading to more body dissatisfaction for those who are overweight). There is a paucity of work including these outcomes in children.

- Quantitatively and qualitatively investigate the reasons for the differences in outcomes for some sub-groups (e.g., gender, income levels of families, cultural differences, racial differences).

Conclusions

Fifty studies were included in this review, of which 27 were RCTs. The authors of many of the studies had produced more than one paper on the subject. In these instances, all the papers were reviewed and evaluated as one for relevance and methodological rigour.

The interventions varied by intensity, duration and the number of strategies employed to increase physical activity and to improve nutrition. As well, some of the studies were focused on improving heart health and also included strategies to prevent smoking and reduce cholesterol levels.

Overall, the results of most studies were, at best, modest. Several studies included small numbers of participants that might have reduced their statistical power to find a difference. Few reported the integrity of program delivery or the proportion of students that actually received the intervention. Future studies need to address these shortcomings.
Table 1: Quality Assessment Rating of Relevant Studies

Note: Studies listed by the name of the intervention and then by author where applicable

<table>
<thead>
<tr>
<th>Author (date)</th>
<th>Selection Bias</th>
<th>Allocation Bias</th>
<th>Confounders</th>
<th>Blinding</th>
<th>Data Collection Valid</th>
<th>Data Collection Reliable</th>
<th>Withdrawals and Drop-outs</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPLES</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>5/6</td>
<td>4/6</td>
<td>Strong</td>
</tr>
<tr>
<td>Australian Heart Research</td>
<td>Strong</td>
<td>Strong</td>
<td>Moderate</td>
<td>Mixed</td>
<td>3/6</td>
<td>3/6</td>
<td>Strong</td>
</tr>
<tr>
<td>Baxter et al. (1997)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>0/6</td>
<td>0/6</td>
<td>Strong</td>
</tr>
<tr>
<td>Body Power Chicago Health</td>
<td>Strong</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>1/1</td>
<td>1/1</td>
<td>Moderate</td>
</tr>
<tr>
<td>CATCH</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>6/6</td>
<td>6/6</td>
<td>Strong</td>
</tr>
<tr>
<td>CHIC I</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>6/6</td>
<td>6/6</td>
<td>Strong</td>
</tr>
<tr>
<td>CHIC II McMurray et al. (2002)</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak (not reported)</td>
<td>3/3</td>
<td>3/3</td>
<td>Weak</td>
</tr>
<tr>
<td>Chomitz et al. (2003)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>nr/na</td>
<td>1/3</td>
<td>1/3</td>
<td>Weak</td>
</tr>
<tr>
<td>Christodoulidis et al. (2001)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>1/2</td>
<td>1/2</td>
<td>Weak</td>
</tr>
<tr>
<td>Crete</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Mixed</td>
<td>9/9</td>
<td>9/9</td>
<td>Moderate</td>
</tr>
<tr>
<td>Dance for Health Flores (1995)</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Weak</td>
<td>1/1</td>
<td>1/1</td>
<td>Weak</td>
</tr>
<tr>
<td>Davis et al. (1995)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>4/4</td>
<td>4/4</td>
<td>Strong</td>
</tr>
<tr>
<td>Donnelly et al. (1996)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>4/8</td>
<td>4/8</td>
<td>Weak</td>
</tr>
<tr>
<td>Eat Well and Keep Moving Gortmaker, Cheung et al. (1999)</td>
<td>Strong</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak (not reported)</td>
<td>1/3</td>
<td>1/3</td>
<td>Moderate</td>
</tr>
<tr>
<td>Everhart et al. (2002)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>2 Weak/1 Not Applicable</td>
<td>2/3</td>
<td>2/3</td>
<td>Strong</td>
</tr>
<tr>
<td>Fardy et al. (2002)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>Weak (not reported)</td>
<td>4/7</td>
<td>4/7</td>
<td>Strong</td>
</tr>
<tr>
<td>GEMS - Baylor</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>4/4</td>
<td>3/4</td>
<td>Strong</td>
</tr>
<tr>
<td>GEMS - Memphis</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>7/8</td>
<td>7/8</td>
<td>Strong</td>
</tr>
<tr>
<td>GEMS - Minnesota</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>8/9</td>
<td>8/9</td>
<td>Strong</td>
</tr>
<tr>
<td>GEMS - Stanford</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Strong</td>
<td>9/9</td>
<td>9/9</td>
<td>Strong</td>
</tr>
<tr>
<td>Go For Health</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Mixed</td>
<td>2/3</td>
<td>3/3</td>
<td>Weak</td>
</tr>
<tr>
<td>Author (date) Project</td>
<td>Selection Bias</td>
<td>Allocation Bias</td>
<td>Confounders</td>
<td>Blinding</td>
<td>Data Collection Valid</td>
<td>Data Collection Reliable</td>
<td>Withdrawals and Drop-outs</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------</td>
<td>-----------------</td>
<td>-------------</td>
<td>---------</td>
<td>-----------------------</td>
<td>--------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Heart Smart</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Mixed</td>
<td>4/5</td>
<td>3/5</td>
<td>Strong</td>
</tr>
<tr>
<td>Hopper Family Participation Project 1</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>5/5</td>
<td>5/5</td>
<td>Strong</td>
</tr>
<tr>
<td>Hopper Family Participation Project 2</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>3/3</td>
<td>3/3</td>
<td>Strong</td>
</tr>
<tr>
<td>Howard et al. (1996)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak (not reported)</td>
<td>3/3</td>
<td>3/3</td>
<td>Weak</td>
</tr>
<tr>
<td>Jump Into Action Holcomb et al. (1998)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>1/1</td>
<td>1/1</td>
<td>Weak (not reported)</td>
</tr>
<tr>
<td>Kansas Lean</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Mixed</td>
<td>1/2</td>
<td>1/2</td>
<td>Weak</td>
</tr>
<tr>
<td>Know Your Body - California Marcus (1987)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Mixed</td>
<td>2/2</td>
<td>2/2</td>
<td>Weak</td>
</tr>
<tr>
<td>Know Your Body I - Bronx</td>
<td>Moderate</td>
<td>Strong</td>
<td>Moderate</td>
<td>Mixed</td>
<td>4/4</td>
<td>4/4</td>
<td>Moderate</td>
</tr>
<tr>
<td>Know Your Body II – Washington</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>3/3</td>
<td>3/3</td>
<td>Weak</td>
</tr>
<tr>
<td>Know Your Body III - New York Resnicow (1992)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Mixed</td>
<td>2/2</td>
<td>2/2</td>
<td>Weak</td>
</tr>
<tr>
<td>Minnesota Class of ’89</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Mixed</td>
<td>2/3</td>
<td>2/3</td>
<td>Weak</td>
</tr>
<tr>
<td>Moon et al. (1999)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>0/3</td>
<td>0/3</td>
<td>Moderate</td>
</tr>
<tr>
<td>M-SPAN Sallis et al. (2003)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak (not reported)</td>
<td>4/7</td>
<td>7/7</td>
<td>Weak</td>
</tr>
<tr>
<td>Neumark-Sztainer et al. (2003)</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak (not reported)</td>
<td>3/7</td>
<td>7/7</td>
<td>Strong</td>
</tr>
<tr>
<td>North Karelia</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Mixed</td>
<td>1/1</td>
<td>1/1</td>
<td>Strong</td>
</tr>
<tr>
<td>PATH</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>4/4</td>
<td>3/4</td>
<td>Strong</td>
</tr>
<tr>
<td>PATHWAYS</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>Mixed</td>
<td>4/5</td>
<td>4/5</td>
<td>Strong</td>
</tr>
<tr>
<td>Planet Health</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>2/3</td>
<td>2/3</td>
<td>Strong</td>
</tr>
<tr>
<td>Plotnikoff et al. (1999)</td>
<td>Strong</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>6/6</td>
<td>6/6</td>
<td>Strong</td>
</tr>
<tr>
<td>San Diego</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Mixed</td>
<td>4/4</td>
<td>4/4</td>
<td>Strong</td>
</tr>
<tr>
<td>Author (date) Project</td>
<td>Selection Bias</td>
<td>Allocation Bias</td>
<td>Confounders</td>
<td>Blinding</td>
<td>Data Collection Valid</td>
<td>Reliable</td>
<td>Withdrawals and Drop-outs</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------</td>
<td>-----------------</td>
<td>-------------</td>
<td>----------</td>
<td>-----------------------</td>
<td>----------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Schools for Healthy Lifestyles Rhoades et al. (2001)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak (not reported)</td>
<td>6/7</td>
<td>6/7</td>
<td>Strong</td>
</tr>
<tr>
<td>SPARK</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>3/3</td>
<td>3/3</td>
<td>Moderate</td>
</tr>
<tr>
<td>Stanford Adolescent Heart Health</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>5/6</td>
<td>5/6</td>
<td>Strong</td>
</tr>
<tr>
<td>Stolley &amp; Fitzgibbon (1997)</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak (not reported)</td>
<td>3/3</td>
<td>3/3</td>
<td>Strong</td>
</tr>
<tr>
<td>Tamir et al. (1990)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak (not reported)</td>
<td>3/3</td>
<td>3/3</td>
<td>Weak</td>
</tr>
<tr>
<td>Trois Rivieres</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Mixed</td>
<td>6/6</td>
<td>3/6</td>
<td>Weak</td>
</tr>
<tr>
<td>Warren et al. (2003)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>5/5</td>
<td>5/5</td>
<td>Strong</td>
</tr>
<tr>
<td>Wilson et al. (2002)</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak (not reported)</td>
<td>4/4</td>
<td>4/4</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

Healthy Weights Review – Multifaceted Interventions 169
### Table 2: Results of Relevant Studies

*Note: Studies of better quality indicated by bold font; Studies listed by name of intervention and then by author where applicable*

<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| **Alexanderov et al. (1988) Russia** | • Quasi-experimental  
• 4,213 males and females age 11 years  
• Those in one district became the intervention group n=2,250  
• Control group n=1,963 | • Broad health promotion program  
• Three sub-groups within intervention group:  
  1. Smoking and physical activity  
  2. Obesity  
  3. Lipids  
• Three year intervention; intensity not reported  
• Intervention targeted children, their families and the teaching staff  
• Health education materials, lectures, discussions, movies included in the intervention  
Theory:  
• Can’t tell | • All outcomes tested at baseline, annually during the intervention and, after the program ended  
• No statistically significant between group differences in the following outcomes: BMI, dietary intake of fat or fibre, or physical activity  
• Overall no difference between groups in changes in skinfolds; however, among males, the control group had an increase in all three years (p<.05); for females this was true for the first 2 years  | • Only outcomes related to nutrition, obesity and physical activity are reported here  
• Withdrawal and drop-out rates were not reported  
• Unit of allocation was the school and unit of analysis was the individual; no cluster analysis was reported |
| **APPLES Sahota (2001) United Kingdom** | • Randomized trial  
• 636 children in 4th and 5th grade (7-11 years) in 10 schools divided equally between intervention and control | • Implemented over one academic year  
• Program aims to link school with family and community; program focused on parents, teachers, catering staff, students and the school environment  
• Intervention taught by classroom teachers included:  
  • Teacher training  
  • Modification of school meals  
  • Development and implementation of school action plans designed to promote healthy eating and physical activity  
Theory:  
• Health Promoting Schools concept | • Follow-up data collected at the end of the intervention  
• Intervention children had significantly higher vegetable intake (weighted mean difference 0.3; 95% CI 0.2 to 0.4)  
• No significant difference in BMI  
• No significant difference in physical activity and sedentary behaviour | • Intensity of the intervention is unknown and may be a contributing factor to the lack of effect for the intervention  
• Although there is a statistically significant difference in fruit and vegetable intake, .3 servings per day may not be clinically significant |
<table>
<thead>
<tr>
<th>Author (date)</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| Australian Heart Research Burke (1996) Australia | • Randomized trial  
• 1147 children aged 10-12 years  
• 5 intervention groups and one control:  
  - Physical fitness  
  - Fitness plus school nutrition  
  - School nutrition group  
  - School nutrition plus home nutrition  
  - Home nutrition  
  - Control | • Interventions implemented by classroom teachers over the course of one academic year  
• Two half day training sessions provided to teachers on curriculum content and resource packages  
School-based Nutrition:  
• 10 1 hr lessons to improve knowledge, attitudes and eating habits  
• Special teaching guide for teachers  
Home-based Nutrition:  
• 5 nutrition messages communicated through comics  
• Parents encouraged to assist in homework assignments and prepare healthy recipes  
• Students received awards for returning completed homework  
Physical Fitness:  
• 6 30 min classroom sessions replaced the usual weekly health education class  
• Fitness activities were increased on intensity and duration  
• Fitness programs to be carried out for 15 min every school day  
Theory:  
• Can't tell | • Final data collection occurred at the end of the school year  
• Boys in the two fitness and school/home nutrition group had less sugar intake (p<.05)  
• No differences for sugar intake among girls  
• Girls showed a greater decrease in fat intake in the home nutrition group (p<.05)  
• No difference for boys between groups on fat or saturated fat  
• No difference in percent of children consuming more than the daily recommended amount of fat  
• Girls in the school/home nutrition and home nutrition groups decreased saturated fat (p<.05)  
• Girls and boys in fitness groups increased endurance (p<.05)  
• Tricep skinfolds decreased in boys and girls in the fitness/school nutrition group (p<.05)  
• No differences reported for other skinfold measures, % body fat, and BMI between groups | • Some evidence that parental involvement produces more positive results for both dietary and physical activity measures |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| Baxter et al. (1997) United Kingdom | - Quasi-experimental  
- Intervention Group n=601 male and female students aged 11-14 years in 3 schools  
- Control group n=289 same aged students in one school | - Broad heart health promotion intervention over 3 years  
- Included classroom teaching, health policies such as the Action Heart Charter and, school as a non-smoking site  
- Also community based in that printed and audiovisual materials were widely available  
- Took place in the schools, the community, and youth centres  
Theory:  
- Can’t tell | - Only outcomes related to nutrition and physical activity are reported here  
- No statistically significant between group differences in low fat spread or low fat milk consumption  
- Self reported exercise activity increased in 11 year olds in the intervention group (p=.01), however, it declined in 14 year olds | - Reliability and validity of outcome measures not stated  
- Limitations of the study include: short time to produce changes, limited additional resources for the program, intervention not informed by a systematic review of literature but based on best practices understood by health promotion professionals |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Be Smart Program Warren et al. (2003) United Kingdom</td>
<td>• Randomized trial • 218 grade 1 and 2 male and female students (ages 5-7) • High SES • 88% Caucasian • Intervention Group #1 n=56 • Intervention Group #2 n=54 • Intervention Group #3 n=54 • Control Group n=54</td>
<td>• School and family based intervention to prevent obesity • Weekly sessions in term 1, biweekly in terms 2-4: 20 weeks in total over 14 months • Intervention 1: Eat Smart: Series of 25 minute interactive sessions behaviourally focused on nutrition sessions • Intervention 2: Play Smart: similar sessions focused on promoting physical activity in daily life vs specific leisure skills • Intervention 3: half of intervention 1 and 2, plus homework to be shared with parents, and a regular newsletter • Control Group: Be Smart: Education program about food, but not about nutrition Theory: • Social Learning Theory</td>
<td>• No statistically significant difference between group post test differences in dietary fat content, BMI or skinfold measurements, or physical activity level. • Be Smart and Eat Smart groups increased fruit intake (p&lt;.05)</td>
<td>• Increase in fruit intake was not clinically significant • One proposed explanation for lack of changes in fat and fruit and vegetable intake is that most children/families were already eating diets with low/moderate fat content and medium to high fibre</td>
</tr>
<tr>
<td>Author (date)</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Body Power                    | - Randomized trial  
- 647 sixth grade students; rural, suburban, and residential  
- 26 schools assigned to curriculum only, curriculum with parent participation, or control group                                                                 | **Body Power**  
- Taught by classroom teachers over one school year  
- Training for teachers  
- Manual provided  
- Modules: Special You, Foodwise, Movin, and Keeping It Together  
- Content consisted of functions of the circulatory system, influences on diet, nutritional facts, importance of exercise, risk factors for CVD  
- Each module consisted of 2 40 minute sessions  
- Students received sets of activity sheets with each module to encourage children to act in heart healthy ways; received health logs for recording medical information  
Theory:  
- a model of health behaviour                                                                 | **No significant differences between intervention and control group for attitudes and behaviours related to CVD risk factors (nutrition and exercise)**  
**Significant differences observed for:**  
- health knowledge (p<.00005), simulated shopping behaviour (p<.005), and attitude toward nutrition (p<.004)                                                                 | **It is very likely that the intensity of the intervention was insufficient to significantly alter nutrition and physical activity behaviours**                                                                 |
| Chicago Health Petchers (1988) | United States                                                                                                                                  |                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                |                                                                                                      |

