



Addressing Childhood Obesity: The Evidence for Action



Canadian Association of Paediatric Health Centres
Association canadienne des centres de santé pédiatriques



CIHR IRSC
Canadian Institutes of Health Research
Instituts de recherche en santé du Canada

Institute of Nutrition, Metabolism and Diabetes

Institut de la nutrition, du métabolisme et du diabète



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A Message From the Sponsoring Partners

This report has been compiled on behalf of the Canadian Association of Paediatric Health Centres (CAPHC), the Paediatric Chairs of Canada (PCC), and the Canadian Institutes of Health Research, Institute of Nutrition Metabolism and Diabetes (CIHR, INMD). These organizations are ideally positioned to address childhood obesity in Canada. These national bodies are committed to facilitating the communication necessary to ensure that this information benefits children throughout the country.

CIHR provides an opportunity for Canadian researchers to address the research questions required to design or refine a practical, effective and economically viable approach to childhood obesity in Canada. The partnership of these three organizations provides the framework for effective knowledge translation by using clinical care and advocacy.

We are pleased to have participated in the genesis and discussions leading up to this final report. We believe that this report provides a sound basis for moving together as concerned health care administrators, academic professionals and research investigators, on an issue of national importance for the children and youth of Canada.

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EXECUTIVE SUMMARY

Introduction

Current prevalence estimates indicate that approximately 15% of Canadian children may meet CDC criteria for “overweight”, and that another 30–40% may be “at risk for overweight”^{1,7,72}. This high and rapidly increasing prevalence will significantly impact the health of Canadians over the course of the next century. While action to stabilize and reverse this trend is urgently required, such action must be based on the best available evidence to ensure optimal outcomes and cost-effectiveness. This report reviews existing high-quality evidence for interventions to prevent and treat childhood obesity. Interventions supported by high-quality evidence are presented as recommendations for action. Where evidence is lacking or conflicting, recommendations for research priorities highlight information urgently required to direct future interventions.

Main Findings

Intervention

Summary of systematically reviewed literature of obesity prevention or treatment yielded the following recommendations regarding interventions for childhood obesity:

- There is currently no systematically reviewed evidence to support a specific approach to obesity prevention through childhood.
- Any treatment intervention is associated with significantly increased chance of improvement or resolution of obesity, and is favoured over no treatment.
- Exercise included in the treatment intervention improves outcome, but no specific type or amount of exercise can be favoured over another for all children.
- Parental involvement may be best directed at support and reinforcement, while the intervention focuses on child-centred behaviour change.
- Behaviour modification is an important component of obesity treatment interventions and is strongly associated with improved outcomes.
- Degree of obesity does not predict success or failure of interventions. Obesity treatment should therefore be offered when the condition is recognized.
- School-based physical activity interventions can effectively increase regular physical activity and are useful in obesity treatment.
- School-based nutrition programs focused on changing dietary behaviour may be useful in obesity treatment.

Research

Based on evaluation of systematically reviewed literature of obesity prevention, future studies addressing prevention should address the following issues:

- Study of populations unselected by weight status,
- Obesity prevalence as primary outcome measure,
- Adequate power to identify clinically significant differences,
- Comparability between intervention and control groups, and,
- Prolonged follow up to determine characteristics associated with favorable long-term outcome.

Priority research issues related to obesity treatment identified by review of systematically reviewed literature were as follows:

- Interventions require long-term follow up of *both* behaviour patterns and weight status to determine the specific aspects of intervention associated with *long-term* success.
- The role of reinforcement in treatment interventions requires further investigation to determine the efficacy of periodic reinforcement and to identify strategies which support long term successful weight control.
- Comparative studies on dietary interventions should be conducted specifically in populations of overweight children to determine the characteristics associated with improved dietary habits.
- Investigations geared to implementation in school or community settings should be developed and evaluated to provide a scientific basis for population-based interventions.
- Duration of treatment should be evaluated as a specific outcome variable to guide resource utilization and optimize outcomes.
- Age of intervention (independent of degree of obesity) should be evaluated as a specific outcome variable to assist in targeting available resources to achieve maximum impact.
- Pharmacologic and surgical treatment should be systematically evaluated in pediatric patients as literature becomes available.
- Existing and future research should be systematically reviewed to determine appropriate strategies for minority populations, particularly Canadian aboriginal children.
- Interventions to increase physical activity in schools should include measures of both in-school and out-of-school physical activity to determine the effect of these interventions on global behaviour change.
- Long-term follow up is critical to determine the relationship between physical activity interventions and life-long patterns of activity and should be included as a measure of efficacy of the intervention.
- Existing literature regarding the development of eating behaviours in young children should be expanded and replicated to provide a scientific basis for population-wide feeding guidelines consistent with maintaining or achieving a healthy weight.

Methodology

Studies must have met the following criteria to be included in this report:

- Evidence summary, meta-analysis, systematic review or narrative summary of prevention and/or treatment of obesity,
- Subjects 0–18 years of age, and,
- Outcomes summarized using a measure of adiposity (e.g., BMI or % overweight) or a measure of dietary intake and/or physical activity.

Relevant evidence was extracted from these documents and sorted according to the specific questions addressed. All resulting evidence is presented in detail, summarized, and synthesized to produce recommendations.

Conclusion

This report highlights the strengths and weaknesses of the systematically reviewed literature relating to the prevention and treatment of childhood obesity. Prevention is disturbingly under-represented in the existing literature and no specific approach to intervention can be recommended. As prevention is generally considered the most effective, economical and socially acceptable approach to addressing the “obesity epidemic”, the need for clear principles upon which to base prevention strategies must be considered an urgent research priority.

Despite the potential benefits of obesity prevention, current prevalence data indicates that many children will also be candidates for treatment. At present, the reviewed literature can provide an evidence-based framework for treatment interventions. It is clear that treatment programs should include strategies to address diet, physical activity and behavioural change. Many details regarding the optimal design of these components remain to be clarified. Research to determine those specific characteristics associated with successful interventions must also receive priority attention. This research lends itself to a clinically oriented approach, combining the delivery of treatment with the advancement of knowledge in the science of obesity treatment. The research recommendations highlight areas where clarification may have significant impact on treatment efficacy.

Chapter 1 - Introduction

Description of the problem

As we enter the 21st century, childhood obesity has emerged as a highly significant threat to the health and well-being of Canadians with staggering immediate and long-term impact. A proliferation of data and opinion regarding childhood obesity has appeared in the Canadian media, the worldwide professional literature, and among politicians, economists, educators and social scientists. The following tables highlight the increased interest in and awareness of childhood obesity as reflected by a dramatically increasing prevalence in the number of publications over the past decade.

Public Media*	
<u>Reporting Period</u>	<u>Number of Citations</u>
1982-1992 (10 yr)	32
1993-1999 (6 yr)	4761
2000-2003 (3 yr)	765
2003 (10 mo)	257

*from Canadian Business & Current Affairs database

Professional Publications*	
<u>Reporting Period</u>	<u>Number of Citations</u>
1982-1992 (10 yr)	3887
1993-1999 (6 yr)	4136
2000-2003 (3 yr)	3599
2003 (1 yr)	791

*from PubMed database

From the discussion and science, two pre-eminent facts have emerged:

- The prevalence of childhood obesity is increasing in Canada, in parallel to or exceeding those increases noted in other developed countries².
- The consequences of childhood obesity including medical, psychological, economic and social will be transformative forces in the lives of Canadians and in Canadian society in the years to come^{2,4,10,30,55}.

The recognition of these two facts has resulted in a struggle to find effective strategies to reverse the trends. While many details regarding health risk as well as social and economic impact require further clarification, there is a pressing need for efforts directed at intervention.

Rationale for this Report

Current prevalence estimates indicate that approximately 15% of Canadian children may meet currently accepted criteria for “overweight”, and that another 30-40% may be “at risk for overweight”^{1,7,72}. Efforts to address childhood obesity will therefore target not a small subset of children, but perhaps half of all Canadian children and families. Given the magnitude and potential cost of such initiatives, it is critical that they be based on the best available and most current evidence.

Due to the above-mentioned issues, the objective of this report is to identify approaches to prevention and treatment which are supported by high-quality evidence, and to use these approaches as a basis for recommendations for action. This process has identified strategies for which the evidence is insufficient, or has been inadequately evaluated. Where such evidence does provide key information in determining appropriate recommendations, this need will be highlighted as a research priority.

Deliverables

- *Recommendations for Action:*

This report presents recommendations for action to address the prevention and treatment of childhood obesity in Canada, where sufficient high-quality evidence exists to support such recommendations. Systematic reviews and meta-analyses are identified as the highest quality evidence by the Levels of Evidence produced by the Oxford Centre for Evidence-based Medicine (www.cebm.net/levels_of_evidence.asp) and the recommendations in Chapter 3 are based upon this data. The recommendations are also compared to existing clinical practice guidelines.

- *Research Agenda:*

Clinical questions which would provide key information to guide efforts in prevention or treatment, but which could not be adequately answered due to the lack of quantity or quality of evidence will be highlighted as a proposed research agenda. This may guide funding agencies toward supporting the establishment of appropriate evidence.

Chapter 2 - Methodology

Objectives

The primary objective of this report is to summarize published evidence regarding strategies for the prevention and treatment of childhood obesity. Many publications have contributed such summaries from many different perspectives relevant to childhood obesity. This report will provide a composite view of that summarized evidence — a “review of reviews” — with the goal of bringing together the best available evidence and highlighting its strengths and weaknesses.

The resulting evidence summary will be used to formulate a series of recommendations for action with respect to intervention and will highlight issues which require acquisition of additional knowledge or further evaluation of existing data before recommendations can be made.

The search performed for this review retrieved a number of clinical practice guidelines, expert recommendations and other “reviews of reviews” relevant to the subject area. These have been summarized to facilitate comparison with conclusions and recommendations derived from the present review.

Definitions

- For the purposes of this summary, prevention refers to interventions to prevent populations of children *unselected by weight status* from becoming obese.
- Treatment refers to interventions targeting *obese children*, with the objective of preventing worsening of obesity or normalizing body weight.

Clinical Questions

For the purpose of identification of relevant literature, the primary clinical questions used for this review were:

- What strategies are effective in preventing children from becoming obese? This question included both children of normal weight (universal prevention) and children at risk of becoming obese (targeted prevention).
- What treatment strategies are effective in reducing the degree of obesity or normalizing weight in obese children?

As it is clear that both dietary intake and physical activity energy expenditure are tightly related to body weight, a secondary clinical question was developed:

- What strategies are effective in promoting healthy dietary intake and/or physical activity patterns in children and adolescents?

While the evidence related to the secondary question may not be directly applied to the primary questions, it was considered to be useful in providing additional insight into approaches to effective implementation.

Inclusion Criteria

Studies which addressed one or more of the clinical questions must have met the following criteria to be included in this report:

- Evidence summary, meta-analysis, systematic review or narrative summary of prevention and/or treatment of obesity,
- Subjects 0–18 years of age,
- Outcomes summarized using some measure of adiposity (e.g., BMI or % overweight), and,
- Outcomes summarized using some measure of dietary intake and/or physical activity.

A systematic review is defined as: “a review of a clearly formulated question that uses systematic and explicit methods to identify, select and critically appraise relevant research, and to collect and analyse data from the studies that are included in the review. Statistical methods (meta-analysis) may or may not be used to analyse and summarise the results of the included studies”

(www.cochrane.dk/cochrane/handbook/hbookSystematics_review.htm).

Therefore, only those studies which met these criteria and did not answer “no” for the first three questions from the Oxman & Guyatt quality scale for systematic reviews (see Appendix 1) were classified as systematic reviews. All studies not meeting these criteria were classified as narrative overviews.