**Healthy Weights Review – Multifaceted Interventions**
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| CATCH Luepker (2003) United States | • Randomized trial  
• Grade 3 children in 96 elementary schools  
• 28 schools received the school-based intervention  
• 28 schools received the school- and family-based intervention  
• 40 schools served as controls (usual curriculum, food service, and physical education program) | • Implemented over 2½ yrs half-way through gr 3 to end of gr 5 by trained classroom and PE teachers and food service staff  
School-Based Classroom Curricula  
• Adventures of Hearty Heart & Friends (gr 3): 15 sessions in 5 wks  
• -focus on exercise and eating  
• Go for Health (gr 4-5): 24 sessions in 12 wks: monitoring, goal setting, skills training, GO foods  
School Environment  
• Eat Smart School and Nutrition Program: modification to lunch menus, food purchasing, recipes, food preparation and production  
• CATCH PE: increase moderate to vigorous activity in PE  
Family-Based  
• Home Team Program: Hearty Heart Home Team, Stowaway to Planet Strongheart, Unpuffables, Health Trek: activities for home skill development  
Family Fun Nights  
• Hearty Heart’s Fun Night Planet, Strongheart Night: 2hr night activity | Final data collection at the end of the intervention  
• Intervention schools significantly increased the intensity of moderate to vigorous physical activity compared to controls (p<.02)  
• Intervention schools significantly decreased total fat in lunches compared to controls (p<.001)  
• Intervention schools significantly decreased % of calories from saturated fat as compared to controls (p<.01)  
• Significant reduction in total fat intake among students in intervention schools (p<.001)  
• Significant reduction in saturated fat intake among students in intervention schools (p<.01)  
• Significant increase in self-reported vigorous physical activity (p<.003)  
• No difference in total minutes of daily physical activity between groups |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| **CHIC I** Harrell (2003) United States | • Randomized trial  
  2,103 3rd and 4th grade children from 18 elementary schools from urban and rural settings:  
  • 6 groups assigned to the classroom-based intervention (n=588)  
  • 6 assigned to the risk-based intervention (not discussed)  
  • 6 to control group (n=686) | • Implemented by classroom and physical education teachers over 8 weeks  
  • Teachers received 1 day of training in implementing the intervention; guidance and consultation were available during the intervention, and a member of the research team visited each class while the intervention was being taught to ensure compliance with intervention protocol  
  **Classroom-based intervention**  
  • American Heart Association Lower and Upper Elementary School Site Program Kits  
  • Two sessions per week focused on selecting heart healthy foods and getting regular exercise  
  • 30 min sessions 3 times of aerobically-oriented physical activity program from 24 lesson plans developed by an exercise physiologist for this project  
  **Theory:**  
  • Positive Behaviour Model | • Final data collection at 6 years post intervention  
  • Significant increase in physical activity score by intervention schools compared to controls (p<.05)  
  • No difference between groups on VO₂ max, heart rate, skinfolds, and BMI  
  • The one significant difference in physical activity behaviour is obtained from self-report, while other more objective measures did not result in similar findings  
  • The intervention is very likely of insufficient duration, frequency and intensity to result in significant behaviour changes |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| CHIC II McMurray et al (2002) United States | • Randomized trial  
• 1,140 male and female students aged 11-14 years, randomly assigned by school  
• Annual Family income ranged from >$50,000 (23.6%) to <$30,000 (47.2%)  
• 64% White, 24.4% African-American, 11.6% Hispanic, Asian, and other ethnicities  
• Rural settings | Three intervention arms:  
1. ExO: 30 min of aerobic exercise 3 classes/week for 8 weeks; taught by regular PE teacher during PE class  
2. EdO: Information on nutrition, smoking and PE focusing on skill development 2 classes/week for 8 weeks; taught by regular classroom teacher  
3. EE: Both ExO and EdO program  
Control:  
• Regular health and PE curriculum which did not focus on heart health or on exercise, but on skill development | • Skinfolds increased less in the EE group vs EdO or controls (p=.001)  
• No differences in change in BMI among groups  
• Small increase in VO₂ max significantly greater in EE group than in EdO group (p=.001)  
• Aerobic power increased in EE group vs EdO group (p=.0001) | • Only results related to physical activity and nutrition/obesity reported  
• Effectiveness may have been limited by short duration  
• Education alone does not impact body weight  
• Exercise and education had the most positive impact on BMI and skinfold thickness, but exercise seems to be the most important determinant |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| Chomitz et al. (2003) United States | • Quasi-randomized trial  
• Randomised to report card intervention, general information, control group, or post-test only  
• 4 elementary schools  
• 793 families | • Mailed materials  
1. Personalized health and fitness report card:  
   • Child’s weight, height and weight status  
   • Fitness test results with interpretive information  
   • Referral of children outside of health weight range to follow up with primary care provider or school nurse  
2. General information (2-1-5):  
   • <2 hours TV or video  
   • 1 hour physical activity  
   • 5 servings fruit and vegetables  
3. Control group Theory:  
   • Can’t tell | • Assessed 1-6 weeks after materials mailed  
• No effect of the intervention shown on improvement in “2-1-5” health behaviours  
• Among parents who had overweight children, those who received the report care were more likely to plan for medical help (p<.005), dieting (p=.02), and physical activities (p=.02) | • Outcomes assessed by telephone interview; 50% response rate  
• Potential confounder not controlled; control group mothers had less education than in other 2 groups |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| Christodoulidis et al. (2001) Greece | • Quasi-experimental Intervention:  
- 105 tenth-grade students in 2 senior high schools; 47 boys and 58 girls, aged 15 to 16 years  
Control:  
- 529 tenth-grade students in schools (none from the 2 intervention schools) in 9 towns; 189 boys and 349 girls | Intervention:  
- From September to May  
- 1 academic year of 25 daily lesson plans (5 lessons addressed theory and practice in health and exercise issues)  
- Reciprocal teaching style  
- Small groups of 3-6 students to maximize active participation  
- Activities were inclusive, and included cooperative and goal oriented activities, and individualized goal setting  
- Health information related to fitness principles and basic nutrition  
Control:  
- 25 physical education lessons during the year  
Theory:  
- Social cognitive; goal perspectives; planned behaviour | • Intervention and control did not significantly differ on frequency of vigorous sport/exercise involvement  
• Intervention group reported spending significantly more time on sport/exercise participation when involved in vigorous sport/exercise ($p<.001$)  
• Intervention and control did not significantly differ on any measure at the 10-month follow-up  
• No difference between groups in fruit consumption | • Authors suggest interventions be longer than 1 year to maintain effects  
• Physical education classes were limited to 25 during the year due to labour strikes |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crete Manios (2002) Greece</td>
<td>• Quasi-experimental</td>
<td>• Based on the <em>Know Your Body</em> program</td>
<td>• Follow-up at end of 6 year period <em>Nutrition</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 4171 first graders; 24 intervention and 16 control schools</td>
<td>• Taught by classroom and physical education teachers to grades 1 to 6</td>
<td>• Total energy consumed per day: intervention increases (p&lt;.05)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Urban and rural locations</td>
<td>• Health and nutrition component included 13-17hrs of classroom instruction</td>
<td>• Total fat: intervention group showed smaller increase (p&lt;.01)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Physical activity component included 4 to 6 hrs of instruction in two 45 min sessions per week</td>
<td>• Monounsaturated fatty acids: intervention group showed smaller increase (p&lt;.05)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Students supplied with workbooks covering CVD prevention</td>
<td>• Polysaturated fatty acids: intervention group showed smaller increase (p&lt;.005)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ran for 6 years</td>
<td>• Saturated fatty acids: intervention group had smaller increase (p&lt;.01)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Theory:</td>
<td>• Protein: intervention group showed smaller increase (p&lt;.05)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Social Learning Theory</td>
<td>Physical Activity</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Endurance run: intervention group did significantly better (p&lt;.0001)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Difference on leisure time physical activity in favour of intervention (p&lt;.05)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Weight: intervention group had less weight gain (p&lt;.05)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• BMI: intervention group had less weight gain (p&lt;.05)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Arm skinfolds: intervention group had less weight gain (p&lt;.001)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• No difference between groups noted for daily consumption of trans fatty acids and carbohydrates</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• No significant difference on fitness measures or supra-iliac and subscapular skinfold</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Authors conclude positive results due in part to parent involvement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Authors attribute more healthy food choices to the provision of heart healthy alternatives in school tuck shops</td>
<td></td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| **Dance for Health Flores (1995) United States** | • Randomized trial  
• 81 students in four 7th grade physical education classes in a California school  
• mean age 12.6 yrs, 54% female, 43% Hispanic, 44% African American, and 13% other ethnicity; low income  
• 43 intervention students  
• 38 control students | **Intervention:**  
• 12-weeks; 2 components:  
  1. Aerobic dance-oriented physical education classes 3 times per week; 50 min class included 10 min warm-up/cool-down and 40 min moderate- to high-intensity aerobic dance  
  2. Health education classes 2 times per week; each class consisted of 10 min didactic activity and 20 min of other types of activities: 25-lesson curriculum included nutrition, exercise, obesity and unhealthy weight regulation practices, smoking prevention, substance abuse, stress management, and peer pressure  
**Control:**  
• Usual physical education classes (mostly playground activities)  
**Theory:**  
• Can’t tell | • Significantly greater reduction in BMI among intervention girls compared to control girls (p<.05)  
• Difference in BMI between intervention and control boys was not significantly different (p<.05)  
• Intervention girls had a significantly greater decrease (p<.01) in resting heart rate than control girls  
• Intervention and control groups did not significantly differ on the timed mile run | • Author concluded that intervention was more effective for girls |
| **Davis et al. (1995) United States** | • Quasi-experimental  
• 2,018 5th grade children in 11 isolated schools: 6 Navajo and 5 Pueblo  
• Ages ranged from 9-13 years with most 11 and 12 years | **Intervention:**  
• Broad-based CVD curriculum specifically designed to be culturally sensitive for Navajo and Pueblo students in New Mexico  
• Five year program  
• Two hours per week for 13 weeks  
• Sessions led by Elders and teachers  
**Theory:**  
• Can’t tell | • Comparisons were made only within the same tribe  
• Intervention group in the Pueblo tribe reported reduced salt consumption (p<.01) and reduced use of butter on bread (p<.04)  
• No statistically significant differences noted in physical activity or self-perception | • All outcome measures were developed and pretested during the pilot phase of this study for cultural sensitivity  
• Only physical activity, nutrition and obesity outcomes are reported here |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Donnelly et al. (1996) United States</td>
<td>• Quasi-experimental • Grades 3-5 students • Intervention group n=102 • Control group n=236</td>
<td>• Program delivered over 2 years • Lunchpower (changes in meal planning by the kitchen staff) • Nutrition education: 9 modules per year over the two years • Aerobic activities 3 times per week for 30-40 min over the two years • Student activities were teacher led • Control group received regular curriculum in these areas Theory: • Can’t tell</td>
<td>• Outcomes measured at baseline and at the end of year 1 and year 2 of the program • No statistically significant between group differences after the two years in physical activity, BMI, one mile run • Statistically significant differences favouring the intervention group in decreased total energy and fat (p=.05) and increased fibre consumption (p=.05)</td>
<td>• Unit of allocation was the school and unit of analysis was the student; no cluster analysis is reported • Drop-out rates are not reported • The percentage of selected individuals who agreed to participate is not reported</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Eat Well and Keep Moving Gortmaker, Cheung et al. (1999) United States</td>
<td>• Quasi-experimental • 479 grade 4 and 5 male and female students • Intervention group n=190 (from 6 schools) • Control group n=289 (from 8 schools matched to intervention schools) • Mean age 9.2 years • Mixed ethnicity • Low income families</td>
<td>• 2 year intervention consisted of a variety of teaching aids and training (1 day) to be integrated into math, science, social studies and language arts; 13 lessons per year to be integrated plus 5 physical education lessons per year • Focus of lessons: decreasing consumption of fats, increasing fruit and vegetable consumption, reducing TV viewing and increasing physical activity • Control schools received regular curriculum Theory: • Can’t tell</td>
<td>• Based on 24 hr dietary recall, intervention group reported less energy from fat (p=.04), less energy from saturated fat (p=.05), increased fruit and vegetable intake (p=.01) • No significant difference in vigorous activity levels or reduction in TV and video game use • Both longitudinal and cross-sectional results have the same impact on dietary consumption and physical activity</td>
<td>• Intervention is a relatively straightforward one that has potential to be sustainable because it is taught by teachers and integrated into the regular curriculum • Teachers completed 71% of the possible 31 nutrition and physical activity lessons • Teachers found the lessons “effective” and students liked them • Although results are statistically significant, still high rates of energy from fat and clinical significance of changes is unknown</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Everhart et al. (2002) United States</td>
<td>• Randomized trial • 78 students in a high school: • 39 intervention students • 39 control students</td>
<td>Intervention: • Students interacted with multi-media software four times during the school year under the supervision of a physical education professional • Students recorded their physical activity and eating habits in the program for about 10 min during each interaction • Program provided guidance on nutrition and physical activity Control: • Students participated in their normal physical education classes and did not interact with the multi-media software program</td>
<td>• Intervention and control groups did not significantly differ on push ups, sit ups, and self-reported physical activity patterns post intervention • No nutrition outcomes reported</td>
<td>• Authors suggested that results may have been different if students were able to interact with the program more frequently • Small sample size leading to reduced statistical power may account for lack of statistically significant findings</td>
</tr>
<tr>
<td>Fardy et al. (1995) United States</td>
<td>• Quasi-experimental • Intervention group n=42 males and females • Control group n=12 • Mean age 16 years • New York City</td>
<td>Broad health promotion program • 10 week curriculum including classroom education re: CVD prevention and a walking and running exercise program • 25 classroom sessions for 40 min each alternating with 25 activity sessions for 20-25 min each</td>
<td>• Outcomes measured at baseline and program completion (3 months later) • No BMI, skinfold thickness, physical activity or food intake measures available for the control group, therefore can’t assess between group differences</td>
<td>• Socioeconomic information not reported • Only between group outcomes related to physical activity, nutrition and obesity are reported here</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| GEMS – Minnesota Story (2003) United States | • Randomized trial  
• 54 8-10 year old African-American girls from low-income neighbourhoods in Minneapolis  
• Recruited from the community  
• Girls were randomized into a treatment group (after school community program) or a control group (The GEMS club focused on self-esteem building) | • Implemented over 12 wks by trained GEMS staff  
Girlfriends for Keeps Intervention: (Keeps: Keys to Eating, Exercising, Playing and Sharing)  
• Club meeting format; 2 1hr sessions wk after school at 3 schools  
• Consisted of fun, culturally appropriate, interactive, hands-on activities emphasising skills building and practice of the specific health behaviours; incentives provided  
• Healthy snack provided, sometimes prepared by the girls; bottled water provided  
• Spent major portion of session on physical activity such as dance  
• Weekly family packets sent home to reinforced messages from program  
• Family night events  
• Phone calls by staff to parents to encourage and check progress  
Control Group  
• 1 session each month on Sat. mornings included arts and crafts, self-esteem activities, creating memory books and a workshop on African percussion instruments  
Theory:  
• Social Cognitive Theory | • Final data collection at the end of the intervention  
• No difference between groups on: BMI, waist circumference, fruit juice and vegetable servings/day, sweetened beverage/day, water servings/day, total energy intake, % calories from fat, self-efficacy for healthy eating, fruit and vegetable snack availability, parent encouragement for healthy eating, minutes of moderate-vigorous physical activity, physical activity self-concept, self-efficacy, sedentary activity preference, positive expectancy for physical activity, or physical activity home environment  
• Significant increase in healthy choice behavioural intentions for the intervention group (p<.001), and in moderate and unhealthy behaviours to control weight by treatment (p<.004 and p<.04)  
• Significant difference on physical activity preference in favour of treatment group (p<.04)  
• Significant increase in low fat food in the intervention group (p<.01) and % energy from fat (p<.03) | • Study is likely underpowered to observe a significant difference between groups on certain outcomes  
• Intervention is likely of insufficient duration, intensity and frequency to have a significant impact on behavioural outcomes |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| GEMS – Baylor Baranowski (2003) United States | • Randomized trial  
• 35 8-10 year old African-American girls from low-income neighbourhoods in Texas  
• Recruited from the community  
• Girls were randomized into a treatment group (4 week summer camp followed by 8 week home Internet intervention) or a control group (4 week summer camp) followed by a monthly Internet intervention (4 sessions) covering different topics | • Implemented over 12 weeks Summer Camp Program and Internet Intervention  
• 4 wk day camp conducted with Kid Venture Camps of Houston  
• Regular activities & topics/activities promoting Fun, Food and Fitness  
• Used interactive multimedia activities, buddy groups, dance training, games to increase fruit juice and vegetable intake and physical activity, snack recipe preparation, and goal setting  
• Weekly behavioural/environmental assignments provided through websites for girls and their parents  
• Focused on one fun physical activity, choose fruit or vegetable snack, physical activity in evening with parent, water vs soft drink  
• Reviewed previous week’s goals  
• Links to various websites of interest | • Final data collection at the end of the intervention  
• No difference between groups on BMI, waist circumference, total kCal, %kCal from fat, fruit and vegetable servings/day, soft drink servings/day, water intake/day, physical activity level or physical activity preference | • This study is extremely underpowered to see significant differences between groups  
• Intervention is likely of insufficient duration, intensity and frequency to produce significant differences in behaviour |
| Control Group | 4 wk regular summer day camp  
Girls asked to log onto website once a month; received general health information and links to other sites (different from intervention) Theory:  
• Social Cognitive Theory |  |  |  |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEMS – Memphis Beech (2003) United States</td>
<td>• Randomized trial&lt;br&gt;• 60 8-10 year old African-American girls from low-income neighbourhoods in Tennessee&lt;br&gt;• Recruited from the community&lt;br&gt;• Participants allocated to two intervention groups and one control</td>
<td>• Implemented over 12 wks by a trained graduate student and a member of the community centre&lt;br&gt;• 2 day training session prior to study with booster session as needed&lt;br&gt;Child-Targeted Intervention – GEMS Jamboree&lt;br&gt;• 90 min weekly sessions for 12 wks&lt;br&gt;• “Movin it” (physical activity- primarily hip hop dance) and “Munchin it” (nutrition)&lt;br&gt;Parent-Targeted Intervention -- EASY (Eating and Activity Skills for Youth)&lt;br&gt;• 90 min weekly sessions for 12 wks; dancing (EASY Moves) &amp; didactic nutrition (EASY Tips); 25 min each&lt;br&gt;• Alternating food preparation and nutrition-related games (EASY Fun)&lt;br&gt;Childcare for 8-10 yr old daughters&lt;br&gt;Control Group&lt;br&gt;• 1 90 min session for each month (3) of the intervention&lt;br&gt;• Focused on enhancing self-esteem in 8-10 year old girls</td>
<td>• Final data collection at the end of the intervention&lt;br&gt;• No difference between groups on: BMI, waist circumference, physical performance self-concept, physical activity preference, self efficacy for physical activity, fruit juice and vegetable servings/day, sweetened beverage servings/day, water servings/day, total energy intake, % calories from fat, physical activity on minutes or moderate – vigorous activity, comparing body shapes, weight concern – moderate behaviour, or weight concern – unhealthy behaviour&lt;br&gt;• Significant difference in over-concern with weight and shape by control girls (p&lt;.01)</td>
<td>• Likely that the study is underpowered to detect significant differences in the outcomes of interest&lt;br&gt;• Intervention is likely of insufficient duration and intensity to produce significant behavioural changes</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| **GEMS – Stanford Robinson (2003)** United States | • Randomized trial  
• 61 8-10 year old mostly African-American girls from low-income neighbourhoods in California  
• Recruited from the community  
• Randomized into the treatment group or the ‘Active Control’ intervention | • Implemented over 12 wks by female African-American college students and dance troupe grads  
*Treatment Group*  
1. GEMS Jewels dance class  
• 5 days/wk at 3 community centres  
• Healthy snack; 1 hr homework, 1 hr dance class, 30 min discussion  
• Developed to produce sustained moderate to vigorous activity  
2. START (Sisters Taking Action to Reduce Television)  
• 5 lessons during home visits with family; specialist as behaviour change partner/role model  
• Encouraged non-selective reduction in total hrs and/or access to TV  
• Newsletters to reinforce lessons and update dance class activities  
*Control Group*  
• Info-based health education to promote healthful diet and physical activity delivered by African-American volunteers from American Heart and Diabetes Associations  
• Included monthly community health lectures and newsletters focused on reducing CVD risk  
**Theory:**  
• Social Cognitive Model | • Final data collection at the end of the intervention  
• No difference between groups on BMI, waist circumference, video game playing, and TV watching  
• Families in the treatment group had significant reduction in total household TV viewing *(p<.007)*  
• No difference in TV watching while eating breakfast between groups  
• Significant reduction in TV viewing while eating dinner by intervention girls *(p<.03)*  
• No difference between groups on total dietary calorie intake per day, % calories from fat  
• No difference between groups on physical activity between noon – 6 PM, moderate to vigorous physical activity noon – 6 PM, previous day self-reported moderate to vigorous physical activity, physical activity liking, number of physical activities ever tried  
• Significant difference in over-concern with weight and body shape by intervention girls *(p<.03)*  
• No difference in body shape dissatisfaction | • Number of girls in the treatment unable to attend the dance class more often due to lack of transportation to the centre  
• Girls attending dance class reported practising dance 3.9 days outside of class  
• Likely inadequate power to observe significant differences on most outcomes  
• Likely insufficient duration to produce significant physical activity changes and likely insufficient intensity to produce significant changes in TV viewing |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go For Health Simons-Morton (1991) United States</td>
<td>• Quasi-experimental • Four elementary schools, two assigned to intervention and two to control (included grades kindergarten through grade 4) • Data collected from third and fourth grade children during three consecutive spring data collection periods</td>
<td>• Three-component intervention including training, consultation and technical support to teachers and food service staff who implemented the intervention Go for Health Curriculum • Six classroom-based education sessions promoting healthy eating and physical activity in and outside of school Children’s Active Physical Education • Five 6-8 week units in PE class • Encouraged enjoyable moderate to vigorous physical activity New School Lunch • Provided lower-fat, lower-sodium lunches within school environment • Modifications made to food purchasing, menus, recipes, and food preparation practices Theory: • Social Learning Theory • An organizational change model (Charters and Jones)</td>
<td>• Final data collection at end of the 24 month intervention • From imputed baseline values there were decreases in fat and sodium in the school lunches of intervention schools; no statistical comparisons between intervention and control schools reported • No significant differences in total fat, saturated fat, total energy and sodium between intervention and control groups • No significant differences reported on observed physical activity between intervention and control</td>
<td>• Appeared to be an effect in the expected direction for make up of school lunches although likely not significant; lack of baseline data collection severely limits the strength of this analysis • Appeared to be a trend toward a positive effect; comparisons between groups not reported • Very likely that the study was underpowered to see a significant difference between groups • Intensity, frequency and duration likely insufficient to produce significant changes in behaviour</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| Healthy Heartbeat School Project Plotnikoff et al. (1999) Australia | • Quasi-experimental  
• 15 intervention grade 6 classes (n=294 students) and 15 matched classes (n=363 students) from another region  
• Male and females students 11 and 12 years of age  
• Over 50% of the classes were in small rural schools | • Heart Health program including content areas related to heart disease, exercise, diet and smoking  
• Teachers of intervention classes provided with curricular materials, training, and on-going support and follow-up  
• Advice given to intervention schools re: possible structural changes to consider  
• Community campaign and involvement  
• Ten lessons (one per week for one term) on nutrition and physical activity  
• Control classes received the regular curriculum and had a school lunch committee  
Theory:  
• Ecological theory | • No statistically significant between group differences in attitudes to exercise and self-reported exercise or food intake  
• Statistically significant differences favouring the intervention group in flexibility for males and females (p<.01), aerobic endurance for females (p<.01), muscle strength for males and females (p<.05), and muscle endurance for males and females (p<.01) | • Unit of allocation was the classroom, unit of analysis was the student; no cluster analysis is reported  
• Only 38% of teachers in the intervention group reported using the program as designed, suggesting that the lack of significant results may be in part due to inconsistent program implementation |
• Male and female grade three students  
• Intervention group n=33  
• Control group n=25 | • Intervention: 30 min per week for one year focusing on knowledge re: heart health, nutrition and exercise, actual physical activity, meal planning and living tobacco-free in addition to the regular curriculum  
• Teachers and student nurses provided with resource books, posters, videocassettes and audiocassettes  
• Control received regular curriculum  
Theory:  
• Can’t tell | • Only outcomes related to nutrition and physical activity are reported here  
• No significant between group differences in BMI, physical activity self-report or 24 hr food recall. | • Convenience sample |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Smart Berenson (1995) United States</td>
<td>Quasi-experimental 266 4th and 5th grade students from 4 schools Mixed racial and socioeconomic population</td>
<td>Implemented over 1 school year by classroom/P.E. teachers Cardiovascular Disease Screening In providing CVD risk screening, students received knowledge re risk factors and how lifestyle contributes CV Health Curriculum Curriculum incorporated into a general science course; focused on healthful eating and exercise, self-esteem, adoption of healthy lifestyle Training Program for Staff 2 day school workshop on principles of CV health; bimonthly boosters Teacher facilitators received additional training in CV health promotion &amp; assisted other teachers Modification of School Lunch More healthful food alternatives offered and reduction in fat, saturated fat and sodium Aerobic Physical Education Program 12 lessons plus aerobic activities Students encouraged to increase leisure time physical activity Students received a Superkids-Superfit Resource guide Theory: Social Cognitive model primary framework</td>
<td>Final data collection at the end of the one year intervention Comparison between intervention and control groups not reported for skinfolds, waist circumference, blood pressure, or diet; assume no difference between groups Intervention group had significant increase in HDL compared to controls (p&lt;.05) Boys in the 5th grade in the intervention group had significantly reduced 1 mile run times compared to boys in the control group (p&lt;.01) No significant difference observed in the 1 mile run for girls Positive improvements in the amount of fat and sodium in school recipes reported along with more CV healthful food choices available; however, not reported as significantly different between intervention and control grades</td>
<td>There was a trend of decreased skinfolds in those students who improved their 1 mile run; however, comparisons between intervention and control students on these variables were not reported Intensity and frequency of the intervention may not have been sufficient to produce significant changes on behavioural measures</td>
</tr>
<tr>
<td>Author (date) Country</td>
<td>Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Hopper Family</td>
<td>United States</td>
<td>Randomized trial</td>
<td>Implemented over 6 wks by classroom teachers receiving assistance from elementary school PE specialist and a nutritionist</td>
<td>Final data collection occurred at the end of the intervention</td>
</tr>
</tbody>
</table>
| Participation Project 1 | Hopper (1996) | 132 grade 5 and 6 students | School only and school and home received the following interventions:  
  Physical Activity  
  - 3 40 min sessions/wk for 6 wks; focused on non-competitive games, educational gymnastics, dance and rhythmic activities  
  - Based on Superkids-Superfit from Heart Smart/Know Your Body  
  Nutrition  
  - 2 half hr sessions/wk for 6 wks; topics included reducing fat in the diet, preparing healthy snacks and heart healthy meals, etc.  
  - Teaching strategies included hands-on preparation, films, games, group discussion, and role playing  
  - School and home group received packets to read with their family; received points for completing activities as a family and submitting scorecards; students received stickers for handing in scorecards and a balloon if goal was achieved | School and home group differed significantly from controls for sit and reach flexibility (p<.05) but school only group did not | Length, intensity and frequency of intervention may not have been sufficient to produce the desired effects |
|                       |         | one 5<sup>th</sup> and one 6<sup>th</sup> grade class assigned to each of:  
  1. school and home intervention  
  2. school only  
  3. control |  | No significant difference observed between groups on sit-ups, pulse, and time to run one mile | Some indication that the involvement of parents in the intervention resulted in more promising effects |

Intervention groups had significantly less % of calories from fat than controls (p<.05)
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| Hopper Family Participation Project 2 | • Randomized trial • 97 grade 2 and 4 students • one 2nd and one 4th grade class received the school and home intervention • remaining 2nd and 4th grade class served as controls | • Implemented over 6 wks by classroom teachers receiving assistance from elementary school PE specialist and a nutritionist • School only and school and home received the following interventions:  
  **Physical Activity** • 4 30 min sessions/wk for 10 wks; focused on non-competitive games, educational gymnastics, dance and rhythmic activities • Based on Superkids-Superfit from Heart Smart/Know Your Body  
  **Nutrition** • 2 half hour sessions/wk for 10 wks; topics included reducing fat in the diet, preparing healthy snacks and heart healthy meals, etc. • Teaching strategies included hands-on preparation, films, games, group discussion, and role playing • School and home group received packets to read with their family; received points for completing activities as a family and submitting scorecards; students received stickers for handing in scorecards and a balloon if goal was achieved | • Final data collection occurred at the end of the intervention • No difference between groups on sum of skinfolds, time to run a mile, servings of grain and cereal per day, cholesterol intake, or saturated fat intake • Intervention group consumed significantly more servings of fruits and vegetables per day than controls (p<.05) | • Study could be underpowered to see differences between groups on certain physical fitness outcomes • Length, intensity and frequency of intervention may not have been sufficient to produce the desired effects • Some indicated that the involvement of parents in the intervention resulted in more promising effects • Clinical significance of nutritional change is not known |
| Hopper (1996) United States | | | | |