Relevant Clinical Practice Guidelines or practice recommendations were also retrieved in order to facilitate a comparison of evidence against current recommendations.

Search Strategies

OVID's database "All EBM Reviews" (includes Cochrane Library, ACP Journal Club, Database of Abstracts of Reviews of Effectiveness and the Cochrane Controlled Trials Register) was searched from its inception to May 2003 to identify relevant systematic reviews and meta-analyses pertaining to obesity. OVID's MEDLINE (1966–2003) and EMBASE were searched next for supplementary reviews not found these databases. The reference lists of all included studies were checked and all potentially appropriate studies were obtained and assessed for addition to this study. For policy and other grey literature, the Internet was searched using Google (www.google.com). Online collections of Clinical Practice Guidelines were searched including: The Canadian Medical Association's CPG Infobase, Alberta Medical Association Clinical Practice Guidelines, National Guideline Clearinghouse and the American Academy of Pediatrics.

Terms used in the search included obese and obesity along with filters to capture articles which dealt with children and which were systematic reviews. All EBM Reviews yielded 86 potential systematic reviews and meta-analyses. The content expert and one reviewer screened this initial group of studies for relevance. Next, MEDLINE and EMBASE respectively identified 6 and 26 potential reviews. When duplicates were removed, citations unique to each database were: All EBM Reviews (69), MEDLINE (6) and EMBASE (26).

The Canadian national advisory committee (composed of members from the Pediatric Chairs of Canada and the Canadian Association of Paediatric Health Centres) also provided citations for and information about other potential reports and/or authors in the area of childhood obesity that were not included in the list from the above searches.

Relevance Assessment

All systematic reviews, meta-analyses and narrative overviews were reviewed for inclusion according to the clinical questions and inclusion criteria by the content expert.

Quality Assessment

All included articles were assessed for methodological quality using Oxman and Guyatt's Index of the Scientific Quality of Research Overviews (Appendix 1). Using this tool, each review was assessed according to nine defined parameters, and assigned a final quality score varying between 1 (extensive flaws) and 7 (minimal flaws). Two reviewers independently scored each study and resolved discrepancies through discussion. Clinical Practice Guidelines were not assessed for quality.

Data Extraction

Relevant data was extracted from included studies independently by two reviewers and checked for completeness and accuracy by a clinician with content expertise. All data were entered into a working table.

Data Synthesis

As this report includes only data derived from evidence summaries, it was not appropriate to attempt a statistical combination of results. Data was not excluded on the basis of methodological quality. However, the conclusions and recommendations presented in this review were derived solely from evidence which had been systematically reviewed. Summarized information from narrative reviews is clearly identified and was included only for comparison with data from systematic reviews.

Final conclusions are presented using a narrative format. Results are summarized, including the number and quality of articles contributing to the conclusions and evidence which is conflicting. Chapter 3 is divided into three sections: Section A examines evidence specifically pertaining to obesity prevention; Section B focuses on evidence related to treatment of established obesity and Section C summarizes the effectiveness of strategies to change behaviour where diet and physical activity are the measured outcomes, and thus presents information relevant to both prevention and treatment.

Limitations of Evidence

The purpose of this report is to summarize the evidence evaluating strategies for obesity prevention and treatment. This evidence has been derived from relevant systematic reviews and meta-analyses and, as such, is considered to be of high quality. However, several limitations of this approach should be noted.

First, it is evident that high quality studies of obesity prevention and/or treatment are not numerous. Challenges to the completion of such studies include program delivery, outcome measurement and the need for long-term follow up. Though these challenges can be addressed by a high quality study design such as a randomized controlled trial, these studies are costly and time-consuming. As a result, single high quality studies may not be replicated to confirm or refute findings, and may constitute the bulk of the evidence with respect to a particular aspect of an intervention. These single studies are also repeatedly cited in both systematic and narrative reviews. Because of these issues, conclusions from systematic reviews cannot simply be tallied to provide an evidence summary. Thus, it is vital to consider the evidence from which the conclusions were derived. Similar conclusions derived from different sources of evidence adds strength to them; similar conclusions derived from the same body of evidence does not. This report has attempted to provide information regarding the use of common sources where such information could be derived from the source documents.

Second, for reasons similar to those described above, the number of investigative groups contributing to the obesity literature is limited. In some specific areas of investigation, it is clear that single groups have contributed the majority of available evidence. While this does not necessarily impact the quality of the evidence (which may vary from good to poor), it may significantly impact the generalizability of results.

Third, as in all evidence summaries, the scope of the conclusions is limited by the available evidence. For the purposes of this report, only interventions which have been previously evaluated in a systematic review are discussed. It should be recognized that interventions which have not been assessed by systematic review are not included, even though a body of evidence to evaluate their effectiveness may be available.

Finally, prevalence and incidence data indicate that approaches directed at both prevention and treatment will be required to effectively address this problem. This report makes no attempt to emphasize one approach over the other, but merely reflects the quantity and quality of evidence which currently exists to guide policy and practice.

Chapter 3 - Results

After final review, 19 articles addressing the primary clinical questions and 13 articles addressing the secondary clinical question were included for detailed analysis. In addition 8 reports of clinical practice guidelines, reviews of reviews or recommendations were retrieved. Studies included in this review varied in methodological quality between 1 and 7. Excluded studies and reasons for exclusion are listed in Appendix 2.

A. Prevention of Obesity

Sources of Evidence

Search strategies yielded 12 review papers which evaluated approaches to prevention using measures of adiposity as primary outcome measures (Table 1). Six of these were systematic reviews (Campbell⁶, Hardeman³², Reilly⁵⁶, Resnicow 1997⁵⁷, Schmitz⁶², Swedish⁶⁹) and six were narrative reviews (Dietz¹⁰, Fulton²⁴, Muller⁴⁷, Raine⁵⁴, Resnicow 1993⁵⁸, Story⁶⁶). Quality scores for the systematic reviews ranged from 2–7. All narrative reviews received a quality score of 1. Limited information was available from the Swedish Council’s study⁶⁹, as only their conclusions and a summary have been published in English. The remaining systematic reviews included data from 34 individual studies. Some primary studies were included in more than one review: 1 study was included in 4 reviews; 3 studies were included in 3 reviews; 10 studies were included in 2 reviews; the remainder of studies (n=20) were included in a single review only (Table 2).

Table 1: Studies Using Adiposity as Primary Outcome Measure (Prevention)

Study	Objective	Population	Quality Score
Systematic reviews			
Campbell ⁶	To assess the effects of a range of lifestyle interventions designed to treat obesity in childhood.	Less than 18 years excluding pregnant and critically ill.	7
Hardeman ³²	To inform an ongoing intervention aimed at the prevention of weight gain among people not selected by weight.	Mothers & daughters, school children, family	3
Reilly ⁵⁶	To provide evidence based on answers to five frequently asked questions: <ul style="list-style-type: none"> • How should obesity be diagnosed? • What is its prevalence in the UK? • Is it preventable? • Is it treatable? • How should it be managed? 	Children	4
Resnicow 1997 ⁵⁷	Reviews 16 major school-based cardiovascular disease prevention trials.	School children with quantitative assessment of at least one major cardiovascular disease (CVD) physiologic risk factor or two major CVD behavioural or cognitive risk factors.	3

Study	Objective	Population	Quality Score
Systematic reviews			
Schmitz ⁶²	To outline the known or suspected risk factors for obesity, summarize a proposed three tiered obesity prevention approach, review prior studies focusing on general population obesity prevention and outline future research efforts towards obesity prevention.	General population including United States and Europe	2
Swedish Council on Technology Assessment in Health Care ⁶⁹	Reviews the scientific evidence concerning the medical interventions against obesity.	School children 5-13 years; parents	2
Narrative reviews			
Fulton ²⁴	Review the weight loss treatment and weight gain prevention studies conducted among youth, consider the current issues related to these studies and outline new approaches for weight loss treatment and weight gain prevention research.	Children, adolescents, Indian children	1
Muller ⁴⁷	Not stated	Children & adults, children & parents	1
Raine ⁵⁴	To provide adequate surveillance of obesity and associated non-communicable diseases for targeting appropriate and effective public health interventions.	General population, concentrating on North American data.	1
Resnicow 1993 ⁵⁸	To review the methods, results, and limitations of the major school-based studies as well as to discuss their potential for large-scale dissemination.	Elementary and Junior High students	1
Story ⁶⁶	To review the research on school-based interventions to treat or prevent obesity.	Children, adolescents, youth	1

Table 2: Citation Analysis for Prevention of Obesity

	Campbell	Hardeman	Reilly	Resnicow	Schmitz	Total
Alexandrov 1998					x	1
Alexandrov 1992				x		1
Bush 1989 (AM J Epi)				x	x	2
Bush 1989 (Health Edu Quart)				x		1
Donnelly 1996	x	x		x	x	4
Dwyer 1983					x	1
Edmunson 1996				x		1
Epstein 2001 (Obesity Res)	x					1
Fardy 1996					x	1
Flores 1995	x				x	2
Gortmaker 1999	x		x		x	3
Harrell 1996				x	x	2
Kellen 1998				x	x	2
Lionis 1991					x	1

	Campbell	Hardeman	Reilly	Resnicow	Schmitz	Total
Luepker 1996			x	x	x	3
Mo-Suwan 1998	x				x	2
Muller 2001	x					1
Parcel 1989				x		1
Perry 1985				x		1
Resnicow 1992				x	x	2
Rosensen 1999	x				x	2
Sahota 2001	x					1
Sallis 1997		x			x	1
Simonetti 1986	x				x	3
Simons-Morton 1991				x		1
Stolley 1997	x	x				2
Tamir (Harefuah)				x		1
Tamir 1990 (Prev Med)				x	x	2
Tell 1987					x	1
Vandongen 1995					x	1
Vartainen 1987					x	1
Walter 1988				x	x	2
Walter 1989				x		1
Worsley 1987					x	1
Studies included x 1						20
Studies included x 2						10
Studies included x 3						3
Studies included x 4						1

Description of interventions

In 5/6 of the reviews, characteristics of the interventions were highly variable between studies. This variation precluded statistical combination of results to determine overall treatment effect in these reviews. Despite this, some features were common to many interventions. The majority of interventions were school-based, but some included components in the family or community setting. Both physical activity and diet were components of virtually all preventive programs and delivery was multifaceted in most. Information delivered in a classroom setting was often accompanied by changes in scheduled physical activity and foods available within the school. In many cases, a specific model of behavioural change was explicitly identified or could be inferred to be underpinning the intervention strategy. Duration of the intervention and follow up periods was highly variable, ranging from weeks to years. Outcomes were commonly expressed as change in Body Mass Index (BMI), change in percent overweight (%OW), change in skinfold measurements or change in obesity prevalence.

One of the systematic reviews (Resnicow 1997)⁵⁷ focused specifically on programs designed to reduce cardiovascular risk in children. In this review, outcomes were combined statistically using meta-analysis.

Results - Systematic Reviews (Table 3):

In the review by Hardeman³², only 3 of the included studies report outcomes related to adiposity, and benefit was identified in 1/3. These 3 studies are also included in the later review by Campbell⁶, along with 7 additional studies published after Hardeman. Four of these 10 studies demonstrated some beneficial effect on adiposity, while 6 demonstrated no effect. Reilly's⁵⁶ review included only 2 studies, with positive outcome observed in 1/2. The review by Schmitz⁶² considered 22 studies, and could find evidence for benefit in 7/22, no difference in 13/22 and uncertain/equivocal effect in 2/22. The Swedish review⁶⁹ indicated that interventions showed beneficial outcome in 3/7 studies. In the four reviews for which citation analysis was possible, benefit was identified in 7/26 studies (the specific studies included in the Swedish review could not be identified to rule out duplication). These systematic reviews all concluded that current evidence is insufficient to support the effectiveness of interventions directed at obesity prevention in children and adolescents.