Healthy Weights Review – Multifaceted Interventions 193
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Howard et al. (1996) United States</td>
<td>• Quasi-experimental • 98 grade 4 to 6 female and male students • Intervention group n= 5 • Control group n=47 • Ages ranged from 9-12 years (Mean = 10.36 yrs)</td>
<td>• Promotion of prevention of CVD • Five sessions in modules: physiology of the heart, smoking, hypertension, diet and physical activity over one year Theory: • Can’t tell</td>
<td>• Statistically significant increase in self-reported running activity in intervention group at 1 year (p=.02) • No statistically significant differences in fitness, dietary habits, BMI or skinfold thickness</td>
<td>• No data about family/demographic characteristics presented • Only obesity, physical activity &amp; nutrition outcomes are reported here</td>
</tr>
<tr>
<td>Jump Into Action Holcomb et al. (1998) United States</td>
<td>• Quasi-experimental • 1,114 5th grade 10 to 12 year old males and females • 94% Hispanic • Low SES</td>
<td>• Program designed to reduce risk of Type 2 Diabetes in children • Both groups received the program, but the teachers in one group had received focused training regarding the program whereas the others had not Theory: • Can’t tell</td>
<td>• Self-reported eating and exercise behaviours • No between group comparisons • Both groups self-reported eating of healthy foods improved</td>
<td>• Unit of allocation was the class/teacher, unit of analysis was the student; no cluster analysis is reported • Results indicate that teacher training has no effect on outcomes • Drop-out rates are not reported, however appear to be high • Self-report survey had been tested for reliability and content validity</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Kansas Lean Harris (1997) United States</td>
<td>• Quasi-experimental • 136 4th graders in three schools in an urban centre • One school received the intervention (n=74) • Two served as controls (n=62)</td>
<td>• 2 registered dieticians at the school 20-30 hrs/wk give training &amp; guidance to foodservice staff and classroom &amp; physical education teachers, who implement the program Modify School Lunch: • Record and determine nutritional content of menu items/products • Get feedback on % calories from fat • Modify food preparation techniques and recipe ingredients • Change menu combinations Nutrition Education: • Incorporate American Cancer Society’s Changing the Course curriculum into 4th gr. curriculum • Teachers &amp; foodservice staff act as role models • Incentives for teachers to implement program Physical Activity: • Install physical activity stations in each classroom with workbooks • Provide non-competitive rewards • Increase time students spend in vigorous physical activity Theory: • Can’t tell</td>
<td>• Data were collected pre and directly post intervention • No significant difference in % fat content of menus reported • No significant differences between intervention and control schools on physical fitness</td>
<td>• Reduction in fat content of menus decreased from 38% to 30%, although not reported as a significant difference • Improvement in physical fitness occurred in both groups during the intervention period • The study is very likely underpowered to detect a significant difference between groups • Length, intensity, and frequency of intervention is also questionable</td>
</tr>
<tr>
<td>Author (date)</td>
<td>Country</td>
<td>Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------</td>
<td>---------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Know Your Body</td>
<td>California</td>
<td>–</td>
<td>• Quasi-experimental&lt;br&gt;• 1,400 4&lt;sup&gt;th&lt;/sup&gt; and 5&lt;sup&gt;th&lt;/sup&gt; grade children aged 9-11 years from 18 elementary schools&lt;br&gt;• Assigned to one of four comparison groups:&lt;br&gt;1. Know Your Body Curriculum and Health screening (688 students, 7 schools)&lt;br&gt;2. Health Screening only (333 students, 3 schools)&lt;br&gt;3. Know Your Body Curriculum only (253 students, 5 schools)&lt;br&gt;4. Control (234 students, 3 schools)</td>
<td>• Implemented over 3 academic yrs by classroom teachers in all but 2 schools, where Public Health Nurses implemented the program&lt;br&gt;Classroom Curriculum&lt;br&gt;• 2 hr sessions/wk in the school year promoting healthy diet and endurance physical activities&lt;br&gt;• Training provided to teachers&lt;br&gt;• Education guides, textbooks, health passports provided&lt;br&gt;Parent Education&lt;br&gt;• Parents asked to self score chronic disease behavioural risk status&lt;br&gt;• Mailed newsletters, participation in curriculum interactive activities, and evening seminars&lt;br&gt;Risk Factor Screening&lt;br&gt;• Screening results given to students verbally and in health passport&lt;br&gt;• Classroom teacher leads a discussion re optimal scores and strategies for changing scores&lt;br&gt;• Students encouraged to set one or more behavioural goals&lt;br&gt;• Parents/family doctor get a copy&lt;br&gt;• Parents receive copy of health newsletter 'The Pacesetter'&lt;br&gt;Theory:&lt;br&gt;• Can’t tell</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Know Your Body I – Bronx Walter (1989) United States</td>
<td>• Randomized trial • 3,388 grade 4 children from two demographically dissimilar areas • 22 schools from the Bronx, a lower-income inner city area: • 14 schools received the intervention (n=1,590) • 8 were controls (n=693) • 15 schools from Westchester, a middle to upper income suburb: • 8 schools received the intervention (n=485) • 7 were controls (n=620)</td>
<td>• 3 components; delivered over 5 academic yrs by classroom teachers Classroom Curriculum • 2 hr sessions/wk in the school year • Promotes healthy diet and endurance physical activities • Training provided to teachers • Education guides, textbooks, health passports provided Parent Education • Parents asked to self score chronic disease behavioural risk status • Mailed newsletters • Participation in curriculum interactive activities • Evening seminars Risk Factor Screening • Screening results given to students verbally and in health passport • Classroom teacher leads a discussion re: optimal scores and strategies for changing scores • Students encouraged to set one or more behavioural goals • Parents receive a copy Theory: • PRECEDE model • Health Belief Model • Social Learning Theory</td>
<td>• Final data collection at the end of the 5 yr intervention • Significant reduction in total fat intake among Westchester intervention students (p&lt;.05) • No difference in fat intake in Bronx students • No significant difference in intake of saturated fat, polyunsaturated fat, total protein, animal carbohydrate or sodium, for both Westchester and Bronx students • No difference in ponderosity index, or recovery index for either Bronx or Westchester</td>
<td></td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| Know Your Body II – Washington Bush (1990) United States | • Randomized trial  
• 431 students in grades 4-6 in nine elementary schools  
• Schools assigned to three groups:  
• Intervention group 1: Know Your Body curriculum plus parents and students receive results of CVD risk factor screening results  
• Intervention group 2: Know Your Body curriculum but only parents receive results of the CVD risk factor screening  
• Control group: does not receive any of the intervention | • Implemented over three academic years by classroom teachers  
Classroom Curriculum  
• 2 hr sessions/wk in the school year  
• Promotes healthy diet and endurance physical activities  
• Training provided to teachers  
• Education guides, textbooks, health passports provided  
Parent Education  
• Parents asked to self score chronic disease behavioural risk status  
• Mailed newsletters  
• Participation in curriculum interactive activities  
• Evening seminars  
Risk Factor Screening  
• Screening results given to students verbally and in health passport  
• Classroom teacher leads a discussion re optimal scores and strategies for changing scores  
• Students encouraged to set one or more behavioural goals  
• Parents/family doctor get a copy  
• Parents receive copy of health newsletter ‘The Pacesetter’  
Theory:  
• Social Learning Theory  
• PRECEDE framework | • Final data collection at the end of the 3 yr intervention  
• No significant difference in ponderosity index, tricep skinfold, or total cholesterol between groups  
• Significant difference in exercise recovery rate in favour of intervention groups (p<.01) | • Only results related to physical activity and healthy eating are reported here  
• Positive trend toward effectiveness but not statistically significant (p<.07) |
<table>
<thead>
<tr>
<th>Author (date) Country</th>
<th>Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Know Your Body III – New York Resnicow (1992) United States</td>
<td>Quasi-experimental • 1,209 grade 4 children from 5 elementary schools • 3 schools in Bronx received the intervention • 1 school in Bronx served as a control • 1 school from Texas served as a second control</td>
<td>Implemented over three academic years by classroom teachers • Teachers received 1-2 days of training from project staff • Project coordinator met with all teachers in small groups twice a year to distribute materials and provide support • Head teachers were assigned by principals from each school to monitor and facilitate teacher implementation of the intervention</td>
<td>Final data collection at the end of the intervention • No difference in fruit and vegetable, meat, dairy, and dessert consumption between groups • High exposure group reported significantly more consumption of heart healthy foods compared to moderate exposure group (p&lt;.05) • No difference in diastolic blood pressure or BMI between groups • Students in schools with moderate and high program implementation had significantly lower total cholesterol than controls (p&lt;.05)</td>
<td>Only results related to physical activity, nutrition, and weight are reported here</td>
<td></td>
</tr>
</tbody>
</table>

**Food Service Modifications**
- Increased fibre and decreased fat content in school lunches
- Addition of a salad bar
- Increased visibility of low fat milk
- Offer heart healthy entrees

**School-Wide Activities:**
- Peer leader training
- Student health committees
- Food tasting parties
- Drug and nutrition poster and essay contests
- Student aerobics
- Special health lectures
- Social Learning Theory
- Other psychosocial models about health behaviour

---

Healthy Weights Review – Multifaceted Interventions 199
<table>
<thead>
<tr>
<th>Author (date)</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| Minnesota Class of ‘89 Murray (2002) United States | • Quasi-experimental  
• 2,376 sixth grade students in urban centres, primarily white and middle class | • Intervention implemented over five academic years and taught by classroom teachers  
  *Lunch Bag program (6th grade)*:  
  • One brief session introduced components of a heart healthy lunch  
  • Children received a lunch bag with special logo and materials for the program  
  • Students wrote their own newspaper concerning healthy eating  
  *Slice for Life (10th grade)*:  
  • 10 session peer-led curriculum designed to promote healthy eating and physical activity  
  *FM – 250 (8th grade)*:  
  • Peer-led physical activity program  
  • Students encouraged to be physically active outside of school and during school hours  
  • Encouraged to exercise the equivalent of bicycling 250 miles | • Final follow-up at end of the 5 year intervention  
• No significant differences at final follow-up period between intervention and control groups for both males and females on food choice score  
• Intervention females reported significantly more hours of leisure time physical activity per week than controls, except in grade 11 (p<.02)  
• Intervention males did not differ significantly from controls on leisure time physical activity except in grades 7 and 11  
• Females in the intervention group scored significantly higher on the physical activity score than controls for grades 8, 9 and 11 (p<.03) but not grade 12  
• The were no significant differences between males in the intervention and control groups on the physical activity score | • Significant differences, particularly for females, were observed for food choice score until the final data collection period  
• Data suggest the intervention was effective, although unclear why impact was lost by the final year  
• Reasonable to suggest the implementation of this intervention for adolescents to promote healthier diet and to increase physical activity  
• One of the intervention communities was also a part of the larger Minnesota Heart Health Project |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| M-SPAN Sallis et al. (2003) United States | • Randomized trial  
• Students in 24 middle schools (grades 6-8) randomly allocated to intervention or control group  
• Mean school enrolment of 1,109 students  
• 44.5% non-white  
• Although SES not stated, 39% paid reduced prices or had free school meals | • Two year intervention  
• Multiple interventions to increase physical activity in physical education classes and throughout the school day (e.g. changing PE lesson, structure and teacher behaviour and supervision, equipment, organized activities)  
• Nutrition interventions aimed to reduce fat intake during the day; focused on both cafeteria meal choices and on content of lunches brought from home  
• Interventions to create and promote policy changes within the school to increase activity and decrease fat intake  
• Student health committees formed at 8 of 12 intervention schools to promote activities related to project objectives  
• Parent education through newsletters and presentations  
• Financial incentives to intervention schools for PA and kitchen equipment  
Theory:  
• Structural Ecological Model | • Measurements by direct observation, existing records or survey  
• All measurements taken at baseline and end of the program  
• Physical activity at school (kcal/child/school expended in moderate to vigorous activity) increased overall for intervention schools vs controls (p<.009); no significant change for girls (p=.40)  
• Boys increased activity about equally in PE class and out of class, but girls increased activity mainly in class  
• There was no difference in total and saturated dietary fat intake during the school day between intervention and control groups  
• Significant reduction in BMI (p=.04) (self-report) among boys only  
• 72% of eligible student-parent dyads at baseline with 60% response rate post intervention | • Appears to positively affect boys, not girls  
• PE class availability not altered; intervention schools improved activity within class; enablers to increased activity at other times varied by school  
• Altering food in the cafeteria & stores difficult and appeared to be minimally implemented  
• Many financial & other challenges in this area  
• Effectiveness of policy change committees varied widely  
• Communication to parents may be inadequate given other media food marketing |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| New Moves Neumark-Sztainer et al. (2003) United States | • Randomized trial  
• 6 schools randomly assigned  
• 201 females mean age 15.4 years  
• Intervention group n=89  
• Control group n=112  
• Ethnicity: 41.9% White, 28.6% Afro-American, 21.1% Asian American  
• School grades 9-12 | • 16 week program, 5 days per week including:  
• Physical activity 4 x per week  
• Social support 1 day every other week  
• Nutritional guidance 1 day every other week  
• Control group received normal curriculum including some information re: healthy eating and physical activity Theory:  
• Can't tell | • Data collected pre and post program, and 8 months following program completion  
• No statistically significant differences noted between groups at either post tests in physical activity, sedentary activity, BMI, fruit and vegetable intake, perception of physical appearance, or self-acceptance | • Preprogram, 62% of the girls had BMI values >75th percentile for age and gender  
• Although no change in physical activity, there was a statistically significant change in physical activity stage (i.e. Procheska’s TTM)  
• Several results, although not significant, were in the right direction, suggesting a program of longer duration might be effective |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Karelia Puska (2002) Finland</td>
<td>• Quasi-experimental • 851 7th grade adolescents aged 13-15 from 6 schools • two schools received the school-based and community-wide intervention • two schools received the community-wide intervention • two schools served as controls</td>
<td>• Implemented primarily by project team members over 2 yrs <strong>School-based Intervention</strong>  • Nutritionist discussed healthy diet  • Students screened for CVD risk  • Special health passport developed and used on each student  • School nurse gave advice on results of screening  • Physical activity was promoted at school, home and community <strong>Community-Wide Intervention: School Menu Modification</strong>  • Butter replaced with margarine  • Whole milk replaced with skim milk, buttermilk or water  • Vegetable oil used for salad dressing and cooking  • Low-fat meats were encouraged  • Increased fish, poultry, vegetables and fresh salads promoted  • Egg yolks were avoided  • Food industries asked to reduce salt <strong>Theory:</strong>  • A ‘Unified model’ including the Behaviour Change, Communication-Behaviour Change, Innovation-Diffusion, and Community Organization Approaches</td>
<td>• Final data collection 6 months post-intervention  • Students in the school-based intervention received less fat from drinking milk than controls (p&lt;.001)  • No significant difference in fat intake from butter consumption between groups  • No significant increase in vegetable oil and low-sodium salt between groups  • No difference in serum cholesterol for boys between intervention and control groups  • Significant reduction in serum cholesterol among girls across the intervention and control groups; School-based vs control (p&lt;.01); Community-wide vs control (p&lt;.05)  • Significant increase in systolic blood pressure for males in the intervention schools vs controls (p&lt;.01)  • No difference in systolic blood pressure for females between intervention and controls  • No difference in diastolic blood pressure in males or females between intervention and controls</td>
<td>• Physical activity not measured as an outcome although an objective of the intervention  • Positive trend toward decreased fat intake from use of butter seen in intervention schools but not statistically significant  • Positive trend toward increased use of vegetable oil and low-sodium salt although not statistically significant</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| PATH Fardy (2002) United States | • Randomized trial  
• 346 9th and 10th grade adolescents from one inner city high school  
• Intervention students received the health promotion curriculum | Intervention:  
• Implemented over 11 weeks of daily physical activity and health lecture-discussions by physical education teachers assisted by undergraduate and graduate physical education majors  
• Teachers received training and program materials  
*Health Promotion Curriculum*  
• 30 min classes five time a week for 11 weeks  
• 20-25 min of circuit training (resistance and aerobic activities)  
• 5 min of health behaviour lecture/discussion – topics included exercise, nutrition, stress management, heart disease, cancer and motivation  
• Each student received a workbook  
Control:  
• Attended regular PE volleyball class  
Theory:  
• Can’t tell | • Final data collection 24 months post-intervention  
• Significant increase in VO₂ Max for females in the intervention group compared to controls (p<.0001)  
• Females in the intervention group reported significantly less consumption of high-fat foods as compared to controls (p<.04)  
• No difference in skinfolds, or physical activity level between groups  
• No statistically significant changes in boys | • Only results related to physical activity and nutrition are reported here  
• The increased activity during circuit training was effective in improving cardiovascular fitness  
• Duration of the Intervention may not be long enough to produce changes in overall physical activity behaviours  
• Obese girls and boys showed the most improvement |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PATHWAYS Hunsberger (2002) United States</td>
<td>• Randomized trial 1,441 third grade American Indian children representing 7 tribes from 41 schools 21 intervention schools 20 control schools</td>
<td>• Implemented over 3 academic yrs (years 3-5) by classroom teachers Classroom Curriculum 2 45 min lessons/ wk for 12 wks each academic year Children tasted new foods and beverages and practised healthy eating/physical activity behaviours Physical Activity 3 30 min physical education sessions/ wk during school time Guided play at recess, active play encouraged after school; games derived from traditional American Indian games implemented Food Service Nutritionist provided support and monitored lunch preparation Training food service staff to plan and serve meals Family Family packs promoting physical activity at home and healthy eating; family snack packs with locally available, low-fat and sugar food items; family events at school Theory: Social Learning Theory incorporating cultural heritage of American Indians</td>
<td>• Final data collection occurred at the end of the three year intervention in grade 5 No significant differences between intervention and control schools on percent body fat, BMI, or physical activity Statistically significant difference between intervention and control schools on fat intake (p&lt;.05) Intervention schools had significantly greater mean reduction in % calories from fat and saturated fat than control schools (p&lt;.05)</td>
<td>• There was a trend toward increased physical activity in the intervention schools, although not reaching statistical significance (p&lt;.08)</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Planet Health Gortmaker, Peterson et al. (1999) United States</td>
<td>• Randomized trial  1, 295 children grades 6 and 7  5 intervention schools  8 control schools</td>
<td>• Training for teachers  • 32 lessons taught by classroom teachers over 2 year period  • Content on reducing TV time, total fat, saturated fat and increasing activity level and fruit and vegetable intake Theory:  • Behavioural-Choice Theory  • Social-Cognitive Theory</td>
<td>• TV viewing in the intervention group was reduced for boys, 0.4 hours/day (p&lt;.0001) and girls, 0.58 hours (p=.001)  • Minutes in physical activity did not differ significantly  • Prevalence of obesity for girls reduced in the intervention schools (OR 0.47, CI 0.24 to 0.93, p=.03); not for boys  • Girls in the intervention ate 0.32 more servings of fruit and vegetables each day (p=.003) and consumed 575kJ/day less total energy</td>
<td>• Intention-to-treat analysis  • Clinical significance of changes is unknown</td>
</tr>
<tr>
<td>Author (date)</td>
<td>Country</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
</tr>
<tr>
<td>--------------</td>
<td>---------</td>
<td>--------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>San Diego</td>
<td>USA</td>
<td>Randomized trial</td>
<td>Intervention implemented over 1 yr</td>
<td>Final data collection at 12 months post-intervention</td>
</tr>
<tr>
<td>Nader (1993)</td>
<td></td>
<td>206 low to middle income Mexican-American and Anglo-American families</td>
<td>Families received 3 mos. intensive weekly intervention (12 sessions) and 9 mos. monthly or bimonthly maintenance sessions (6 sessions)</td>
<td>No difference between intervention and control groups for both Anglo-American and Mexican-American children for physical activity, physical fitness, serum cholesterol, and BMI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One 5th or 6th grade child from each family recruited from 12 elementary schools</td>
<td>Families grouped for ethnic homogeneity; 6 to 7 families attended a group meeting lasting 1 ½ hours at a local school for all 18 sessions</td>
<td>Anglo-American children in the intervention group had significant decrease in fat intake (p&lt;.0005) and salt intake (p&lt;.0001)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Families received incentive ($50) for completing the study</td>
<td>Structure of the group:</td>
<td>No difference between groups in Mexican-American children on fat and salt intake</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Led by 2 graduate students</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Structured to facilitate intra- and inter-familial interaction through games and discussion, gradually increasing vigorous physical activity</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Children and parents split into education groups and came back together to set behaviour change and support goals</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Dietary education: used &quot;stop light' categories of red/whoa, yellow/slow and green/go foods based on saturated fat content</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Maintenance sessions designed to teach skills to enhance ability to continue new dietary and physical activity habits</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Theory:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Social Learning Theory</td>
<td></td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Schools for Healthy Lifestyles Rhoades et al. (2001) United States</td>
<td>• Quasi-experimental • Intervention and Control Group: 710 fourth and fifth grade males and females from 5 schools including urban and rural and White, Black and Hispanic populations</td>
<td>• Community-based health education program for elementary school-aged children, their families and school staff • Targets CVD, cancer, injury, and promotion of physical activity and fitness, and healthy eating • Schools apply each year • Resources for selected schools include: sending representatives to an intensive 5 day summer institute; holding monthly meetings to review the site plan; $1,000.00 to assist in purchasing necessary resources; health education curricula, materials; and ongoing training and support Theory: • Can’t tell</td>
<td>• No tests of statistical significance of between group differences were calculated • No within group differences in rates of Reaching the Healthy Fitness Zone (6 factors including BMI)</td>
<td>• Great variation in program implementation from school to school • No between group comparisons reported • Planning a more rigorous evaluation</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>SPARK Sallis (1999) United States</td>
<td>Randomized trial • 955 4&lt;sup&gt;th&lt;/sup&gt; and 5&lt;sup&gt;th&lt;/sup&gt; grade children from 7 elementary schools • Schools were randomized to two intervention groups (specialist-led and teacher-led) and a control group</td>
<td>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 Physical Education Specialists • 3 30 min session/wk focused on high levels of physical activity; 15 min health-fitness activity, 15 min skill-fitness activity • 10 health-related activity units; intensity, duration and complexity was increased during intervention; 9 skill-related fitness units • Students recorded fitness level Physical Education Teachers • Taught behaviour change skills to generalize activity outside school • Weekly 30 min classroom sessions included goal setting, self-monitoring, stimulus control, and self-reinforcement • Homework and monthly newsletters to promote parent-child activity Control: • Usual physical education program Theory: • Health Belief Model • Social Learning Theory</td>
<td>Final data collection at the end of the intervention • Significant difference between interventions and control for moderate to vigorous physical activity (min/wk) (p&lt;.001) • Specialist-led group more active than teacher-led • All intervention students expended significantly more kcal/kg/wk than controls (p&lt;.001); specialist-led significantly better than teacher-led • All intervention students spent significantly more time in PE class/wk than controls (p&lt;.001); specialist-led group significantly higher than teacher-led • No differences on physical activity outside of school • No difference between groups for boys on all fitness measures • Girls in specialist-led group had significantly shorter mile runs (p&lt;.03) and did significantly more sit-ups/min (p&lt;.03) than girls in the teacher-led or control groups • No difference on other fitness outcomes</td>
<td>Evidence of strong impact with this intervention when increased minutes of physical activity is the goal • Draws into question to some degree whether various fitness level measures are good indicators of program effectiveness • Physical education specialists maximized activity versus teacher led</td>
</tr>
<tr>
<td>Author (date)</td>
<td>Country</td>
<td>Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------</td>
<td>------------------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Stanford Adolescent</td>
<td>United</td>
<td>Heart Health</td>
<td>Randomized trial&lt;br&gt;• 1,447 adolescents in 10th grade from 4 high schools</td>
<td>Implemented over 7 weeks by classroom teachers who received specialized training to deliver the intervention&lt;br&gt;Delivered as part of the regular physical education curriculum (50 min sessions x 20)&lt;br&gt;First session was an intro to the program, CVD risk factors, and healthy lifestyle&lt;br&gt;Students received a notebook with handouts, worksheets and homework assignments&lt;br&gt;Next 12 sessions were divided into 4 modules: physical activity, nutrition, smoking, and stress; students encouraged to set goals in each area&lt;br&gt;Next 2 sessions focused on a competitive game that quizzed students on the content of the four modules; prizes were awarded to the team with the highest score&lt;br&gt;Final 5 sessions focused on problem-solving and developing action plans to change behaviour&lt;br&gt;Theory:&lt;br&gt;• Social Cognitive Theory&lt;br&gt;• Social Inoculation Theory</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Stolley and Fitzgibbon (1997 United States)</td>
<td>• Randomized trial • Mother and daughter dyads • Intervention group n=32 mothers, 32 daughters • Control group n=30 mothers, 33 daughters • Daughters ages 7-12 years (mean = 10 years) • All African-American • All low SES</td>
<td>• Intervention based on Know Your Body nutrition and fitness units adapted for cultural relevance • Separate programs for one hour weekly for 11 weeks • Weekly meetings of 7-10 dyads Theory: • Can’t tell</td>
<td>• Mothers in intervention group reduced their saturated fat (p&lt;.05), and % fat calories (p&lt;.001) compared to control group • Daughters in intervention group (p&lt;.05) reduced % fat calories</td>
<td>• Participants selected from a tutoring program, not a school • Program had greater effect on mothers than on daughters</td>
</tr>
<tr>
<td>Tamir et al. (1990) Israel Adaptation of Know Your Body</td>
<td>• Quasi-experimental • Intervention schools selected to represent a wide range of children • Matched cohort used as control group • 829 first grade children from 16 schools • 631 Jewish, 198 Arab</td>
<td>• Broad CVD health promotion program • 15-20 hours per year (over 2-3 months) for 2 years • Taught by teachers • Reinforced by community activities and parental involvement Theory: • Can’t tell</td>
<td>• BMI was significantly lower in intervention vs control group at follow-up (p&lt;.05)</td>
<td>• Only results related to nutrition, obesity and physical activity are reported here • Unit of allocation is the school, unit of analysis is the individual; no cluster analysis was reported • 49% drop-out rate, probably influenced by the required blood test for cholesterol levels</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------</td>
<td>----------------</td>
<td>---------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Trois Rivieres Shephard (1999) Canada</td>
<td>• Quasi-experimental; cohort study • 546 elementary school children from two schools, one urban and one rural • Students in grade 1 in both schools the year the intervention was implemented served as the intervention group • Students in grade 1 in the years directly preceding and succeeding the intervention in both schools served as controls • Students followed for 6 years</td>
<td>Intervention: • Implemented by physical education teachers over 6 years • Students received 1 hr/day of physical education; endurance activities were encouraged (swimming, running, bouncing a ball while running) • As students aged more intense activities were added (indoor soccer, touch football, indoor field hockey, ice hockey, figure skating, dance etc.) • Main objective was to involve the whole class and to maximize heart rates for appropriate lengths of time for student ages Theory: • Can’t tell</td>
<td>• Final data collection at end of the 6 year intervention • No significant differences observed at the final data collection (age 12) for boys and girls on physical working capacity performance • Intervention students had significant increases in Peak O$_2$ intake compared to controls (p&lt;.001); slightly smaller effect was observed in females compared to males • Positive trend toward a significant increase in heart rate although not statistically significant across all age groups • No difference between groups observed for BMI or skinfolds</td>
<td>• Authors concluded that a regular physical education program is insufficient to influence body fatness of free-living children</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Wessex Healthy Schools Award</td>
<td>• Quasi-experimental</td>
<td>• Ecological health promotion program</td>
<td>• Testing at baseline and two years later (program completion)</td>
<td>• Unit of allocation and analysis was the school</td>
</tr>
<tr>
<td>Moon et al. (1999)</td>
<td>• 10 intervention secondary schools; 5 control schools matched for area and socio-economic factors</td>
<td>• Key areas covered: curriculum; links with the wider community; smoke-free school; healthy food choices; physical activity; responsibility for health; health promoting workplace; environment; and equal opportunities and equal access to health</td>
<td>• No difference between the two groups in reported physical activity or food intake</td>
<td>• Only physical activity, nutrition and obesity related outcomes are reported here</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>• Males and females 11-16 years old</td>
<td>Theory: • Can’t tell</td>
<td>• Although total scores for intervention schools were higher than controls at post-test, the difference was not statistically significant</td>
<td>• This project points out the challenges for implementing a whole school approach and of involving the wider community</td>
</tr>
<tr>
<td></td>
<td>• Mixed ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Author (date)</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| Wilson et al. (2002) United States | • Randomized trial  
• African-American males and females between 11-15 years  
• All from families with low incomes  
• Students in the groups came from different schools  
• Intervention Group #1 n=17  
• Intervention Group #2 n=20  
• Control Group n=16 | • Intervention #1: Nine weekly 2 hr sessions based on SCT related to eating and physical activity behaviours  
• Intervention #2: #1 plus strategic self-preservation videos and motivational interviewing (MI)  
• Control group spent 12 weekly sessions learning about health related issues  
• All students participated in a weekly after-school intramural sports program  
Theory:  
• Social Cognitive Theory, Strategic Self Preservation, and Motivational Interviewing (MI) | • No between group statistically significant differences in physical activity, BMI, or self-concept.  
• Both intervention groups had statistically significant pre-post test increases in fruit and vegetable consumption (p<.05)  
• No statistically significant changes among groups in scores for self-concept and self-efficacy related to fruit and vegetable intake (p<.05) from pre to post test | • Drop out rates for SCT group 30%; for control group 31%  
• Daily fruit and vegetable intake in SCT and MI group increased over 3 servings per day; SCT groups only 2.3 servings per day |
Reference List


cholesterol, high density lipoprotein, and body mass index after 2 years of intervention in Jerusalem school-children age 7-9 years. *Preventive Medicine*, 19, 22-30.


Environmental Interventions
to Improve Nutrition and Increase
Physical Activity in
Children and Youth
This is a summary statement written to condense the work of the authors of a systematic review. The reference for the full review is below. The intent of this summary is to provide an overview of the findings and implications of the full review. Implications listed in the evidence table have been developed by summary statement authors for health-evidence.ca, and may reach beyond what the authors have stated in the review. For more information on individual studies included in the review, please see the review itself.


Author Contact Info: Sandra Micucci, BSc, MSc; Helen Thomas, RN, MSc Effective Public Health Practice Project 2 King Street West, 3rd Floor Dundas ON L9H 6Z1 (905) 546-2424 x1578 thomash@mcmaster.ca

Issue: Educational interventions focus on changing knowledge, attitudes, skills or the behaviour of individuals. Environmental interventions create opportunities or remove barriers for groups of people. With environmental interventions, the emphasis to change health behaviour moves from the individual to the society or culture that facilitates the unhealthy behaviour (Glanz & Mullis, 1988). For example, in the case of nutrition, educational interventions attempt to influence the individual demand for certain foods such as soda pop or high fat food. Environmental interventions attempt to influence the supply of food. Methods would include replacing soda pop with water in vending machines or changing cafeteria menus to reflect nutritious selections. In the case of physical activity, environmental interventions improve characteristics such as space, facilities, equipment, or safety, to facilitate physical activity.

Review Content Summary: A systematic review was conducted to determine the effectiveness of environmental interventions on improving nutrition and/or increasing physical activity in children and youth. Studies were reported by outcome - improving nutrition, increasing physical activity, improving nutrition and increasing physical activity and by intervention – environmental only or multi-component.

Comments on this review’s methodology: Twenty-one studies met the relevance criteria. All 21 studies were school-based. Five studies implemented an environmental
component only and 16 studies included an environmental component as one of many components of their program. Of the five environmental only studies, four programs were designed to influence nutritional behaviour and one program was designed to influence physical activity levels. All five studies were of poor methodological rigor. Of the 16 multi-faceted studies incorporating an environmental component, four studies were designed to influence nutrition and 12 studies were designed to influence both nutrition and physical activity. All four nutrition studies were of high quality and four of the 12 multi-faceted studies were of high quality. Thirteen of the 21 studies were theoretically based.

Evidence points are not weighted or ranked.

<table>
<thead>
<tr>
<th>What’s the evidence?</th>
<th>Implications for practice and policy:</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Multi-component interventions including an education and an environmental component directed at improving both nutrition and raising physical activity levels in children were the most effective at increasing physical activity and/or improving nutrition.</td>
<td>&gt; Multi-component interventions require the contribution of multiple groups in order to make them successful. School boards, parents, government agencies, community organizations and the private sector are all necessary to make changes such as strong policies that will fund schools adequately. Incentives must be provided to intersectoral groups to collaborate in resolving these challenges. Government should initiate this process.</td>
</tr>
<tr>
<td>&gt; Children’s nutritional intake can be modified when their food source is modified.</td>
<td>&gt; Because environmental interventions can reduce the options available, it is important that the opportunities offered are based on evidence. If food choices are to be limited in a cafeteria where children must eat, the selections should be based on sound research.</td>
</tr>
</tbody>
</table>

Healthy Weights Review – Environmental Interventions 220
> Fewer children are actively commuting to and from school potentially representing a lost opportunity to be physically active. The main deterrents for parents allowing their children to actively commute to school were traffic danger, children were not considered reliable, and distance.

> The barriers preventing children actively commuting to school must be removed. To do so, urban areas need to be designed or redesigned to incorporate safe routes for children to walk or ride bicycles to school.

**General Implications:**

> It is necessary to gain the support of multiple groups, including government agencies, to implement environmental interventions.