Resnicow (1997)⁵⁷ evaluated the effect of multi-component cardiovascular prevention programs on measures of obesity using a meta-analytic technique. Sixteen studies provided information on 77 individual interventions using a measure of adiposity as an outcome. Of the 77 interventions which measured adiposity as an outcome, only 7 produced a significant positive outcome. It was concluded that cardiovascular prevention programs are not effective in improving adiposity in children.

Table 3: Results Summary - (Prevention)

	Benefit	No Benefit	Undetermined/ Equivocal
Campbell	Flores 1995 (short term)	Epstein 2001	
	Gortmaker* 1999 (males only)	Donnelly 1996	
	Robinson 1999 (short term)	Mo-Suwan* 1998	
	Simonetti* 1986	Mueller 2001	
		Sahota 2001	
		Stolley 1997 (short term)	
Harderman	Simonetti* 1986	Donnelly 1996	
		Stolley 1997	
Reilly	Gortmaker* 1999 (males only)	Luepker 1996	
Schmitz	Dwyer 1983	Alexandrov 1988	Killen 1988
	Flores 1995 (short term)	Bush 1989	Tamir 1990
	Gortmaker 1999	Donnelly 1996	
	Lionis 1995	Fordy 1996	
	Robinson 1999	Harrell 1996	
	Simonetti 1986	Luepker 1996	
	Worsley 1987	Mo-Suwan* 1998	

Benefit	No Benefit	Undetermined/ Equivocal
	Resnicow 1992	
	Sallis 1997	
	Tell 1987	
	Vandongen 1995	
	Vartanen 1987	
	Walter 1988	
Swedish		

Results - Narrative Reviews:

Among the 6 narrative reviews, conclusions regarding preventive strategies were based on the results of intervention studies selected by the author (Fulton²⁴, Muller⁴⁷, Raine⁵⁴, Resnicow 1993⁵⁸, Story⁶⁶), or deduction from literature on related topics and opinion (Dietz¹⁰). Despite the differing approaches, several of these reviews also concluded that preventive interventions lack supporting evidence (Fulton²⁴, Muller⁴⁷, Resnicow 1993⁵⁸, Story⁶⁶). In addition, several authors described features of a preventive program which might be most effective in obesity prevention, sometimes providing some supporting evidence. Dietz suggested that anticipatory guidance delivered by health care providers around energy intake and expenditure within the family setting would be a useful strategy in preventing childhood obesity.

Examples of advice such as division of parent/child responsibility around eating, limitation of television viewing and incorporation of physical activity into daily life were provided. Resnicow⁵⁸ recognized the variable outcomes for school-based prevention programs, but described components of successful programs as including nutritional information, skills training, behaviour modification, screening and parental involvement. Muller⁴⁷ also suggested that parental involvement was valuable in the setting of prevention among children at high risk (e.g., children of obese parents). Raine⁵⁴ makes several recommendations regarding school, family and community prevention. While supporting evidence is provided, it should be noted that the evidence does not support a direct effect on obesity prevention, but rather an effect on dietary and physical activity behaviours.

Discussion

Successful prevention as defined in this report involves the *maintenance of normal weight status* in children over time. The interventions described have been applied to populations which are unselected by weight status (e.g., schools). These populations would be expected to include children who are overweight or obese as well as children of normal weight. Strategies which are designed to maintain normal weight status (i.e., prevent the development of obesity) cannot be assumed to have any pre-determined effect on weight status in children who are already overweight or obese. For this reason, *prevalence* of overweight or obesity may be the most specific outcome to measure the success of prevention interventions. Among the 4 systematic reviews which address obesity prevention, 3 studies used obesity prevalence as an outcome measure^{28,29,64}. Two of these demonstrated significantly decreased obesity prevalence in the intervention groups; the third appeared to have no clinically significant effect⁴⁴.

In addition, both studies were large ($n > 1000$ subjects) and long term (≥ 12 months). In the Swedish review, the authors noted that prevalence was used as an outcome in only 2/7 studies, with only 1 reporting a beneficial effect. The remaining studies report outcome based on measures of adiposity, most often BMI. Changes in the BMIs of individual children will influence the BMI of the group as a whole. Therefore, increases in group mean BMI could result from development of obesity in previously normal weight children, or from an increasing degree of obesity in those who were already obese. Without separating normal weight and obese children for analysis, group mean BMI data cannot distinguish between these outcomes. Given that the outcome of particular interest concerns children of normal weight, it is impossible to evaluate preventive interventions based on group BMI data alone.

Conclusion

Based on evidence from 6 systematic reviews of quality ranging from fair to good, there is *insufficient evidence* to support the recommendation of a specific strategy for the prevention of obesity in children.

Recommendation #1

- Studies of prevention strategies with the following objectives and attributes are *strongly recommended*:
- Explicitly define prevention of obesity in populations of children unselected by weight as objective.
- Utilize obesity prevalence as critical outcome measure.
- Adequately powered to identify significant differences in prevalence between intervention and control groups.
- Utilize methods to ensure comparability between intervention and control groups.
- Include follow up assessment of sufficient duration to elucidate the intervention characteristics associated with long-term success.

B. Treatment of Obesity

Sources of Evidence (Table 4)

Search strategies yielded 15 reviews which evaluated obesity treatment interventions using measures of adiposity as an outcome measure (Table 4). Eight of the 15 reviews were systematic (Epstein 1998²², Goldfield²⁷, Jelalian³⁴, NHS⁴⁹, Reilly⁵⁵, Swedish⁶⁹, Haddock³¹, Summerbell⁶⁸) and 7 were narrative (Dietz¹¹, Ebbeling¹⁴, Epstein 1996¹⁹, Epstein 1998²², Fulton²⁴, Resnicow 1993⁵⁸, Story⁶⁶). As indicated in Prevention, only conclusions and summary are available in English for one review (Swedish⁶⁹). One of the systematic reviews presented meta-analysis data on specific components of treatment (Haddock³¹).

Table 4: Studies Using Adiposity as Primary Outcome Measure (Treatment)

Study	Objective	Population	Quality Score
Systematic Reviews			
Epstein 1998 ²²	Reviews the utility of exercise as a treatment for overweight and obese children and adolescents.	Obese children or adolescents (age 7-13)	3
Goldfield ²⁷	Update Epstein 1998 review, adding 7 new clinic-based obesity treatment studies.		3
Haddock ³¹	Investigated methodological factors, including both treatment components and research methodology related to the success of childhood obesity programs, and characteristics of children most likely to benefit from obesity treatment.	Children less than 18 years	3
Jelalian ³⁴	To review the existing literature on intervention with pediatric obesity, with the objective of identifying effective treatment strategies and areas for further research. The focus is on interventions involving diet and activity modification conducted within a clinical research setting.	Children and adolescents (0-18 years old); children and parents	3
NHS Centre for Reviews and Dissemination ⁴⁹ & Glenny ²⁵	To inform the work of the Nutrition Unit by identifying the current state of knowledge of obesity and to highlight future research needs. To summarize the evidence about effectiveness of interventions in preventing and treating obesity and the maintenance of weight loss from RCT's. Focuses on behavioural, dietary, exercise, surgical, pharmacological and complementary interventions.	Family	2
Reilly ⁵⁶	To provide evidence-based answers to five frequently asked questions: <ul style="list-style-type: none"> • How should obesity be diagnosed? • What is its prevalence in the UK? • Is it preventable? • Is it treatable? • How should it be managed? 	Children	4
Summerbell ⁶⁸	To assess the effectiveness of a range of interventions designed to treat obesity, the progression of existing obesity or the maintenance of appropriate weight for height after treatment for obesity in childhood. A second intervention is to identify the characteristics of the interventions that are related to both positive and negative outcomes.	Children less than 18 years, family	6
Swedish Council on Technology Assessment in Health Care ⁶⁹	Reviews the scientific evidence concerning the medical interventions against obesity.	School children 6-18 years; family	2

Study	Objective	Population	Quality Score
Narrative reviews			
Dietz ¹¹	To review what is known about effective strategies for preventing obesity that can operate within our changing environments.	Children, parents	1
Ebbeling ¹⁴	To provide an overview of the available evidence suggesting that dietary glycemic load, and its related factor, glycemic index, should be taken into consideration in the design of weight loss interventions.	Concentrates on youth but includes data from apparently non-discriminate sources (e.g. general population adults)	1
Epstein 1996 ¹⁹	Reviews of controlled clinical research using exercise programs in the treatment of pediatric obesity.	Includes data from studies that met two criteria: 1) children or adolescents were defined as obese using objective criteria for obesity, and 2) obese children or adolescents were provided either different types of exercise programs or an exercise program compared with a no-exercise control condition. Includes studies that use exercise alone as well as studies that use both diet and exercise.	1
Epstein 1998 ²²	Highlight important contributions and developments in primarily dietary, activity, and behaviour change interventions and identify characteristics of successful treatment and maintenance interventions.	Includes data from studies and your (age 2-18)	1
Fulton ²⁴	Review the weight loss treatment and weight gain prevention studies conducted among youth, consider the current issues related to these studies and outline new approaches for weight loss treatment and weight gain prevention research.	Children, adolescents, younger children, parents	1
Resnicow ⁵⁸	To review the methods, results, and limitations of the major school-based studies as well as to discuss their potential for large-scale dissemination.	Elementary and Junior High students	1
Story ⁶⁶	To review the research on school-based interventions to treat or prevent obesity.	Children, adolescents, youth	1

Quality scores for the systematic reviews varied between 2 and 6. All narrative reviews received a quality score of 1. The systematic reviews included data from at least 64 individual studies. Specific references were not available for the Swedish review. Some studies were included in more than 1 review: 1 study was included in 6 reviews, 5 studies were included in 5 reviews; 11 studies were included in 4 reviews; 17 studies were included in 3 reviews; 13 studies were included in 2 reviews; 15 studies were included in a single review (Table 5).

Systematic reviews and narrative reviews differed in their approach to treatment evaluation. Most of the included systematic reviews isolated specific components commonly included in obesity treatment regimes to evaluate their effectiveness.