> Policies need to change, and the emphasis moved from the current focus of fiscal constraint to the long term health of the population, which in turn will translate to a healthier economy. Some examples of policy changes would be designing safe walking and bicycle routes for children to get to school, designing urban areas so that children live closer to their schools, providing adequate funding to make available more nutritional, and maybe more costly, school breakfasts and lunches, reducing availability of unhealthy food and drinks, and keeping school and athletic facilities open after school hours.

**Cost Benefit or Cost-Effectiveness Information:** Not included in review.

**References Used to Outline Issue:**


The format of this summary statement has been adopted from health-evidence.ca (www.health-evidence.ca).
Environmental Interventions to Improve Nutrition and Increase Physical Activity in Children and Youth

Introduction

One way to differentiate environmental interventions is that they create opportunities or remove barriers for groups of people, whereas the previous interventions focused on changing knowledge, attitudes, skills or the behaviour of individuals (Glanz et al., 1988). With environmental interventions, the emphasis to change health behaviour moves from the individual to the society or culture that facilitates the unhealthy behaviour (Glanz et al., 1988). For example, in the case of nutrition, educational interventions attempt to influence the individual demand for certain foods such as soda pop or high fat food. Environmental interventions attempt to influence the supply of food. Methods would include replacing soda pop with water in vending machines or changing cafeteria menus to reflect lower fat selections. In the case of physical activity, environmental interventions improve characteristics such as space, facilities, equipment, or safety, to facilitate physical activity.

This review answers the question:

What is the effectiveness of environmental interventions on improving nutrition and/or increasing physical activity in school-aged children and youth?

Methods

Please refer to the Methods section in the main Introduction, page 16.

Results

Description of Relevant Studies

Twenty-one studies met the relevance criteria. All 21 studies were school-based. The community-based studies employing an environmental intervention to increase physical activity or improve nutrition did not report outcome measurements for children or adolescents in the age group relevant to this review and were not included. Five studies implemented an environmental component only and 16 studies included an environmental component as one of many components of their program. Of the five studies, four programs implemented an environmental component to influence nutritional behaviour and one program implemented an environmental component to influence physical activity levels. All five of the studies that implemented an environmental intervention only were of poor methodological rigor. Of the 16 studies incorporating an environmental component, four studies included other interventions to influence nutrition and 12 studies included other interventions to influence both nutrition and physical activity. All four nutrition studies were of high quality and four of the 12 multi-faceted
studies were of high quality. The quality assessment ratings for all relevant studies are reported in Table 1.

It is the policy of the EPHPP to report on the best quality evidence. The interventions that implemented an environmental component only will be discussed even though they are of poor methodological rigor as that is all that is available. Only the high quality multifaceted studies will be discussed in the text. Details of all relevant studies are included in Table 2; the high quality studies are bolded. Given the variation in methodological rigor, the studies that are not bolded should be viewed with caution because their methodology was judged to contain several threats to internal and/or external validity.

**Environmental Component Only**

Four studies looked at environmental changes alone to improve nutrition (Ellison, Capper, Goldberg, Witschi, & Stare, 1989; Michel, Cyr, & Carbonneau, 1994; National School Lunch Program: Project Account, 2002; Whitaker, Wright, Koepsell, Finch, & Psaty, 1994). All were of poor methodological quality and none of the interventions reported a theoretical basis.

The first study directed the intervention to food service workers in two boarding schools in the United States. Menus were revised and staff were instructed on how to prepare meals with reduced sodium and saturated fat. The intervention resulted in a 20% reduction in sodium (p<0.001), an increase in the polyunsaturated/saturated ratio from 0.46 to 0.84, and a statistically significant reduction in both systolic and diastolic blood pressure (Ellison et al., 1989).

The only Canadian study compared the nutritional quality of school meals served in a school whose food services were managed by a non-profit organization, comprised of parents and members of the community, to a school whose food services were managed by a concessionaire. Lunch nutritional values were compared to nutritional recommendations associated with the prevention of cardiovascular disease and not to each other. The non-profit organization run food service fell short of the nutritional recommendations but were closer than the school managed by the concessionaire (Michel et al., 1994).

A study looking at the National School Lunch Program (NSLP) and School Breakfast Program (SBP) in the United States reported that participants increased their intake in many essential nutrients but consumed a higher percentage of their food energy from fat and unsaturated fat and a lower percentage from carbohydrates than non-participants (National School Lunch Program: Project Account, 2002).

In the fourth study, 16 elementary schools were randomized to the intervention or control groups. Both the intervention and control schools offered one low-fat entrée each day. The intervention consisted of labeling the low-fat entrées, informing parents of their availability, and asking parents to encourage their children to select them. More children in the intervention schools chose low-fat entrées (35.5% vs. 32.2%, p=0.03) (Whitaker et al., 1994).

The environmental component only intervention to increase physical activity was also of poor methodological quality and not theoretically based. The intervention consisted of painting the tarmac playground of two urban primary schools in England with fluorescent

Healthy Weights Review – Environmental Interventions 224
markings that included hopscotch, fun trails, and mazes. Children in the intervention schools increased their moderate to vigorous activity per day by 18 minutes and the control schools by 7 minutes (p<0.01). Body mass index (BMI), heart rate, and duration of playtime did not differ between the two groups (Stratton, 2000).

**Multi-Component Interventions to Improve Nutrition**

Four studies looked at changes in food services with other interventions to improve nutrition. All were of strong methodological quality and reported a theoretical base. Three studies were aimed at primary and middle school students and one study at high school students.

The 5-A-Day Power Plus Program was based on the social learning theory. The program provided training to food preparation staff and promoted fruits and vegetables at the point-of-purchase as well as the curriculum, home and industry coalition. Direct lunchroom observations showed a significant increase in children in the intervention group in combined fruit and vegetable servings of 0.47 servings (p>0.05) and fruit servings alone of 0.30 servings (p<0.05). There was no increase in vegetable servings alone. The results of the 24-hour recall one-year post-intervention showed children in the intervention schools significantly increased their intake of fruit servings by 0.62 servings per day (p<0.02). There were no differences in vegetable servings, and fruit and vegetable combined servings (5-a-Day Power Plus Program: Project Account, 2000).

The High 5 Project consisted of food service, classroom, and parent components and was based on the social cognitive theory. In the food service component, food service managers and workers were offered training on purchasing, preparing and promoting fruit and vegetables. Twenty-four hour diet recall demonstrated a mean daily fruit and vegetable consumption higher in the intervention group than the control group. At one year fruit and vegetable consumption in the intervention group measured 3.96 vs. 2.28 servings/day in the treatment group (p=.0001). The increase was sustained in year two with a measurement of 3.2 vs. 2.21 servings/day (p=.0001). Mean percent energy from fat at the one year measurement was 30.93 in the intervention group vs. 33.37 in the control group (p=.003). Again the increase was maintained in year two at 31.56 vs. 33.23 (p=.0402). Cafeteria observations showed no difference in fruit or vegetable consumption (High Five: Project Account, 2002).

The Teens Eating for Energy and Nutrition at School (TEENS) Project was also based on the social cognitive theory. Students were incrementally exposed to an environmental intervention only, environmental plus classroom intervention, and environmental plus classroom plus peer leader intervention or no exposure. The environment component consisted of promoting and increasing the appeal of fruits and vegetables in the cafeteria, taste testing, increasing the availability of lower fat foods, table tents and posters. Only the environmental plus classroom plus peer leader group reported a significant increase in combined fruit and vegetable consumption (p=.012) and fruit consumption (p=.01). Both the environmental plus classroom plus peer leader group (p=.002) and classroom curriculum plus school environment group (p=.001) reported a tendency for students to choose lower fat food items (TEENS (Teens Eating for Energy at School): Project Account, 2002).

The Gimme 5 High School Project, based on the PRECEDE model, included a cafeteria component along with mass media, curriculum, teacher training, and brochures to
parents. The availability and appeal of fruits and vegetables was increased which resulted in a significant increase in fruit and vegetable intake in children in the intervention schools at two years post-intervention but not at three years. Children in the control schools also increased their intake of fruit and vegetable which was attributed to a national 5-A-Day for Better Health campaign that was going on at the same time (Gimme 5 High School: Project Account, 2002).

Multi-Component Interventions to Improve Nutrition and Increase Physical Activity

Twelve studies looked at changes in food services with other components to improve nutrition and interventions to increase physical activity (Apples: Project Account, 2004; CATCH (Child and Adolescent Trial for Cardiovascular Health): Project Account, 2003; Donnelly et al., 1996; Go for Health: Project Account, 1991; Heart Smart Program: Project Account, 1991; Kansas Lean: Project Account, 1997; Moon et al., 1999; North Karelia Project: Project Account, 2002; Pathways: Project Account, 2002; Plotnikoff, Williams, & Fein, 1999; Resnicow et al., 1992; Sallis et al., 2003). Four studies were of high quality and will be discussed. All studies are reported in detail in Table 2.

The Active Program Promoting Lifestyle Education in School (APPLES) program employed a health promoting schools philosophy, a whole school approach, which links the school, family and community. Ten primary schools took part in this study. The study was implemented over one academic year and included modifications to school meals with teacher training and the development and implementation of a school action plan to promote physical activity and healthy eating. Children in the intervention group reported a significantly higher intake of vegetables per day (0.3 servings) but no difference in BMI, physical activity or sedentary behaviour. The authors questioned the clinical significance of such a small difference in vegetable intake. The intensity of the intervention was not reported and may account for the lack of difference between the two groups (Apples: Project Account, 2004).

The Child and Adolescent Trial for Cardiovascular Health (CATCH) program was based on a combined behavioural-epidemiological and health belief models. Ninety-six elementary schools were randomized to receive a school-based intervention, a school- and family-based intervention or to act as control. CATCH integrated classroom curricula, a physical activity component and a school environment component – the Eat Smart School and Nutrition Program. This component consisted of modifications to meals, food purchasing, recipes, food preparation and food production. The intervention schools significantly raised intensity of physical activity (p<.02), increased self-reported vigorous physical activity (p<.003), decreased fat intake in lunches (p<.001), decreased percent calories from saturated fat (p<.01), reduced total fat intake (p<.001), and reduced saturated fat intake (p<.01). Total minutes spent in daily physical activity, BMI or skin fold thickness did not differ between the groups. There were no statistically significant differences in outcomes between the school-based and school- and family-based intervention groups (CATCH (Child and Adolescent Trial for Cardiovascular Health): Project Account, 2003).

The Pathways study took place over three academic years. The study was based on social learning theory with special attention given to incorporating a culturally appropriate approach. American Indian children in the third grade were randomized to receive a four-component intervention or to control. The environmental component consisted of a nutritionist support for lunch preparation and training for food service staff. The other...
components were classroom curriculum, physical activity and a family component made up of take-home packs promoting physical activity and healthy eating in the home. There were significant reductions in fat intake and percent calories from fat and saturated fat (p<.05). There were no differences in BMI or skin fold thickness between groups (Pathways: Project Account, 2002).

The Middle-School Physical Activity and Nutrition (M-SPAN) study used a structural-ecological model approach. Children in grades 6 to 8 were randomized to a multi-component, two-year intervention or to control. The intervention targeted cafeteria meal choices as well as physical education classes, school-wide health promotion, and parent education. Financial incentives were offered to intervention schools to purchase kitchen and physical activity equipment. There were no differences in total and saturated dietary fat intake and only an increase in physical activity in boys (p<0.001). The investigators reported that a major challenge was that the school food services had to be financially self-supporting thereby making them reluctant to replace the availability of popular high-fat food items with lower-demand and perishable items (Sallis et al., 2003).

**Discussion**

Of the 127 relevant studies included in the Healthy Weights Review, five studies utilized an environmental component alone and 16 studies included an environmental component with other components such as change to curriculum and parent involvement.

The environmental only studies to improve nutrition were of poor quality but did show that children’s nutritional intake can be modified when their food source is modified. Care should be taken when modifying a school lunch program. As in the National School Lunch Program (National School Lunch Program: Project Account, 2002), meals provided may have been richer in some vitamins and minerals but were also higher in food energy, fat, saturated fat, cholesterol and sodium. As a result, children who participated in the intervention consumed higher amounts of these dietary components that would have removed any benefit increasing the intake of vitamins and minerals might have had.

Because of the diversity of the 16 multi-component interventions, it is not possible to determine if an environmental component increased the effectiveness of the intervention over an intervention that did not contain an environmental component. Only one study isolated the environmental component to determine its unique contribution. The environmental only arm performed better than the control group but not as well as the environmental plus classroom plus peer leader and environmental plus classroom arms.

Only one study implemented an environmental component to increase physical activity (Stratton, 2000). The single-component environmental intervention study to increase physical activity did show an increase in vigorous physical activity and heart rate but was not followed long enough to see if this increase could be sustained or if it made a difference in other outcomes such as blood pressure or BMI.

Most of the literature that does exist on environmental interventions to increase physical activity is observational and did not meet the relevance criteria set out by this review.
Some of these observational studies are worth mentioning given that they may provide a direction for future research. One observational study reported that the school physical environment is associated with increased physical activity but that less than 2% of girls and 6% of boys chose to be active during unstructured time (Sallis et al., 2001). Given that only a fraction of the recess period is spent engaging in physical activity, and that most of that physical activity is not vigorous (Wechsler, Deveraux, Davis, & Collin, 2000), opportunities to increase physical activity must be sought elsewhere.

The lost opportunity of children not actively commuting to school merits further attention. A longitudinal study from Russia, where car ownership is lower than it is in Canada, reported that when active commuting to school was absent the prevalence of achievement of health-related guidelines decreased about 12-20% and the prevalence of sedentary behaviour increased by 17-22%.(Tudor-Locke, Neff, Ainsworth, Addy, & Popkin, 2002) The Organisation for Economic Co-operation and Development (1998) reported that in Canada, 36% of parents surveyed allowed their children to walk to school. Of these children 86% lived within one kilometre of the school and 50% lived within three kilometres of the school. Only about 5% of children were allowed to take their bicycle to school (Frank & Engelke, 2000). The reasons parents cite as the main deterrents for letting their children actively commute to school is traffic danger (>40%), their children are not reliable (20%) and the distance is too great (15%) (Frank et al., 2000). An example of an environmental intervention to remove the barriers for children to actively commute to school can be found in programs like the Safe Routes to School Program. The Safe Routes to School Program brought the school, community, government and private sector together to identify and create safe routes and to promote actively commuting to school. From 2000 to 2002, the number of children walking to school increased by 64%, biking by 114% and car pooling by 91% (Staunton, Hubsmith, & Kallins, 2003).

As was stated in the beginning of this review, with environmental interventions, the emphasis to change health behaviour moves from the individual to the society or culture that facilitates the unhealthy behaviour (Glanz et al., 1988). A single person or group cannot implement many of the environmental interventions. It is necessary to gain the support of multiple groups including government agencies. In many cases, policies need to be changed and the emphasis moved from their current focus of fiscal constraint. Some examples of policy changes would be designing safe walking and bicycle routes for children to get to school, designing urban areas so that children live closer to their schools, providing adequate funding to make available more nutritional, and maybe more costly, school breakfasts and lunches, reducing availability of unhealthy food and drinks, and keeping school and athletic facilities open after school hours.

**Implications**

**Implications for Practice and Policy**

- Because environmental interventions can reduce the options available, it is important that the opportunities offered are based on evidence. For example, if food choices are to be limited in a cafeteria where children must eat, the selections should be based on sound research.
• Many environmental programs require the contribution of multiple groups in order to make them successful. School boards, government agencies, community organizations and the private sector are all necessary to make changes such as strong polices that will fund schools adequately so that they do not rely on soft drink machines to make up the shortfall, designing safe routes to schools, keeping schools open after hours, and coaching intramural sports. Incentives must be provided to intersectoral groups to collaborate in resolving these challenges. Governments should initiate this process.

Implications for Research

There is a paucity of research on environmental interventions for children.

• More rigorous research methods need to be applied in this area. Specifically, control communities need to be identified to assess the effectiveness of community-based environmental interventions.

• Future research needs to focus on children, not only in the school setting but in the community. Given the influence parents have over their children’s actions, this research could be expanded to include interventions directed to parents but outcomes measured in children.

• If possible, long-term follow-up will ascertain if the changes in behaviour carry forward to adult years.

Conclusions

There is a paucity of high quality evidence on environmental interventions to improve nutrition and increase physical activity in children and adolescents. Most of the interventions are multi-component and it is not possible to isolate the benefit the environmental component might contribute. The evidence that does exist demonstrates that modifying food services in schools can be successful at modifying the nutritional value of food children consume at school. The one environmental intervention to increase physical activity in children at school was successful at raising children’s physical activity to a moderate level.

Environmental changes are not always easy to implement. Many of them, such as planning safe routes so that children can commute to school, offering school lunch programs, increasing access to existing recreational facilities and funding new facilities, take time, money and the cooperation of multiple organizations or levels of government. It is the work of researchers to supply evidence of the effectiveness of environmental programs but to do so it takes government and private institutions to make these interventions possible. Until then, the state of knowledge in environmental interventions to improve nutrition and increase physical activity levels in children and adolescents will not increase. The commitment is great but the positive outcomes on children’s health could be great as well.
<table>
<thead>
<tr>
<th>Author (date) Project</th>
<th>Selection Bias</th>
<th>Allocation Bias</th>
<th>Confounders</th>
<th>Blinding</th>
<th>Data Collection Valid</th>
<th>Reliable</th>
<th>Withdrawals and Drop-outs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENVIRONMENT INTERVENTION ONLY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OUTCOME = NUTRITION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ellison et al. (1989)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>1/1</td>
<td>1/1</td>
<td>Weak</td>
</tr>
<tr>
<td>Michel et al. (1994)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
<td>0/3</td>
<td>0/3</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>National School Lunch Program</td>
<td>Moderate</td>
<td>Weak</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>1/1</td>
<td>Weak</td>
</tr>
<tr>
<td>Whitaker et al. (1994)</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Weak</td>
<td>1/1</td>
<td>1/1</td>
<td>Not Applicable</td>
</tr>
<tr>
<td><strong>OUTCOME = PHYSICAL ACTIVITY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stratton (2000)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>2/2</td>
<td>2/2</td>
<td>Moderate</td>
</tr>
<tr>
<td><strong>MULTI-COMPONENT INTERVENTIONS INCLUDING ENVIRONMENTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OUTCOME = NUTRITION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-A-Day Power Plus</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>1/1</td>
<td>1/1</td>
<td>Strong</td>
</tr>
<tr>
<td>Gimme 5--High School</td>
<td>Strong</td>
<td>Strong</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>0/1</td>
<td>0/1</td>
<td>Strong</td>
</tr>
<tr>
<td>High 5</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>2/2</td>
<td>2/2</td>
<td>Moderate</td>
</tr>
<tr>
<td>TEENS</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>1/1</td>
<td>1/1</td>
<td>Strong</td>
</tr>
<tr>
<td><strong>OUTCOME = NUTRITION + PHYSICAL ACTIVITY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APPLES</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>5/6</td>
<td>4/6</td>
<td>Strong</td>
</tr>
<tr>
<td>CATCH</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Mixed</td>
<td>6/6</td>
<td>6/6</td>
<td>Strong</td>
</tr>
<tr>
<td>Donnelly et al. (1996)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>4/8</td>
<td>4/8</td>
<td>Weak</td>
</tr>
<tr>
<td>Go For Health</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Mixed</td>
<td>2/3</td>
<td>3/3</td>
<td>Weak</td>
</tr>
<tr>
<td>Heart Smart</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Mixed</td>
<td>4/5</td>
<td>3/5</td>
<td>Strong</td>
</tr>
<tr>
<td>Kansas Lean</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Mixed</td>
<td>1/2</td>
<td>1/2</td>
<td>Weak</td>
</tr>
<tr>
<td>Moon et al. (1999)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Not Applicable</td>
<td>0/3</td>
<td>0/3</td>
<td>Moderate</td>
</tr>
<tr>
<td>North Karelia</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Mixed</td>
<td>1/1</td>
<td>1/1</td>
<td>Strong</td>
</tr>
<tr>
<td>PATHWAYS</td>
<td>Strong</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
<td>4/5</td>
<td>4/5</td>
<td>Strong</td>
</tr>
<tr>
<td>Plotnikoff et al. (1999)</td>
<td>Strong</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>6/6</td>
<td>6/6</td>
<td>Strong</td>
</tr>
<tr>
<td>Resnicow (1992)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Mixed</td>
<td>2/2</td>
<td>2/2</td>
<td>Weak</td>
</tr>
<tr>
<td>Sallis et al. (2003)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak (not Reported)</td>
<td>4/7</td>
<td>7/7</td>
<td>Weak</td>
</tr>
</tbody>
</table>

Table 1: Quality Assessment Rating of Relevant Studies

(Project titles italicized indicate a project account)
Table 2: Results of Relevant Studies to Improve Nutrition

Note: Studies of better quality indicated by bold font

<table>
<thead>
<tr>
<th>Author (date)</th>
<th>Country</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ellison et al. (1989)</td>
<td>United States</td>
<td>• Quasi-experimental • Food services at 2 boarding schools</td>
<td>Environmental intervention: • Planning sessions and education to food services personnel; review and revision of menus with nutritionist; product substitution Theory: • Can’t tell</td>
<td>• 20% less saturated fat intake increase in polyunsaturated/ saturated fat ratio from 0.46 to 0.84 (Note: No level of statistical significance given with these results) • 20% reduction in added salt (p&lt;.001) • Intervention effect on blood pressure: 1.7 mmHg for systolic; 95%CI -0.6 to –2.9 • 1.5 for diastolic; 95% CI –0.6 to –2.5</td>
<td></td>
</tr>
<tr>
<td>Michel et al. (1994)</td>
<td>Canada</td>
<td>• Quasi-experimental • Students in grades 4-6 • One intervention school cafeteria • One control cafeteria (traditional school food service that includes fast foods and higher prices than intervention)</td>
<td>• Non-profit school food service with parent and community involvement • Served hot healthy meals at low price Theory: • Can’t tell</td>
<td>• Significant differences in protein and cholesterol consumption (22.6 g vs. 27.4g, p&lt;.01; 54.6mg vs. 72.7mg, p&lt;.02)</td>
<td>• Limitations: meals were analyzed and compared to daily Nutrition Recommendations (NR) yet outcomes were based on only one lunchtime meal, and the macronutrient composition of the 2 schools’ menus did not differ according to NR, however children’s consumption did</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>---------------------</td>
<td>---------------------</td>
<td></td>
</tr>
</tbody>
</table>
• Nationally representative sample of 3350 students in grades 1-12  
• Compared participants versus non participants | • Provision of lunch and breakfast programs – available in US to 92% of all students  
Theory:  
• Can't tell | • 24 hour recall  
• Lunch program participation is associated with higher lunch and 24 hour intake of fat (37% vs. 33% of total energy) and saturated fat (14 vs. 11) (p<.01) | • Among schools offering the program lunch participation was 56% and breakfast participation 19%  
• Availability of breakfast did not effect likelihood of students eating breakfast  
• Participation in lunch program associated with higher lunch intake of vitamin A, calcium and magnesium and lower intake of vitamin C |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| Whitaker et al. (1994) United States | • Randomized trial  
       • 16 elementary schools randomized to intervention (n=8) and control (n=8)  
       • Participants were students eating lunch at school (average of 2,445 students/day) | • Both sets of schools had one low-fat entrée every day  
       • 4 month intervention with the goal to increase selection of low-fat food at school lunch  
       • Labelled low-fat foods in the menu  
       • Parents notified of low-fat food choices and availability, and asked to encourage children to select low fat foods  
       • Theory:  
       • Can’t tell | • Intervention schools increased in proportion of students who chose low fat selections compared to control schools (31.5% vs. 30.7%, p=.03) | • Unit of randomisation and analysis was school  
       • 221 parents surveyed; 71% remembered receiving mailing; 53% remembered that there were low fat entrées on the menu; 10% reported requesting their child choose a low-fat selection |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICAL ACTIVITY ENVIRONMENT INTERVENTION ONLY</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• 5-7 year old boys and girls in two urban primary schools in England  
• 27 intervention students from one school  
• 20 control students from the other school | Intervention:  
• Included a phase where students designed the tarmac playground area; markings were a castle, dragon, pirate ship, clock face, flower maze, fun trail and dens, hopscotch, letter squares, snakes and ladders, and circular maze  
• Except for a single football, play equipment was not allowed  
Control:  
• No playground markings  
• Limited equipment allowed  
Theory:  
• Can’t tell | • Body mass (kg) changed little  
• Percent of playtime spent in moderate to vigorous physical activity (MVPA) and vigorous physical activity was stable among control students compared to an increase among intervention students (p<.01)  
• Before intervention, intervention and control students spent 27 and 29 minutes of playtime respectively in MVPA per school day; post-intervention, this increased to 45 and 36 minutes (p<.01) | • Percent of playtime spent in MVPA and vigorous physical activity and number of minutes of playtime in MVPA measured by recording time on a heart rate radio telemeter (time spent in heart rate zones)  
• Small sample size  
• Needs replication |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUTRITION ENVIRONMENT INTERVENTION + OTHER NUTRITION INTERVENTION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 5-a-Day Power Plus | • Randomized trial  • 20 schools; 536 grade 4 students | Intervention:  
• Food Service  
• Point-of-purchase promotion of fruits and vegetables  
• Increased variety and attractiveness of fruits and vegetables  
Provided 2-hour training of food service staff  
School Curriculum  
• 16-40 min classroom sessions (2/week X 8 weeks)  
• Snack preparation and taste testing  
• Comic books about nutrition  
• Team competitions  
• Education package to parents; 5 packages sent at intervals; Parents signed they received them  
• Snack packs  
Industry  
• Coalition of producers  
• 30 minute presentation to classes  
• Additional educational material  
Control:  
• Usual health curriculum  
Theory:  
• Social Learning Theory | • 1 year after intervention:  
• 24 hour recall: no significant difference in total fruit and vegetable intake; saturated fats;  
• Difference between groups in fruit servings/day (0.62 servings) (p<.02); in total fat (-1.81 %kcal) (p<.02)  
• Lunch intake: 1.53 servings of fruits and vegetables/day for intervention group vs. 1.06 for control group (p<.001) and increased consumption of fruits (p<.001) | • Intervention increased fruit intake but not vegetables or total intake of fruits and vegetables  
• Significant intervention effect on asking for fruits and vegetables and knowledge  
• No effect on preference or on family consumption |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gimme 5 High School</strong>&lt;br&gt;Nicklas et al. &lt;br&gt;(1997, 1998, 2000);&lt;br&gt;O’Neil et al. &lt;br&gt;(2002)&lt;br&gt;United States</td>
<td>• Randomized trial&lt;br&gt;• 12 schools (matched pairs, then randomised)&lt;br&gt;• Grade 9 students randomized to Gimme 5 or control&lt;br&gt;• Followed to grade 12</td>
<td>Intervention over 3 years&lt;br&gt;• Cafeteria increased availability, variety, appeal of fruits and vegetables&lt;br&gt;• Mass media campaign in school&lt;br&gt;• Curriculum of 5 workshops of 55 minutes each re: knowledge, attitudes and skills&lt;br&gt;• Teachers trained&lt;br&gt;• Brochures to parents, taste testing, recipes, calendar with food tips&lt;br&gt;Control:&lt;br&gt;• Usual health curriculum&lt;br&gt;Theory:&lt;br&gt;• PRECEDE model</td>
<td>• Significant increase in fruit and vegetable intake in intervention group (p&lt;.05) reported at 1 year and maintained at 2 years; not maintained at 3 years</td>
<td>• Significant increase in knowledge in intervention group (p&lt;.05)&lt;br&gt;• Increased fruit and vegetable consumption maintained in the intervention group at follow-up; increased intake by control group resulted in no significant differences&lt;br&gt;• Control group increase attributed to 5-A-Day campaign&lt;br&gt;• Stages of Change: fewer intervention students in pre- and contemplation and more in preparation stage at post-test</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| NUTRITION ENVIRONMENT INTERVENTION + OTHER NUTRITION INTERVENTION | • Randomized trial  
• 28 schools with 1,698 grade 4 students | • Multiple level intervention  
• Cafeteria-food service involved  
• Classroom taught by usual teachers  
• 14 lessons (3 consecutive days/week; 30-45 min)  
• 3 booster sessions delivered year following the intervention  
• Parents - 7 homework assignments Theory:  
• Social Cognitive Theory | 24 hour diet recall  
• Mean daily fruit and vegetable serving consumption higher in intervention than controls; 1 year measurement: 3.96 vs. 2.28 servings/day (p<.0001); 2 year measurement: 3.2 vs. 2.21 servings/day (p<.0001)  
• Mean % energy from fat; 1 year measurement: 30.93 vs. 33.37 (p<.003); 2 year measurement: 31.56 vs. 33.23 (p<.0402)  
Cafeteria observations  
• No significant difference in fruit or vegetable consumption | • Mean daily consumption of fruit and vegetables higher for intervention parents at one year; not at 2 year follow-up  
• Significant effect on fibre intake, knowledge, fruit and vegetable self-efficacy and asking skills in students; knowledge and health benefits outcome expectancy in parents |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| **TEENS** Story et al. (2002); Lytle et al. (2001); Birnbaum et al. (2002) United States |  | Intervention delivered across 2 years to grade 7 students followed into grade 8 | Fruit consumption  
- environment + classroom + peer (p=.014)  
- environment + peer leaders (p=.01)  
- environment + classroom (p=.052)  
- environment only (p=.087)  
- control (p=.742)  
Vegetable consumption  
- environment + classroom + peer (p=.107)  
- environment + peer leaders (p=.059)  
- environment + classroom (p=.097)  
- environment only (p=.300)  
- control (p=.895)  
Choose lower fat foods  
- environment + classroom + peer (p=.001)  
- environment + peer leaders (p=.002)  
- environment + classroom (p=.001)  
- environment only (p=.058)  
- control (p=.490)  
|  |  |  |  | • an increase in p=.01 translates to approximately 1/2 serving a day |
### Author (date) Country Project

**APPLIES**

Sahota (2001) United Kingdom

### Design and Participants

- Randomized trial
- 636 children in 4<sup>th</sup> and 5<sup>th</sup> grade (7-11 years) in 10 schools divided equally between intervention and control

### Intervention(s)

- Implemented over one academic year
- Program aims to link school with family and community; program focused on parents, teachers, catering staff, students and the school environment
- Intervention taught by classroom teachers included:
  - teacher training
  - modification of school meals
  - development and implementation of school action plans designed to promote healthy eating and physical activity
- Theory:
  - Health Promoting Schools concept

### Outcomes and Results

- Follow-up data collected at the end of the intervention
- Intervention children had significantly higher vegetable intake (weighted mean difference 0.3; 95% CI 0.2 to 0.4)
- No significant difference in BMI
- No significant difference in physical activity and sedentary behaviour
- Intensity of the intervention is unknown and may be a contributing factor to the lack of effect for the intervention
- Although there is a statistically significant difference in fruit and vegetable intake, .3 servings per day may not be clinically significant