Table 5: Citation Analysis for Treatment of Obesity (Systematic Reviews)

	Epstein 1998	Goldfield	Haddock	Jelalian	NHS	Reilly	Summer- bell	Total
Amador 1990		x	x	x				3
Aragona 1975		x	x	x				3
Becque 1998	x	x	x	x				4
Blomquist 1965	x			x				2
Brownell 1982			x					1
Brownell 1983		x	x	x	x			4
Christakis 1966			x					1
Coates 1982 (Beh Ther)		x	x	x				3
Coates 1982 (Int J Eat Dis)		x	x	x				3
De Wolfe 1984					x			1
Duffy 1993		x		x			x	3
Epstein 1980 (J Ped Psychol)		x	x	x				3
Epstein 1981 (J Consult Clin Psychol)		x	x	x				3
Epstein 1982 (Beh Ther)	x	x	x	x				4
Epstein 1984 (Beh Ther)				x				1
Epstein 1984 (J Consult Clin Psychol)	x	x	x	x	x			5
Epstein 1985 (Beh Ther) 205- 212		x	x	x	x		x	5
Epstein 1985 (Beh Ther) 345- 356	x	x	x	x			x	5
Epstein 1985 (J Ped)	x	x	x	x	x		x	6
Epstein 1986 (J Consult Clin Psychol)		x	x	x				3
Epstein 1987 (Beh Model)			x	x				2
Epstein 1994 (Addiction Beh)		x		x	x		x	4
Epstein 1995 (Health Psychol 10 yr)	x	x		x	x	x		5
Epstein 1995 (Health Psychol)	x	x			x		x	4
Epstein 2000 (J Consult Cur Psychol)		x				x		3

	Epstein 1998	Goldfield	Haddock	Jelalian	NHS	Reilly	Summer- bell	Total
Erres 1990				x				1
Ewart 1988	x							2
Figueroa-Colon 1993		x		x	x			3
Flodmark 1993		x		x	x		x	4
Foster 1985			x					1
Golan 1998		x					x	1
Graves 1988		x	x	x			x	4
Gropper 1987								2
Gutrin 1997	x	x					x	2
Hills 1988	x	x	x	x				4
Ikeda 1982			x	x				2
Israel 1984 (Beh Ther)		x	x	x				3
Israel 1985 (Beh Ther)		x	x	x			x	4
Israel 1990 (Int J Eat Dis)			x					1
Israel 1994 (J Ped Psychol)				x	x		x	3
Jette 1977			x					1
Johnson 1997		x		x				2
Kingsley 1977			x	x				2
Kirshenbaum 1984		x	x	x				3
Lansky 1982			x					1
Lansky 1983			x					1
Mellin 1987			x	x	x	x	x	5
Mendonca 1983		x	x	x				3
Owens 1999	x	x					x	1
Pena 1980			x					1
Pena 1989		x	x	x				3
Reybrouck 1990			x					2
Rocchini 1987		x	x	x				3
Rocchini 1988	x			x				2
Rotatori 1980	x	x	x					2
Schwingshandl 1999							x	2
Seltzer 1970			x					1
Senediak 1985		x	x	x			x	4
Wadden 1990		x	x	x			x	4

	Epstein 1998	Goldfield	Haddock	Jelalian	NHS	Reilly	Summer- bell	Total
Warschburger 2001							x	1
Weiss 1977			x	x				2
Wheeler 1976		x	x	x				3
Studies included x 1								15
Studies included x 2								13
Studies included x 3								17
Studies included x 4								11
Studies included x 5								5
Studies included x 6								1

1. Overall Treatment Effect

Sources of Evidence/Description of Intervention/Results (Table 6):

Seven reviews examined the issue of treatment effectiveness in general (Epstein 1998²², Goldfield²⁷, Haddock³¹, Jelalian³⁴, NHS⁴⁹, Reilly⁵⁶, Swedish⁶⁹). Five reviews compared the effect of various treatment regimes compared to waitlist controls using measures of adiposity. Overall 9/10 studies provided evidence of benefit of treatment. The study which did not find a beneficial effect used an intervention consisting only of increased physical activity. One review provided statistical combination of results and identified an effect size of 0.56 indicating a moderate-sized effect (Haddock³¹). The Swedish review⁶⁹ is consistent with these results, with 3/3 included studies showing a beneficial effect of treatment.

Discussion

While the following points focus on the specifics of an effective treatment intervention, this question looks more generally at treatment of childhood obesity to determine whether treatment results in improved obesity status when compared with untreated controls. To examine this question, treatments need not be uniform in their structure or components. This question could be viewed as a “summary” of treatments which have been reported in the literature. Evidence which does not support the efficacy of treatment should stimulate a re-examination of the evolution of childhood obesity and the concepts and assumptions which underlie current treatment strategies. Evidence which supports the efficacy of treatment strengthens the base upon which current lines of investigation were founded. This issue is addressed in these reviews using both qualitative and quantitative methods. Results consistently support improvement in measures of adiposity conferred by treatment, in comparison to waitlist control.



Table 6: Results Summary - Overall Treatment Effect

	Benefit	No Benefit	Unclear/ Equivocal
Epstein 1998	Gutin	Blomquist 1965	
	Owens 1999		
Goldfield (exercise alone)	Gutin	Blomquist 1965	
	Owens 1999		
Haddock	Meta-analysis - mean effect size = 0.56		
Jelian	Aragona 1975		Blomquist 1965
	Epstein 1984 (J Consult Clin Psychol)		
	Israel 1984		
	Israel 1985		
NHS	Mellin		
Reilley	Epstein 1995 (Health Psychol)		
	Epstein 2000 (Arch Ped Adolesc Med)		
	Mellin 1987		
Swedish	Benefit 3/3		

Conclusion

Based on evidence from 7 systematic reviews of fair quality, including data from at least 44 studies, there is *good evidence* that treatment is effective in reducing or eliminating obesity in children.

Recommendation #2

It is *strongly recommended* that treatment be advised for obese children, as treatment confers significantly increased chance of improvement or resolution of obesity.

2. Diet vs. Diet and Exercise

Sources of Evidence

Five reviews evaluated the effect of interventions to increase physical activity when added to dietary modifications on measures of adiposity (NHS⁴⁹, Jelalian³⁴, Epstein 1998²², Goldfield²⁷, Summerbell⁶⁸). In two of the reviews (Goldfield²⁷ and Epstein 1998²²), the same data and analysis is presented.

Description of Interventions

Exercise programs varied widely between studies. Variability was noted in type (e.g., lifestyle, aerobic, callisthenic, etc.), intensity, frequency, schedule and duration of exercise regimens, as well as length of follow-up post-intervention.

Results (Table 7)

Overall 6/10 studies provided some evidence of improvement in treatment outcomes when exercise was added to diet. Although in 2 of these studies, the effect was variable at different points of follow up. Four of 10 studies found no difference between diet and diet + exercise groups. Epstein's meta-analysis of 6 studies (Epstein 1998²², Goldfield²⁷) determined that the addition of exercise to a diet regimen resulted in a mean effect size of 0.45 compared to the diet alone group.

As the NHS review included a single study¹⁶, no conclusions were drawn. Both Jelalian³⁴ and Epstein 1998²² concluded that exercise interventions are useful components of obesity treatment programs.

Discussion

Obesity treatment strategies are designed to impact the energy balance equation, either by decreasing energy intake (dietary modification), increasing energy expenditure (physical activity) or both. The relative importance of manipulations on either side of the equation has been explored in a variety of studies, but variation in dietary interventions and exercise regimens make these studies difficult to compare. Furthermore, it is predictable that increasing energy expenditure should accentuate the effect of dietary manipulations during the course of a treatment intervention. While this effect may have some value, more significant effects might result from long-term behaviour changes initiated during the intervention period. From this perspective, it could be postulated that the value of including exercise in the treatment protocol may relate not to short-term improvements in obesity status, but to the long-term behaviour changes which could influence long-term outcomes. Although these reviews collectively present evidence of the beneficial effect of exercise added to diet in 6/10 studies, limited follow-up data included in the Epstein review presents a somewhat different picture. Of the 5 studies which demonstrated short-term improvements in obesity status among subjects receiving diet and exercise interventions, 3 were unable to demonstrate sustained benefit at follow-up of up to 120 months.



Table 7: Results Summary - Diet vs. Diet and Exercise

	Benefit	No Benefit	Equivocal/ Unclear
Epstein 1998	Epstein 1985 (J Ped)	Beque 1988	
	Hills 1988	Epstein 1984 (J Consult Clin)	
	Reybrouck 1990	Rocchini 1988	
	Meta-analysis mean effect = 0.45		
Goldfield	Meta-analysis from Epstein 1998		
Jelailian	Epstein 1994 (10 yr)	Rocchini 1987	Epstein 1982 (Beh Ther)
	Epstein 1982 (Beh Ther) long-term	Rocchini 1988	Epstein 1985 (J Ped)
NHS	Epstein 1985 (J Ped)		Epstein 1985 (J Ped)
Summerbell 2003	Epstein 1985 (J Ped)		
	Schwingshandl 1999		

Conclusion

Based on evidence from 5 systematic reviews of fair to good quality presenting data from 10 studies, there is *fair evidence* to support the use of exercise in conjunction with dietary interventions in the treatment of obesity.

Recommendation #3

- It is *recommended* that protocols for the treatment of childhood obesity include a component of exercise intervention.
- It is *strongly recommended* that follow-up of treatment outcomes include measures of change in dietary and physical activity behaviour as well as measures of adiposity to enhance understanding of the influence of exercise interventions on long-term outcomes.

3. Exercise Strategies

Sources of Evidence

Four reviews evaluated the benefit of lifestyle exercise in obesity treatment (Epstein 1998²², Haddock³¹, Goldfield²⁷, Summerbell⁶⁸). In two reviews (Goldfield²⁷, Epstein 1998²²), evidence included was derived from the same 3 studies. The Haddock³¹ review did not specifically identify the studies used to provide the data for meta-analysis.

Four reviews also addressed the approach to increasing physical activity as part of an obesity treatment program (Goldfield²⁷, NHS⁴⁹, Epstein 1998²², Summerbell⁶⁸). All 4 reviews included 1 study¹⁷; 1 additional study¹⁵ was included in 2 reviews (Goldfield²⁷, Summerbell⁶⁸).

Description of Intervention

In the studies included in the reviews, lifestyle exercise differs from other exercise programs in 3 aspects: a) it includes activities of daily living that would not normally be considered exercise (e.g., walking), b) caloric expenditure occurs in small “doses” throughout the day, and c) no specific intensity was prescribed¹⁹. The contrasted exercise programs were variable in structure but included activity of structured frequency and intensity, occurring on a set schedule.

Two studies included in reviews addressing approach to increasing physical activity compared reinforcement of increasing physical activity, reinforcement of decreasing sedentary behaviours, or reinforcement of both.

Results (Table 8)

Three of 3 studies included in Goldfield²⁷, Summerbell⁶⁸ and Epstein 1998²² reviews provided evidence of enhanced weight loss using lifestyle exercise interventions compared to programmed aerobic exercise. Haddock³¹ provided meta-analysis data to compare outcomes from interventions using lifestyle exercise to those without exercise components and to those with other exercise regimens. Data were statistically combined from 2 studies for lifestyle exercise vs. no exercise and from 3 studies for lifestyle exercise vs. other exercise regimens. There was no difference in the magnitude of the treatment effects for lifestyle exercise vs. either control or other exercise. On the basis of the analysis, this review concludes that the evidence does not support the benefit of lifestyle exercise over no exercise or other structured exercise in the treatment of childhood obesity, although the conclusions are limited by the small number of included studies.

One study¹⁷, targeting sedentary behaviours vs. physical activity, demonstrated significantly greater improvement in percent overweight in favor of the group reinforced for decreasing sedentary behaviour. On this basis, 2 reviews (NHS⁴⁹, Epstein 1998²²) made strong statements in favor of using this approach. Goldfield²⁷ and Summerbell⁶⁸ included a recent study¹⁵ which was unable to demonstrate a difference in outcomes using these 2 strategies.

Discussion

Comparison of exercise strategies is useful to determine the optimum regimen to enhance short term and long-term outcomes of obesity treatment. The 3 reviews present divergent conclusions about the value of lifestyle exercise in comparison to aerobic, programmed exercise. It is likely that the studies reviewed by Epstein 1998²², Summerbell⁶⁸ and Goldfield²⁷ were also included in the meta-analysis reported by Haddock³¹, but the list of included studies in this review is not subdivided by question analyzed. Despite this uncertainty, it is apparent that additional studies were included in this meta-analysis. This may be of particular importance given that all of the included studies in the Epstein²² review were

published by the same research group. If the additional studies included in the meta-analysis contribute results from another group, the reported lack of significant benefit may reflect different outcomes obtained using different treatment protocols.

Four reviews also addressed the approach to motivate increased physical activity in children during treatment for obesity, comparing rewards for decreasing sedentary activity vs. rewards for increasing physical activity. All reviews quoted results obtained by a single study showing greater improvements in percent overweight in the group rewarded to decrease sedentary activity¹⁷. Although these results are intriguing, replication of this data would enhance its value, the inclusion of a contradictory study in the Goldfield²⁷ and Summerbell⁶⁸ reviews¹⁵ precludes any definite conclusions.

Table 8: Results Summary - Exercise Strategies

	Benefit	No Benefit	Equivocal/ Unclear
Lifestyle vs. other			
Epstein 1998	Epstein 1982 (Beh Ther)	Ewart	
	Epstein 1985 (Beh Ther 345)		
	Epstein 1994 (Health Psychol)		
Goldfield			
	Epstein 1982 (Beh Ther)		
	Epstein 1985 (Beh Ther 345)		
	Epstein 1994 (10 yr)		
Haddock			
		Meta-analysis - specific studies not identified	
Summerbell			
	Epstein 1985 (Beh Ther 345)		
Decreased sedentary vs. increased PA			
Epstein 1998	Epstein 1995		
Goldfield			
	Epstein 1995	Epstein 2000 (Arch Ped Adolesc Med)	
NHS			
	Epstein 1995		
Summerbell			
	Epstein 1995	Epstein 2000	

Conclusion

Based on evidence presented in 4 systematic reviews of fair and good quality, including data from at least 4 individual studies, there is *insufficient evidence* to support a unique benefit associated with lifestyle exercise. Based on evidence presented in 4 systematic reviews of fair to good quality including data from 2 studies, there is *insufficient evidence* to support the use of a specific approach to increasing physical activity.

Recommendation #4

It is *recommended* that exercise incorporated into childhood obesity treatment be adapted to the needs and preferences of the individual children without emphasis on a particular exercise strategy or approach to motivation.

4. Parental Involvement

Sources of Evidence

Five reviews examined the effect of levels of parental involvement on treatment outcomes (NHS⁴⁹, Jelalian³⁴, Haddock³¹, Goldfield²⁷, Summerbell⁶⁸). Four reviews included data from a total of 13 studies. One study was included in 3 reviews; 6 studies were included in two reviews; 6 studies were included only once. One review provided data from a meta-analysis (Haddock³¹).

Description of Intervention

Parental involvement was varied in several ways in the studies included in these reviews. In some studies, the effect of intervention delivery to parents and children together or separately was assessed. Others evaluated the effect of targeting parent or child as the recipient of the intervention. In some cases, parents were targeted for weight loss along with children. Some interventions were strongly family oriented, with parents responsible for ensuring completion of homework assignments and motivation of their children, whereas others required enhanced participation by the child. One study directed the intervention solely at parents²⁶.

Results (Table 9)

All reviews presented conflicting reports of the relationship between parental involvement and adiposity outcomes. Overall 5/13 cited studies provided evidence for beneficial effect of parental involvement, while 8/13 found no benefit. It was noted by 2 reviews (Jelalian³⁴ and Goldfield²⁷) that long-term follow up data suggested improved weight status in children with increased parental involvement in treatment, and on this basis recommended this approach. However, the long-term outcomes cited in both reviews were reported in a single study²⁰. The meta-analysis by Haddock³¹ was unable to demonstrate an improvement in treatment effect with increasing parental involvement, even when age was included as a covariate.

The NHS⁴⁹ and Jelalian³⁴ reviews evaluated the effect of targeting both parents and children jointly for weight loss. Both indicated that this strategy appeared to offer no benefit over targeting the child alone. These two reviews also pointed to evidence that longer term follow-up (5 year) revealed weight loss in the group jointly targeted, in contrast to weight gain in the child targeted group. However, it should be noted that this evidence is provided by a single study, which was cited in both reviews²¹.

Discussion

The role of parental involvement has important practical implications for the development of obesity treatment programs. Programs in which interventions are delivered to parents and children are more costly to develop and deliver, so evidence of effectiveness is critical to justify this investment. The 5 systematic reviews included data from at least 13 studies (studies included in Haddock could not be identified). Only 5 of these studies showed any benefit; 4 were small studies (n=19-60 total subjects) involving different populations and different interventions. The fifth study showed improved outcome on long-term follow-up despite lack of short-term benefit²⁰. Haddock's meta-analysis suggests that treatment effect is not affected by parental participation, even when adjusted for subject age.

Table 9: Results Summary - Parental Involvement

	Benefit	No Benefit
Goldfield	Brownell 1983	Coates 1982
	Epstein 1990 (JAMA)	Epstein 1981 (J Consult Clin Psychol)
	Golan 1998	Flodmark 1993
	Israel 1985	Kirschenbaum 1984
		Wadden 1990
Haddock		Meta-analysis - no benefit even when adjusted for age
Jelalian	Epstein 1990	Israel 1994
		Epstein 1986 (J Consult Clin Psychol)
		Epstein 1987
		Israel 1984
NHS	Brownell	Israel 1994
	Epstein 1985 (Beh Ther)	
Summerbell	Golan 1998	Israel 1994
	Israel 1985	Wadden

Conclusion

Based on evidence presented in 4 systematic reviews of fair quality, including data from at least 13 studies, there is *good evidence* to indicate that parental involvement does not enhance outcome of childhood obesity treatment.

Recommendation #5

It is *recommended* that childhood obesity programs focus resources toward interventions directed at the child. This does not imply a lack of parental involvement, but rather parental involvement directed toward the critical tasks of supporting and reinforcing the child's emerging behaviour change, without being directly responsible for directing it.

5. Behaviour Modification Strategies

Sources of Evidence

Sources of Evidence: Reviews by Haddock³¹, Jelalian³⁴ and Goldfield²⁷ included an assessment of the effect of including behaviour modification techniques in interventions for obesity treatment. Evidence from 9 individual studies was included in 2 of the reviews (Jelalian³⁴, Goldfield²⁷); 1 study was cited in both. Meta-analysis data was presented by Haddock³¹.

Description of Intervention

In most cases, little information was provided as to the specific nature of the behavioural component of the intervention, particularly where studies were comparing interventions including behaviour therapy to those which did not include it. In several studies, specific behavioural components were “added on” to a behavioural program and the effectiveness of these “add-on” components was evaluated. Examples of such components are specific problem-solving strategies and training in child self-control techniques.

Results (Table 10)

Jelalian³⁴ concluded from 1 study that the use of behaviour modification techniques to alter pattern of diet or physical activity are superior to education alone. Concordant evidence from a second study was provided in the review by Goldfield²⁷. Meta-analysis of treatments with and without behaviour modification components also supported an enhanced treatment effect when behaviour modification was included (Haddock³¹). Furthermore, strategies which included behaviour modification, diet and exercise (“comprehensive behavioural treatments”) resulted in improved greater treatment effects than strategies using behaviour modification plus either diet or exercise. Additional training in problem solving was addressed by 2 studies in the Goldfield review²⁷, with 1 showing improved outcome and 1 showing no benefit. Additional child self-control training did not improve outcome in 3/3 studies cited in Goldfield²⁷.

Discussion

Obesity treatment interventions are by their very nature, externally imposed upon the child. While such external controls can lead to short term success, continued successful outcome may depend upon the ability of the child to embrace new patterns of behaviour. Behaviour modification strategies may be incorporated into treatment programs to provide children with some tools to achieve and maintain long-term behaviour changes around diet and physical activity. The efficacy of this approach requires careful validation as it implies that the intervention would address not only issues of diet and physical activity, but also issues of behaviour change.

The development and inclusion of this component must be justified by improvements in outcome. Reviews by Jelalian³⁴, Haddock³¹ and Goldfield²⁷ address this issue and present data which strongly supports improvement in obesity status when behaviour modification strategies were added to dietary and physical activity interventions, at least in the short term. Long-term outcomes are more difficult to assess as the most frequently cited long-term studies incorporate behavioural strategies into the treatment protocol.

Table 10: Results Summary - Behaviour Modification Strategies

	Benefit	No Benefit	Equivocal
Goldfield	Epstein 1980 (J Ped Psychol)	Duffy 1993	Aragona
	Graves 1988	Epstein 1986	
	Johnson 1997	Epstein 1994	
		Epstein 2000	
		Israel 1994	
Haddock	Meta-analysis; comprehensive behavioural therapy superior to all; including behaviour + diet and behaviour + exercise		
Jelalian	Epstein 1980 (J Ped Psychol)		
Summerbell	Epstein 1985 (Beh Ther 205)	Duffy 1993	Flodmark
	Gross 1988	Epstein 1994 (Add Beh)	Senediak
		Epstein 2000	
		Warschburger 2001	

Conclusion

Based on evidence presented in 3 systematic reviews of fair quality, including data from at least 5 studies, there is *good evidence* to support the benefit of the use of behavioural strategies in childhood obesity treatment.

Recommendation #6

It is *strongly recommended* that obesity treatment interventions include behavioural components, both to support the development of adaptive behaviours around diet and physical activity and to facilitate the maintenance of those changes.

6. Reinforcement

Sources of Evidence/Description of Intervention/Results

The NHS⁴⁹ review examined the role of scheduled reinforcement incorporated into follow-up of obesity treatment interventions. Although this study suggested that periodic reinforcement following an obesity treatment program enhanced weight loss, only 15 subjects were evaluated and comparability of subjects between groups was not evident.

Discussion

This issue was addressed by a single study presented in a single review (NHS⁴⁹). The limitations of the evidence preclude extensive analysis or specific conclusions. Despite the limitations of the evidence, the question of reinforcement may have important implications for obesity treatment programs. Widespread societal reinforcement for obesity-promoting behaviour appears to have had a role in the genesis of the “obesity epidemic”. The adoption of health-promoting behaviours may require equally frequent and strong reinforcement to be sustained over the long term.

Conclusion

Based on evidence from 1 review of fair quality including data from a single study, there is *insufficient evidence* to evaluate the role of reinforcement of treatment concepts during follow-up of obesity treatment interventions.

Recommendation #7

Assessment of the effect of period reinforcement of behaviour change is *recommended* in future protocols evaluating obesity treatment.

7. Dietary Interventions

Sources of Evidence

Haddock³¹ used data from 17 studies to evaluate outcome when dietary interventions used “suggested” components vs. those which did not use “suggested” components. The NHS review⁴⁹ identified a single study comparing the effects of a protein-sparing modified fast (PSMF) and a balanced hypocaloric diet on weight loss.

Description of Interventions

Haddock³¹ evaluated the characteristics of dietary interventions postulated by previous authors to be beneficial in treating obesity. The “suggested” interventions were:

- structured to be easily understood by children,
- tailored to child’s age and metabolic needs,
- focused on the reduction of dietary fat, and
- supervised by a dietary expert.

Interventions including any one or more of these characteristics were compared with those which included none. The PSMF was evaluated by a single study included in the NHS review⁴⁹. This is a very low calorie (600–800 kcal/d) diet which includes 1.5–2.5 g/kg high quality protein and carbohydrate restriction. The goal of the PSMF is to achieve rapid weight loss. This diet was compared with a less restrictive balanced diet (800–1000 kcal/d).

Results

Meta-analysis revealed no significant improvement in outcome in studies using the dietary interventions with the “suggested” characteristics. Although the PSMF resulted in improvements in early weight loss, this was no longer statistically significant at 6 months, and no difference was observed at 1 year.

Discussion

Dietary intervention is a key component of virtually all interventions to treat childhood obesity. Despite this, the specifics of appropriate dietary intervention have received relatively little attention in literature specifically addressing obesity. Only 2 of the systematic reviews examined the structure of dietary interventions (Haddock³¹, NHS⁴⁹), attempting to identify characteristics associated with improved outcome. The results of the Haddock³¹ analysis are somewhat confusing, not only refuting the value of components presumed to be beneficial, but even suggesting that advantages are seen in the control group. The protein-sparing modified fast was evaluated by a single study presented in a single review (NHS⁴⁹). This study was unable to demonstrate sustained benefit of this approach over the use of a balanced hypocaloric diet in long-term weight loss. The study is limited by small numbers (treatment: 12 subjects; control: 7 subjects).

Conclusion

Based on the evidence presented in 2 systematic reviews of fair quality, there is insufficient evidence to support the benefit of specific characteristics of a dietary intervention for obesity.

Recommendation #8

It is *strongly recommended* that the efficacy of dietary interventions be evaluated **in the context of childhood obesity**. Information gleaned from nutrition education studies in other contexts may provide some useful direction (See C. 2. Strategies to Promote Dietary Change.)

8. Setting

Sources of Evidence

Using data from 21 individual studies, Haddock³¹ compared the treatment effect of school-based interventions with interventions occurring in other settings using a meta-analytic approach. Five of the 21 studies were school-based, and 16 were based in other settings.

Description of Interventions

No information is provided regarding the specifics of the settings. However, it is likely that most of the comparison interventions occurred in a specialized setting such as an obesity treatment clinic.

Results

When the effect on absolute weight was evaluated, there was no significant difference in effect size based on treatment setting. When measures of obesity status were used as the outcome variable, school-based treatments produced a significantly smaller effect size than treatments carried out in other settings.

Discussion

Whereas a large majority of obesity prevention strategies are delivered in the school setting, treatment interventions may occur in a variety of settings including school, community, physician's office, and experimental settings. Setting is important in two ways. First, determining the setting which is associated with the most desirable outcomes helps to frame widespread intervention planning. Second, determining the setting where treatment is occurring will define interventions which are feasible and cost-effective. This issue was examined in a very limited fashion in Haddock's meta-analysis. In this review, interventions occurring in the school setting were compared with those occurring in all other settings. The results suggest that treatment effect is significantly smaller in the school setting than elsewhere.

Some additional insight into school-based treatment is provided by 2 narrative reviews (Resnicow 1993⁵⁸, Story⁶⁶). Eleven of 12 studies included in these reviews demonstrated significant improvement of children who were treated compared to no-treatment controls. Although follow-up was extremely limited, this evidence suggests that obesity treatment in this setting may result in a mean reduction in percent overweight of approximately 10%.

While treatment in the school setting may be less effective than in the experimental setting, the opportunity to provide treatment to children without ready access to it in a specialized centre may make school-based action a realistic option. This demonstrated efficacy would support the role of the school as a reasonable venue to deliver obesity interventions. Given the high and rising prevalence of childhood obesity, the development of treatment interventions with widespread accessibility must become a priority.

Conclusion

Based on evidence presented in 1 systematic review of fair quality including data from 21 studies, there is *good evidence* that treatment delivered in a specialized or experimental setting results in improved obesity status when compared to school-based treatment. However, given that this method of delivery is unlikely to be available or appropriate for large numbers of affected children, the development of interventions suited to delivery in the community and/or school settings requires priority attention.

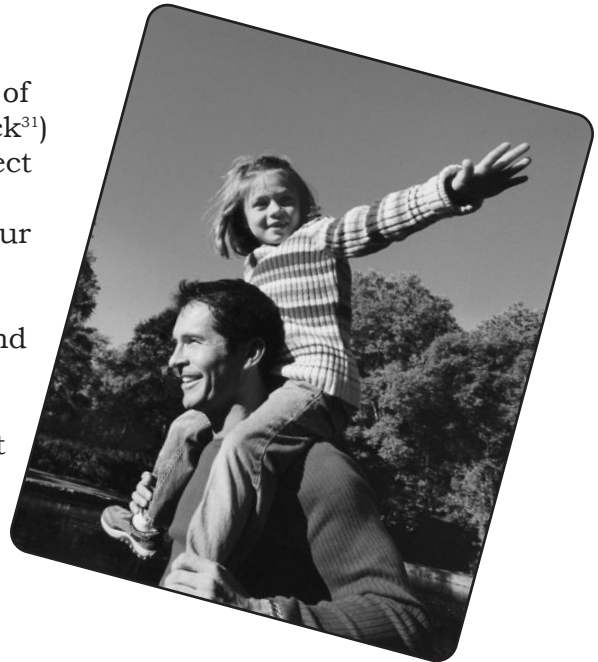
Recommendation #9

It is *strongly recommended* that interventions based in the school and community settings be further developed and evaluated to provide a model for service delivery which facilitates widespread accessibility to children and their families.

9. Duration of Treatment

Sources of Evidence/Description of Intervention/Results

Two reviews evaluated the effect of duration of intervention on outcome (Goldfield²⁷, Haddock³¹) (Table 5). Haddock³¹ evaluated treatment effect size relative to duration of intervention for treatment strategies which included behaviour modification, diet and physical activity components. No statistically significant correlation between duration of treatment and outcome was identified. Goldfield²⁷ used a linear regression model to compare duration of treatment to change in percent overweight using data from 25 individual studies (55 interventions). Using this model, treatment duration accounted for 16% of the variation in the change in percent overweight.



Discussion

This important issue addresses the duration of intervention which would be associated with best outcomes, either short-term or long-term. This information is also useful in ensuring that proposed interventions are maximally cost effective, using available resources to deliver the intervention to maximize availability, while maintaining successful outcomes. This issue is addressed using statistical methods in one review (Haddock³¹), but interpretation is somewhat hampered by the inability to determine which studies were included in this analysis. While there was no significant correlation between duration of treatment and outcome, the similarities and differences between included studies cannot be determined. It is not possible to rule out the influence of confounding factors which might mask an association. The analysis by Goldfield²⁷ assumes that the relationship between treatment duration and change in percent overweight is linear in nature. Although this model does support a statistically significant association, it accounts for only a small proportion of the outcome variance. Perusal of the data presented graphically in the review raises the question of a non-linear relationship. Further exploration may shed additional light on the nature of the relationship.

Conclusion

Based on the evidence presented in 2 systematic reviews of fair quality, there is *insufficient evidence* to evaluate the relationship between duration of intervention and outcome.

Recommendation #10

It is *strongly recommended* that existing evidence be examined in a systematic and detailed fashion, controlling for possible confounding factors, to examine the effect of treatment duration on outcome.

10. Age

Sources of Evidence/Results

Haddock³¹ (Table 2) examined the relationship between age of subjects and treatment outcome and could identify no statistically significant relationship.

Discussion

The adult literature suggests that established obesity is difficult to treat effectively⁷⁷. It has been postulated that greater success in reducing the prevalence of adult obesity might be achieved by targeting children, whose diet and activity patterns are not as well established and possibly more amenable to successful long-term change. This concept might also be extended to treatment within the childhood years, raising the question of optimal timing of treatment interventions. Haddock³¹ evaluated the included data for evidence of a statistical relationship between age of intervention and outcome and could identify no significant relationship. This validity of this result may also be limited by the specifics of the studies and populations included in the analysis, which cannot be ascertained from the review.

Conclusion

Based on the evidence presented in 1 systematic review of fair quality, there is *insufficient evidence* to evaluate the relationship between age of intervention and outcome.

Recommendation #11

It is *strongly recommended* that existing evidence be examined in a systematic and detailed fashion, controlling for possible confounding factors, to examine the relationship between age of intervention and outcome.

11. Initial Weight Status

Sources of Evidence/Results

The impact of initial weight status on outcome was considered in reviews by Goldfield²⁷ and Haddock³¹ (Table 5). Haddock identified a significant positive relationship between initial absolute weight and treatment effect (i.e., treatment groups including heavier children attain greater weight loss). However, there was no significant relationship between percent overweight at enrollment and outcome. Goldfield's²⁷ comparison of treatment duration and outcome included evaluation using baseline percentage overweight in the model. The inclusion of this factor accounted for 20% of the variance of change in percent overweight, more than was accounted for by treatment duration.

Discussion

The relationship between initial weight status and treatment effect is complicated by the fact that both growth and obesity significantly impact weight during childhood. Therefore, it is inappropriate to directly compare initial absolute weight to outcome, and both must be assessed using a scale which reflects degree of adiposity. Accordingly, while the systematic review by Haddock³¹ described a strong relationship between initial absolute weight and outcome, this is not useful in making recommendations about appropriate targeting of children for intervention. Haddock also evaluated outcome by initial percent overweight and failed to identify a relationship.

The review by Goldfield²⁷ provides some conflicting data, suggesting that 20% of the variance in percent overweight can be attributed to baseline percent overweight. This implies that children who are more overweight are more likely to achieve greater changes in percent overweight. The data from these reviews^{27,31}, although conflicting, makes a useful point in the interpretation of treatment studies. It is possible that initial weight status may be an important confounding variable in studies evaluating treatment programs. Studies which include children who are markedly overweight may produce outcomes which cannot be duplicated in children with lesser degrees of overweight. Similarly, treatment effect can only be evaluated in the context of careful matching of treatment and control groups for initial percent overweight. If treatment is based on the premise that early intervention is more likely to reverse maladaptive behaviour patterns, smaller changes in percent overweight would be observed and large numbers of subjects required to demonstrate statistically significant outcomes.

Conclusion

Based on the evidence provided in 2 systematic reviews of fair quality, there is *insufficient evidence* to determine the nature of the relationship between degree of obesity at treatment initiation and outcome.

Recommendation #12

It is *recommended* that treatment for obesity be undertaken as soon as possible after recognition, based on the circumstances of the child and family, but without regard for the degree of obesity.

13. Pharmacologic Treatments

Sources of Evidence

No systematic review is currently available to evaluate the efficacy of pharmacologic agents in the treatment of childhood obesity.

Discussion

As the health consequences of obesity receive increasing attention, the search for pharmacologic agents which safely and effectively promote weight reduction has intensified. Though this approach has not been extensively evaluated in children, reports of drug trials in children have become more prevalent^{4,41}. To date, the existing evidence has not been systematically reviewed.

Conclusion

There is *insufficient evidence* to determine the role of pharmacologic therapies in the treatment of childhood obesity.

Recommendation #13

It is *recommended* that existing and future evidence be systematically reviewed to clarify the evidence for the use of pharmacologic therapy in childhood obesity.

14. Surgical Treatments

Sources of Evidence

Surgical treatments for children have not been evaluated through a systematic review.

Discussion

Refinements in bariatric surgery and post-operative care have renewed interest in this approach to morbid obesity in adult patients. Although the risks and benefits of the surgical approach in the adult population have been systematically reviewed^{46,53}, only individual studies of pediatric bariatric surgery have been published to date⁶⁷.

Conclusion

There is *insufficient evidence* to determine the role of surgical therapies in the treatment of childhood obesity.

Recommendation #14

It is *recommended* that existing and future evidence be systematically reviewed to clarify the evidence for the use of surgical therapy in childhood obesity.

15. Treatment in Minority Population Groups

Sources of Evidence

There were no systematic reviews which addressed the treatment of obesity in minority population groups.

Discussion

Ethnic minorities within a society may require special consideration when examining obesity treatment. Genetic susceptibilities may predispose populations to obesity or to obesity associated co-morbidities. Social and cultural factors may determine willingness to recognize obesity as a problem and significantly impact the acceptability and effectiveness of treatment regimes. Because of differing demographics, social, economic and cultural environments, each country must evaluate this issue independently, addressing the needs of its own populations. In Canada, the factors which have contributed to the rise in obesity prevalence appear to have had even greater impact on aboriginal populations. Although some recent literature has emerged to help shed light on some of the unique issues facing the aboriginal populations, none has as yet been summarized by systematic review. This information is urgently needed to direct intervention strategies among these populations.

Conclusion

At present, no systematic review has evaluated obesity treatment in ethnic minority/aboriginal children; as such there is *insufficient evidence* to recommend specific strategies.

Recommendation #15

It is *strongly recommended* that existing and future literature be evaluated by systematic review to determine appropriate and effective treatment approaches for implementation among ethnic minority groups, particularly Canadian aboriginal populations.

C. Diet and Physical Activity Behaviour Change

The most direct evidence for efficacy of obesity prevention or treatment is provided by studies using measures of prevalence or degree of adiposity as the measured outcomes, such as those described above. However, given the importance of diet and physical activity in the genesis of obesity, studies aimed at fostering change in these factors may also contribute useful, if less direct evidence toward defining effective obesity prevention and treatment. Interventions which measure dietary and/or physical activity change, without specifically focusing on adiposity are described below.

Sources of Evidence

Search strategies yielded 18 reviews evaluating the effects of interventions designed to promote change in dietary and physical activity behaviours.

1. Strategies to Promote Increased Physical Activity

Sources of Evidence (Table 11)

Eight reviews evaluated interventions designed to promote increased physical activity. Four of these reviews were systematic (Kahn³⁶, Dishman¹², Dobbins¹³, Stone⁶⁵) and four were narrative (Keays³⁷, Sallis⁶¹, Nicholson⁵⁰, Meininger⁴²). The systematic reviews received quality scores ranging from 2–5; all narrative reviews received a quality score of 1. These studies included data from 21 individual studies. Three studies were included in 2 reviews; the remainder were included in a single review.



Table 11: Studies Which Promoted Increased Physical Activity

Study	Objective	Population	Quality Score
Systematic reviews			
Dishman ¹²	To provide a quantitative synthesis of the literature examining the effects of interventions used to increase physical activity.	Youth, adults, aged, combined (Group, individual, family)	3
Dobbins ¹³	<ul style="list-style-type: none"> To evaluate the effects of school-based interventions on promoting physical activity and fitness in children and adolescents To evaluate the effects of school-based interventions on improving physical health status To determine if certain combinations of school-based interventions are more effective than others in promoting physical activity and fitness in this target population 	Grade school children with parental involvement; adolescents & parents; grade school & adolescents	4
Kahn ³⁶	To evaluate the effectiveness of informational, behavioural and social, and environmental policy approaches to increasing physical activity.	Adults, children, general public, college students	5
Stone ⁶⁵	Reviews studies of physical activity interventions in school and community settings to determine characteristics and effects of interventions.	Participants who were preschool through college age and be conducted in the United States or foreign school community settings.	2
Narrative Reviews			
Keays ³⁷	To review studies on the effects of regular (three to five times per week) periods of moderate to vigorous physical activity (MVPA) on the health, academic performance, attitudes, and classroom behaviour of children at school.	School age children (mostly elementary, grades 5-9)	1
Nicholson ⁵⁰	Integrative review of health promotion studies.	Studies relevant to elementary school children published between 1986 and 1998	1
Meininger ⁴²	To analyze and evaluate the results of school-based studies that have used population-wide approaches for primary prevention of cardiovascular diseases and to assess the extent to which strategies tested to date have been effective for minority populations in the United States.	School aged children	1
Sallis ⁶¹	Analyzes the contributions physical education can make to the health of children and adults.	Focuses on children (grade school) and focuses on adults	1

Description of Interventions/Results

Using data from 127 published studies and 14 unpublished dissertations, Dishman¹² provided meta-analysis data to identify components of interventions which were significantly associated with improvement in physical activity outcomes. Although interventions targeting children were included, they were not analyzed or presented separately as initial analysis indicated that effect size was independent of age. Characteristics of interventions associated with increased physical activity included: use of behaviour modification techniques; targeting healthy people in communities; targeting groups rather than individuals or families; use of a media-based rather than face-to-face approach, and inclusion of unsupervised physical activity, particularly leisure time low-intensity physical activity.

Insight into the effectiveness of school-based interventions is provided by Dobbins¹³, Kahn³⁶ and Stone⁶⁵. All of these reviews assess the effect of classroom-based educational interventions on physical activity outside of the school setting (Table 12). Kahn³⁶ evaluated studies that utilized a classroom-based approach separately from those focused on changes during the physical education classes. Although the paper indicates that 10 classroom-based studies are included, only data from 5 is described. Benefit was identified in 4/5 included studies; 1 study revealed differing results in different treatment arms. Studies utilizing interventions focused in physical education classes are cited, but no results are provided. Dobbins noted a significant effect in 5/8 included studies and concluded that there is evidence to support some effectiveness of school-based intervention. Stone noted a positive effect in 8/12 included studies. Furthermore, 2 of the included studies reported physical activity on long-term follow-up and found evidence for continued differences between intervention and control groups at 3 and 12 years. The studies described in reviews by Dobbins¹³ and Stone⁶⁵ were diverse in nature, encompassing components of both classroom and physical education interventions. Overall, some beneficial effect was noted in 13/20 studies cited by these reviews.

Table 12: Results Summary - Out of School Physical Activity

	Benefit	No Benefit	Equivocal
Dobbins	Killen 1989	Gortmaker 1999	
	Ewart 1998	Harrell 1998	
	Klepp 1994	Moon 1999	
	Luepker 1996		
	Manois 1999		
Kahn	Dale 2000*	Dale 2000*	
	Davis 1995	Perry 1987	
	Holcomb 1998		
Stone	Dale 1988	Donnelly 1996	
	Davis 1995	Parcel 1989	
	Harrell 1996	Perry 1987	
	Homel 1981	Sallis 1997	

	Benefit	No Benefit	Equivocal
Stone	Killen 1988		
	Luepker 1996		
	Marcus 1987		
	Tell 1987		

*Both beneficial and non-beneficial results were reported

School-based curriculum interventions directed at decreasing television and video game use were also evaluated by Dobbins¹³ and Kahn³⁶. Both included 3 studies and 2/3 were common to both reviews. Both Dobbins¹³ and Kahn's³⁶ reviews concluded that this strategy is effective in reducing the targeted behaviours (i.e., television and video game use). However, Kahn noted that six measures of physical activity reported within the 3 included studies showed inconsistent results; increased physical activity by 2 measures and decreased physical activity by 4 measures. The specific measures were not identified in the review.

Two reviews examined the effect of changes to the school-based physical activity curriculum on physical activity outcomes (Kahn³⁶, Stone⁶⁵). These changes were effected in a variety of ways including: the addition of physical education classes; lengthening of existing classes; and/or increasing the time spent in moderate to vigorous physical activity during class time. Both reviews described outcomes from the same 4 studies, which consistently found an increase in physical activity, including moderately vigorous physical activity, during physical education class time in the intervention groups. Both reviews concluded that changes to physical education classes were highly effective in increasing physical activity during school hours.

Stone⁶⁵ also reviewed studies which used a community-based approach to increasing physical activity. Three completed studies were identified: 1 found no effect on physical activity, 1 had only 20% participation by the end of study precluding results and 1 found decreases in physical activity over time in all groups, with smaller decreases in intervention groups.



Several additional points are made by the narrative reviews. Keays³⁷ cited 2 studies to support the assertion that increases in moderate to vigorous physical activity during physical education classes may result in increased physical activity outside of school.

Sallis⁶¹ provides a thoughtful review of physical education classes in school settings. Several studies were cited to support the contention that vigorous activity occurs during only a small fraction of time during physical education classes. These classes neither met the children's current needs for physical activity, nor prepared children for life-long physical activity. In addition, literature examining the relationship between sports participation in youth and adult activity showed mixed results, with clear positive association in only 2/9 studies. Sallis⁶¹ suggests that physical education curricula need to focus on skills and activities which lay the groundwork for life-long physical activity and should ensure high levels of moderately vigorous physical activity for all students during class time. The remaining 2 narrative reviews consider the effects of cardiovascular prevention programs on specific populations: Nicholson's⁵⁰ review focuses on elementary school children, Meininger's⁴² focuses on minority populations. Although increasing physical activity was clearly a goal of many of the studies included in Nicholson's⁵⁰ review, few outcomes are described. Meininger⁴² notes

that most of the cardiovascular prevention trials include multi-ethnic populations and cited overall beneficial effects in 4/5 studies including some reviewed by systematic reviews. No specific conclusions about strategies specific to minority populations are described.

Discussion

While not specifically addressing obesity, these reviews make an important contribution toward understanding approaches to effectively increase physical activity both during childhood and into adult life, and thus are highly relevant to obesity prevention and treatment.

The information provided by the meta-analysis (Dishman¹²) highlights some features of behaviour change that were also recognized to be important in obesity treatment (i.e., use of behaviour modification techniques). In this review, low-intensity leisure time activity (analogous to “lifestyle” activity discussed above) was associated with favorable outcome.

School is an obvious setting for an intervention, given the large proportion of children who could be targeted. Reviews by Kahn³⁶ and Stone⁶⁵ cite strong evidence that alterations to physical education classes can enhance the proportion of students who are active and the level of activity during class time. Given that students spend much of their day in school, regular physical activity provided in school assures that all students meet basic physical activity goals, an important outcome in itself.

The effect of school-based interventions on out-of-school physical activity is less clear. While evidence reported by Stone⁶⁵ suggests increased physical activity in adults years after an intervention, few studies report long-term outcomes, making interpretation difficult. If increased physical activity within school hours is accepted as a goal, additional opportunities for long-term follow-up will be available. Part of the goal of school-based programs should be to provide children with the knowledge, attitudes and skills necessary for life-long physical activity. The effectiveness of programs in meeting this goal can only be measured by long-term follow-up.

Conclusion

Based on evidence provided by 4 systematic reviews of good quality, there is *very good evidence* that school-based interventions are effective in increasing physical activity during school hours. Furthermore, there is *fair evidence* that physical activity outside of school hours is increased.

Recommendation #16

- Interventions to increase physical activity in the school setting are *strongly recommended*.
- Analysis of existing and future data to evaluate the effect of enhanced physical education classes on physical activity outside of school is *recommended*.
- It is *strongly recommended* that future intervention studies include long-term follow-up to clarify the relationship between physical activity in childhood and adolescence, and adult activity.

2. Strategies to Promote Dietary Change

Reviews evaluating the promotion of dietary change may be categorized into two groups based on the model of behaviour change underpinning the intervention:

- The Knowledge, Attitude and Behaviour model (KAB) is built on the theory that behaviour change must be preceded by changes in food-related knowledge and attitudes. In most cases, interventions using this model impart information about why healthy eating is beneficial, often in a formal setting using a pre-determined curriculum. Measured outcomes include changes in knowledge, attitudinal change and change in food-related behaviour. For the purpose of this report, only changes in food-related behaviour are included.
- The second model is focused on the acquisition of skills needed to influence behaviour change. This model includes components to address how to achieve behaviour change including consideration of: personal factors (e.g., beliefs, values); environmental factors (e.g., peer, family influence); and skills to facilitate the behaviour change process⁹. In these studies, behaviour change is the most commonly measured outcome.

Sources of Evidence (Table 13)

Search strategies yielded 12 reviews which evaluated interventions to promote dietary change. Seven reviews were systematic (Lister-Sharp³⁹, Tedstone⁷¹, Roe⁵⁹, White⁷⁵, Contento 1995⁹, McArthur⁴⁰, Koivisto Hursti³⁸) and 5 were narrative (Meininger⁴², Nicholson⁵⁰, Contento 1992⁸, Perez-Rodrigo⁵², Weiss⁷⁴). Quality scores for systematic reviews ranged from 1 to 4. The narrative reviews received a quality score of 1.

Table 13: Studies Which Promoted Dietary Change

Study	Objective	Population	Quality Score
Systematic Reviews			
Contento 1995 ⁹	To provide insight into the effectiveness of nutrition education for the public: <ul style="list-style-type: none"> • Does nutrition education work? If so, what are the successful elements across interventions? • What are the implications of the findings for nutrition education program implementation, research and policy? 	Preschool children, school-aged children, adults, pregnant women and caretakers of infants, older adults, health professionals	2
Koivisto Hursti ³⁸	<ul style="list-style-type: none"> • assess the current state of knowledge as described in the literature and • to identify implications for further practice and research 	Restricted to school or community based studies conducted with an experimental or quasi-experimental design during the 1980s and early 1990s. Examines and discusses major intervention studies conducted internationally during the 1980's and 1990's.	3

Study	Objective	Population	Quality Score
Systematic Reviews			
Lister-Sharp ³⁹	Evaluate the effectiveness of school-based health promotion interventions through: <ul style="list-style-type: none"> • a systematic review of primary studies of the effectiveness of the health promoting schools approach • a systematic review of existing reviews of the effectiveness of other health promoting interventions in schools in the following areas: nutrition, exercise, safety, psychological aspects of health, sexual health, substance use, personal hygiene, environmental issues and family life education, indicate areas where further research is needed and make recommendations for practice in the UK, if research findings permit. 	School-aged children	3,4
McArthur ⁴⁰	To estimate the effects of school-based interventions on heart healthy eating behaviours of fourth and fifth grade students.	4th and 5th grade students	2
Roe ⁵⁹	Aims to provide a summary of recent evaluations of the effectiveness of healthy eating interventions and to critically assess both the reliability of the evidence on effectiveness and its implications for future practice.	Adults, adolescents, school-aged children	4
Tedstone ⁷¹	To search for published and unpublished reports of interventions which evaluated outcomes that promoted healthy eating for 1-to-5-year-old children.	Preschool children (1-5 years), their parents, other family members, and other careers (nursery staff)	4
White ⁷⁵	To thoroughly review and critically appraise research published since 1985 on the effectiveness of nutritional health promotion in minority ethnic groups.	Children and adults	4
Narrative Reviews			
Contento 1992 ⁸	Examined the major school-based nutrition education research studies conducted during the 1980s.	School-aged children, teachers, parents	2
Meininger ⁴²	To analyze and evaluate results of school-based studies that have used population-wide approaches for primary prevention of cardiovascular diseases and to assess the extent to which strategies tested to date have been effective for minority populations in the United States.	Elementary, middle, or high school students	1
Nicholson ⁵⁰	To present, analyze and synthesize the research conducted over the past 15 years that represents the outcomes of cardiovascular health promotion practices and programs for elementary school children and determine if any have shown practical value.	Elementary school children (Grades 1-8)	1
Perez-Rodrigo ⁵²	Not stated	Students, teachers, parents, community	1
Weiss ⁷⁴	Reviews instructional methods, materials and curricula at the elementary school level.	Students from K-12	1

Description of Interventions/Results

Interventions aimed at preschool children were discussed in two systematic reviews (Tedstone⁷¹, Contento 1995⁹) (Table 14). Both reviews describe mixed results from included studies based on the KAB model: overall 7/10 studies found improvements in dietary behaviours after intervention. Although the majority of studies demonstrated some beneficial effect, both reviews conclude that there is insufficient evidence to support the benefit of this approach in achieving behaviour change.

Table 14: Results Summary - Preschool Dietary Change KAB Model

	Benefit	No Benefit	Equivocal
Contento 1995	Byrd-Bredbenner 1993	Davis 1983	
	Community Research Centre 1980	Hunsley 1982	
	Gunn 1985		
	Koblinsky 1992		
	Lawatsch 1990		
Tedstone	Byrd-Bredbenner 1993	Peterson 1984	
	James 1993		
	Koblinsky 1992		
	Lawatsch 1990		
	Smith 1986		

Studies using a behavioural model were also reviewed by Tedstone⁷¹ and Contento⁹. These studies have described strategies which are associated with improvements in dietary intake in preschool-aged children including: repeated exposures to novel foods; modeling by peers and adults; opportunities taste novel foods, in addition to smelling and touching; use of a positive emotional tone in food presentation; and use of appropriate rewards. One study suggested that use of food as a reward increased preference, while receipt of a reward contingent upon eating a food decreased preference. The evidence for these guidelines has been provided almost exclusively by a single group, in many cases by single studies.

School-based initiatives were evaluated in 6 reviews and included data from approximately 59 individual studies. There was some duplication among these reviews: 1 study was included in 4 reviews, 4 studies were included in 3 reviews and 12 studies were included in 2 reviews (Table 15). Contento (1995⁹) evaluated programs separately according to model and noted evidence of behavioural change in 8/17 studies based on KAB, and 18/23 studies based on the behavioural model. McArthur⁴⁰ presented data from 12 studies analyzed by meta-analytic techniques to estimate the overall effect size of school-based interventions on eating behaviours. A significant, but small effect size was attributed to this approach. Among the remainder of reviews, distinguishing between the KAB and behavioural models was challenging due to insufficient information contained within the review. Overall, the majority of studies (42/59) demonstrated some positive outcome related to dietary intake behaviour (Table 16).

Table 15 - Citation Analysis for School-Based Dietary Intervention

	Contento 1995	Koivisto- Hursti	Lister- Sharp	McArthur	Roe	White	Total
Baranowski 1990	x	x					2
Brunberg 1990					x		1
Burnett 1989	x						1
Bush 1989		x		x		x	3
Byrd-Bredbenner 1984	x						1
Byrd-Bredbenner 1988	x	x					2
Coates 1981	x	x		x			3
Coates 1985	x		x				2
Cohen 1989				x			1
Davis 1995				x			1
Devine 1992	x						1
Domel 1993					x		1
Fardy 1995/96						x	1
Friedman 1990		x					1
German 1981	x						1
Gillespie 1988	x						1
Hearn 1992	x						1
Holund 1990		x					1
Hopper 1994				x			1
Howison 1988	x						1
Johnson 1991				x			1
Kelder 1995	x	x					2
Killen 1988	x						1
King 1988	x						1
Kirks 1982	x						1
Kirks 1986	x						1
Klepp 1993		x					1
Kumar 1993					x		1
Lewis 1988	x						1
Lindholm 1984	x						1
Lionis 1991					x		1
Luepker 1996			x	x	x	x	4
Marcus 1987	x						1
McDonald 1981	x						1
Moberg 1990		x					1
Nader 1989	x	x		x			3
Nader 1992					x		1

	Contento 1995	Koivisto- Hursti	Lister- Sharp	McArthur	Roe	White	Total
Parcel 1989	x						1
Perry 1985	x	x					2
Perry 1987	x	x					2
Perry 1988/89	x	x					2
Petchers 1987		x					1
Puska 1982		x					1
Resnicow 1992	x					x	2
Resnicow 1993	x	x					2
Shannon 1982	x						1
Simons-Morton 1988/91		x				x	2
St. Pierre 1981	x						1
Stark 1986		x					1
Vandongen 1995		x					1
Wagner 1992	x						1
Walter 1988		x			x	x	3
Walter 1989	x					x	2
Whitaker 1994		x					1
White 1988	x	x					2
Young 1993			x				1
Studies included x 1							39
Studies included x 2							12
Studies included x 3							4
Studies included x 4							1



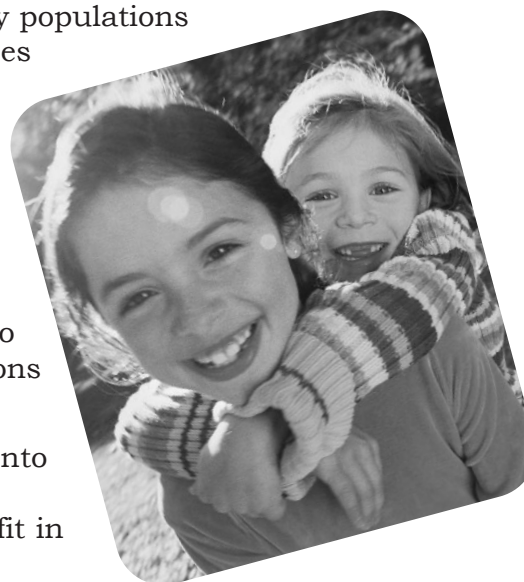
Table 16: Results Summary - School-Based Dietary Intervention

	Benefit	No Benefit	Equivocal
Contento 1995	Baranowski 1990	Byrd-Bredbenner 1984	
	Burnett 1989	Byrd-Bredbenner 1988	
	Coates 1981	German 1981	
	Coates 1985	Lewis 1988	
	Devine 1992	Lindholm 1984	
	Gillespie 1988	Marcus 1987	
	Hearn 1992	Shannon 1982	
	Howison 1988	Wagner 1992	
	Kelder 1995		
	Killen 1988		
	King 1988		
	Kirks 1982		
	Kirks 1986		
	McDonald 1981		
	Nader 1989		
	Parcel 1989		
	Perry 1985		
	Perry 1987		
	Perry 1988/89		
	Resnicow 1992		
	Resnicow 1993		
	St. Pierre 1981		
	Walter 1989		
	White 1988		
Koivisto-Hursti	Baranowski 1990	Bush 1989	
	Coates 1981	Byrd-Bredbenner 1988	
	Friedman 1990		
	Holund 1990		
	Kelder 1995		
	Klepp 1993		
	Moberg 1990		
	Nader 1989		
	Perry 1985		
	Perry 1987		
	Perry 1989		
	Petchers 1987		
	Puska 1982		
	Resnicow 1993		
	Simons-Morton 1988, 1991		

	Benefit	No Benefit	Equivocal
Koivisto-Hursti	Stark 1986		
	Vandongen 1995		
	Walter 1988		
	Whitaker 1994		
	White 1988		
Lister-Sharp	Coates 1985		
	Luepker 1996		
	Young 1993		
McArthur	Coates 1981	Bush 1989	
	Cohen 1989	Davis 1995	
	Davis 1995	Johnson 1991	
	Hopper 1996		
	Luepker 1996		
	Nader 1989		
Roe	Kumar 1993	Brunberg 1990	
	Luepker 1996	Domel 1993	
	Nader 1992	Lionis 1991	
	Walter 1988		
White	Fardy 1995/96	Bush 1989	
	Luepker 1996		
	Resnicow 1992		
	Simons-Morton 1991		
	Walter 1988/89		

White⁷⁵ evaluated specific targeting of minority populations using dietary interventions. Many of the studies included in this review were also included in others as they incorporated both children from various minority groups and Caucasian children. Although favorable results were described in 5/6 studies, it was unclear in most whether ethnic background significantly affected outcome. This review concluded that there is insufficient evidence to support the effectiveness of dietary interventions in minority populations.

Four narrative reviews (Perez-Rodrigo⁵², Contento 1992⁸, Nicholson⁵⁰, Meininger⁴²) reinforced the variability of outcome, with an apparent benefit in favor of behaviourally based programs.



Discussion

Strategies described in this portion of the report are aimed at supporting changes in diet-related behaviour not specifically set in the context of childhood obesity.

Strategies for nutrition-related behaviour change in preschool children are evaluated in 2 systematic reviews (Tedstone