---

Healthy Weights Review – Environmental Interventions 239
<table>
<thead>
<tr>
<th>Author (date)</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATCH</td>
<td>• Randomized trial</td>
<td>Implemented over 2½ years half-way through grade 3 to end of grade 5 by trained classroom and PE teachers and food service staff</td>
<td>• Final data collection at the end of the intervention</td>
<td></td>
</tr>
<tr>
<td>Luepker (2003)</td>
<td>• Grade 3 children in 96 elementary schools</td>
<td>School-Based Classroom Curricula</td>
<td>• Intervention schools significantly increased the intensity of moderate to vigorous physical activity compared to controls (p&lt;.02)</td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>• 28 schools received the school-based intervention</td>
<td>• Adventures of Hearty Heart &amp; Friends (grade 3): 15 sessions/5 wks</td>
<td>• Intervention schools significantly decreased total fat in lunches compared to controls (p&lt;.001)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 28 schools received the school- and family-based intervention</td>
<td>• Focus on exercise and eating</td>
<td>• Intervention schools significantly decreased % of calories from saturated fat as compared to controls (p&lt;.01)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 40 schools served as controls (usual curriculum, food service, and physical education program)</td>
<td>Go for Health (grades 4-5): 24 sessions in 12 wks: monitoring, goal setting, skills training, GO foods</td>
<td>• Significant reduction in total fat intake among students in intervention schools (p&lt;.001)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>School Environment</td>
<td>• Significant reduction in saturated fat intake among students in intervention schools (p&lt;.01)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Eat Smart School and Nutrition Program: modification to lunch menus, food purchasing, recipes, food preparation and production</td>
<td>• Significant increase in self-reported vigorous physical activity (p&lt;.003)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CATCH PE: increase moderate to vigorous activity in PE</td>
<td>• No difference in total minutes of daily physical activity between groups</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Family-Based</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Home Team Program: Hearty Heart Home Team, Stowaway to Planet Strongheart, Unpuffables, Health Trek: activities for home skill dev.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Family Fun Nights</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hearty Heart’s Fun Night Planet, Strongheart Night: 2 hours/night activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Theory:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Behavioural-Epidemiological model of distal to proximal risk</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Health Belief model</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Healthy Weights Review – Environmental Interventions 240
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUTRITION ENVIRONMENT INTERVENTION + OTHER NUTRITION + OTHER PHYSICAL ACTIVITY INTERVENTIONS</td>
<td>• Quasi-experimental • Grades 3-5 students • Intervention group n=102 • Control group n=236</td>
<td>Program delivered over 2 years • Lunchpower (changes in meal planning by the kitchen staff) • Nutrition education: 9 modules per year over the two years • Aerobic activities 3 times per week for 30-40 min over the two years • Student activities were teacher led • Control group received regular curriculum in these areas Theory: • Can’t tell</td>
<td>• Outcomes measured at baseline and at the end of year 1 and year 2 of the program • No statistically significant between group differences after the two years in physical activity, BMI, one mile run • Statistically significant differences favouring the intervention group in decreased total energy and fat (p=.05) and increased fibre consumption (p=.05)</td>
<td>• Unit of allocation was the school and unit of analysis was the student; no cluster analysis is reported • Drop-out rates are not reported • The percentage of selected individuals who agreed to participate is not reported</td>
</tr>
<tr>
<td>Author (date)</td>
<td>Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------</td>
<td>-----------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Go For Health</td>
<td>United States</td>
<td>- Quasi-experimental&lt;br&gt;- Four elementary schools, two assigned to intervention and two to control (included grades kindergarten through grade 4)&lt;br&gt;- Data collected from third and fourth grade children during three consecutive spring data collection periods</td>
<td>Three-component intervention including training, consultation and technical support to teachers and food service staff who implemented the intervention&lt;br&gt;Go for Health Curriculum&lt;br&gt;- Six classroom-based education sessions promoting healthy eating and physical activity in and outside of school&lt;br&gt;Children’s Active Physical Education&lt;br&gt;- Five 6-8 week units in PE class&lt;br&gt;- Encouraged enjoyable moderate to vigorous physical activity&lt;br&gt;New School Lunch&lt;br&gt;- Provided lower-fat, lower-sodium lunches within school environment&lt;br&gt;- Modifications made to food purchasing, menus, recipes, and food preparation practices&lt;br&gt;Theory:&lt;br&gt;- Social Learning Theory&lt;br&gt;- An organizational change model (Charters and Jones)</td>
<td>Final data collection at end of the 24 month intervention&lt;br&gt;From imputed baseline values there were decreases in fat and sodium in the school lunches of intervention schools; no statistical comparisons between intervention and control schools reported&lt;br&gt;No significant differences in total fat, saturated fat, total energy and sodium between intervention and control groups&lt;br&gt;No significant differences reported on observed physical activity between intervention and control groups</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td><strong>Heart Smart Berenson (1995) United States</strong></td>
<td>• Quasi-experimental 266 4th and 5th grade students from 4 schools  • Mixed racial and socioeconomic population</td>
<td>Implemented over 1 school year by classroom/P.E. teachers Cardiovascular Disease Screening  • In providing CVD risk screening, students received knowledge re risk factors and how lifestyle contributes CV Health Curriculum  • Curriculum incorporated into a general science course; focused on healthful eating and exercise, self-esteem, adoption of healthy lifestyle Training Program for Staff  • 2 day school workshop on principles of CV health; bimonthly boosters  • Teacher facilitators received additional training in CV health promotion &amp; assisted other teachers Modification of School Lunch  • More healthful food alternatives offered and reduction in fat, saturated fat and sodium Aerobic Physical Education Program  • 12 lessons plus aerobic activities  • Students encouraged to increase leisure time physical activity  • Students received a Superkids-Superfit Resource guide Theory:  • Social Cognitive model primary framework</td>
<td>• Final data collection at the end of the one year intervention  • Comparison between intervention and control groups not reported for skin folds, waist circumference, blood pressure, or diet; assume no difference between groups  • Intervention group had significant increase in HDL compared to controls (p&lt;.05)  • Boys in the 5th grade in the intervention group had significantly reduced 1 mile run times compared to boys in the control group (p&lt;.01)  • No significant difference observed in the 1 mile run for girls  • Positive improvements in the amount of fat and sodium in school recipes reported along with more CV healthful food choices available; however, not reported as significantly different between intervention and control grades</td>
<td>• There was a trend of decreased skin folds in those students who improved their 1 mile run; however, comparisons between intervention and control students on these variables were not reported  • Intensity and frequency of the intervention may not have been sufficient to produce significant changes on behavioral measures</td>
</tr>
<tr>
<td>Author (date)</td>
<td>Country</td>
<td>Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
</tr>
<tr>
<td>--------------</td>
<td>---------</td>
<td>---------</td>
<td>-------------------------</td>
<td>----------------</td>
</tr>
</tbody>
</table>
| Kansas Lean Harris (1997) | United States | NUTRITION ENVIRONMENT INTERVENTION + OTHER NUTRITION + OTHER PHYSICAL ACTIVITY INTERVENTIONS | Quasi-experimental  
136 4<sup>th</sup> graders in three schools in an urban centre  
One school received the intervention (n=74)  
Two served as controls (n=62) | 2 registered dieticians at the school 20-30 hrs/wk give training and guidance to foodservice staff and classroom and physical education teachers, who implement the program  
Modify School Lunch:  
• Record and determine nutritional content of menu items/products  
• Get feedback on % calories from fat  
• Modify food preparation techniques and recipe ingredients  
• Change menu combinations  
Nutrition Education:  
• Incorporate American Cancer Society’s Changing the Course curriculum into 4<sup>th</sup> grade curriculum  
• Teachers and foodservice staff act as role models  
• Incentives for teachers to implement program  
Physical Activity:  
• Install physical activity stations in each classroom with workbooks  
• Provide non-competitive rewards  
• Increase time students spend in vigorous physical activity | Data were collected pre- and directly post-intervention  
No significant difference in % fat content of menus reported  
No significant differences between intervention and control schools on physical fitness | Reduction in fat content of menus decreased from 38% to 30%, although not reported as a significant difference  
Improvement in physical fitness occurred in both groups during the intervention period  
The study is very likely under-powered to detect a significant difference between groups  
Length, intensity, and frequency of intervention is also questionable |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUTRITION ENVIRONMENT INTERVENTION + OTHER NUTRITION + OTHER PHYSICAL ACTIVITY INTERVENTIONS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moon et al. (1999) Wessex Healthy Schools Award United Kingdom</td>
<td>• Quasi-experimental • 10 intervention secondary schools; 5 control schools matched for area and socio-economic factors • Males and females 11-16 years old • Mixed ethnicity</td>
<td>Ecological health promotion program. Key areas covered: curriculum; links with the wider community; smoke-free school; healthy food choices; physical activity; responsibility for health; health promoting workplace; environment; and equal opportunities and equal access to health Theory: • Can’t tell</td>
<td>• Testing at baseline and two years later (program completion) • No difference between the two groups in reported physical activity or food intake</td>
<td>• Unit of allocation and analysis was the school • Only physical activity, nutrition and obesity related outcomes are reported here • Although total scores for intervention schools were higher than controls at post-test, the difference was not statistically significant • This project points out the challenges for implementing a whole school approach and of involving the wider community</td>
</tr>
<tr>
<td>Author (date) Country Project</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>North Karelia Puska (2002) Finland</td>
<td>• Quasi-experimental 851 7th grade adolescents aged 13-15 from 6 schools  Two schools received the school-based and community-wide intervention  Two schools received the community-wide intervention  Two schools served as controls</td>
<td>Implemented primarily by project team members over 2 years  <strong>School-based Intervention</strong>  • Nutritionist discussed healthy diet  • Students screened for CVD risk  • Special health passport developed and used on each student  • School nurse gave advice on results of screening  • Physical activity was promoted at school, home and community  <strong>Community-Wide Intervention: School Menu Modification</strong>  • Butter replaced with margarine  • Whole milk replaced with skim milk, butter milk or water  • Vegetable oil used for salad dressing and cooking  • Low-fat meats were encouraged  • Increased fish, poultry, vegetables and fresh salads promoted  • Egg yolks were avoided  • Food industries asked to reduce salt</td>
<td><strong>Final data collection 6 months post-intervention.</strong> Students in the school-based intervention received less fat from drinking milk than controls (p&lt;.001)  <strong>No significant difference in fat intake from butter consumption between groups</strong>  <strong>No significant increase in vegetable oil and low-sodium salt between groups</strong>  <strong>No difference in serum cholesterol for boys between intervention and control groups</strong>  <strong>Significant reduction in serum cholesterol among girls across the intervention and control groups; School-based vs. control (p&lt;.01); Community-wide vs. control (p&lt;.05)</strong>  <strong>Significant increase in systolic blood pressure for males in the intervention schools vs. controls (p&lt;.01)</strong>  <strong>No difference in systolic blood pressure for females between intervention and controls</strong>  <strong>No difference in diastolic blood pressure in males or females between intervention and controls</strong></td>
<td><strong>Physical activity not measured as an outcome although an objective of the intervention</strong>  <strong>Positive trend toward decreased fat intake from use of butter seen in intervention schools but not statistically significant</strong>  <strong>Positive trend toward increased use of vegetable oil and low-sodium salt although not statistically significant</strong></td>
</tr>
</tbody>
</table>

Healthy Weights Review – Environmental Interventions 246
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| **PATHWAYS**  
Hunsberger (2002)  
United States | • Randomized trial  
• 1,441 third grade American Indian children representing 7 tribes from 41 schools  
• 21 intervention schools  
• 20 control schools | Implemented over 3 academic years (grades 3-5) by classroom teachers  
Food Service  
• Nutritionist provided support and monitored lunch preparation  
• Training food service staff to plan and serve meals  
Classroom Curriculum  
• Two 45 min lessons/ week for 12 week each academic year  
• Children tasted new foods and beverages and practiced healthy eating/physical activity behaviours  
Physical Activity  
• Three 30 minute physical education sessions/week during school time  
• Guided play at recess, active play encouraged after school; games derived from traditional American Indian games implemented  
Family  
• Family packs promoting physical activity at home and healthy eating; family snack packs with locally available, low-fat and sugar food items; family events at school | • Final data collection occurred at the end of the three year intervention in grade 5  
• No significant differences between intervention and control schools on percent body fat, BMI, or physical activity  
• Statistically significant difference between intervention and control schools on fat intake (p<.05)  
• Intervention schools had significantly greater mean reduction in % calories from fat and saturated fat than control schools (p<.05) | • There was a trend toward increased physical activity in the intervention schools, although not reaching statistical significance (p<.08) |
<table>
<thead>
<tr>
<th>Author (date) Country Project</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
</table>
| Plotnikoff et al. (1999) Healthy Heartbeat School Project Australia | • Quasi-experimental  
• 15 intervention grade 6 classes (n=294 students) and 15 matched classes (n=363 students) from another region  
• Male and females students 11 and 12 years of age  
• Over 50% of the classes were in small rural schools | Heart Health program including content areas related to heart disease, exercise, diet and smoking  
• Supported canteens in schools in promoting healthy food choices  
• Teachers of intervention classes provided with curricular materials, training, and on-going support and follow-up  
• Community campaign and involvement  
• Ten lessons (one per week for one term) on nutrition and physical activity  
• Control classes received the regular curriculum and had a school lunch committee Theory:  
• Ecological theory | • No statistically significant between group differences in attitudes to exercise and self-reported exercise or food intake  
• Statistically significant differences favouring the intervention group in flexibility for males and females (p<.01), aerobic endurance for females (p<.01), muscle strength for females (p<.05), and muscle endurance for males and females (p<.01) | • Unit of allocation was the classroom, unit of analysis was the student; no cluster analysis is reported  
• Only 38% of teachers in the intervention group reported using the program as designed, suggesting that the lack of significant results may be in part due to inconsistent program implementation |
<table>
<thead>
<tr>
<th>Author (date)</th>
<th>Design and Participants</th>
<th>Intervention(s)</th>
<th>Outcomes and Results</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resnicow (1992) Know Your Body III – New York United States</td>
<td>• Quasi-experimental • 1,209 grade 4 children from 5 elementary schools • 3 schools in Bronx received the intervention • 1 school in Bronx served as a control • 1 school from Texas served as a second control</td>
<td>Implemented over three academic years by classroom teachers • Teachers received 1-2 days of training from project staff • Project coordinator met with all teachers in small groups twice a year to distribute materials and provide support • Head teachers were assigned by principals from each school to monitor and facilitate teacher implementation Food Service Modifications • Increase fibre content and decrease fat content of school lunches • Addition of a salad bar • Increased visibility of low fat milk • Offer heart healthy entrees School-wide activities • Peer leader training • Student health committees • Food tasting parties • Drug and nutrition poster and essay contests • Student aerobics • Special health lectures Theory: • Social Learning Theory • Other psychosocial models about health behaviour</td>
<td>• Final data collection at the end of the intervention • No difference in fruit and vegetable, meat, dairy, and dessert consumption between groups • High exposure group reported significantly more consumption of heart healthy foods compared to moderate exposure group (p&lt;.05) • No difference in diastolic blood pressure or BMI between groups • Students in schools with moderate and high program implementation had significantly lower total cholesterol than controls (p&lt;.05)</td>
<td>• Only results related to physical activity, nutrition, and weight are reported here</td>
</tr>
<tr>
<td>Author (date)</td>
<td>Country</td>
<td>Design and Participants</td>
<td>Intervention(s)</td>
<td>Outcomes and Results</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Sallis et al. (2003)</td>
<td>United States</td>
<td>Randomized trial; Students in 24 middle schools (grades 6-8) randomly allocated to intervention or control group; Mean school enrolment of 1,109 students; 44.5% non-white; Although SES not stated, 39% paid reduced prices or had free school meals</td>
<td>Two year intervention: • Multiple interventions to increase physical activity in physical education classes and throughout the school day (e.g., changing PE lesson, structure and teacher behaviour and supervision, equipment, organized activities) • Nutrition interventions aimed to reduce fat intake during the day; focused on both cafeteria meal choices and on content of lunches brought from home • Interventions to create and promote policy changes within the school to increase activity and decrease fat intake • Student health committees formed at 8 of 12 intervention schools to promote activities related to project objectives • Parent education through newsletters and presentations • Financial incentives to intervention schools for PA and kitchen equipment Theoretical model: • Structural Ecological Model</td>
<td>Measurements by direct observation, existing records or survey; All measurements taken at baseline and end of the program • Physical activity at school (kcal/child/school expended in moderate to vigorous activity) increased overall for intervention schools vs. controls (p&lt;.009); no significant change for girls (p=.40) • Boys increased activity about equally in PE class and out of class, but girls increased activity mainly in class • There was no difference in total and saturated dietary fat intake during the school day between intervention and control groups • Significant reduction in BMI (p=.04) (self-report) among boys only • 72% of eligible student-parent dyads at baseline with 60% response rate post intervention</td>
</tr>
</tbody>
</table>


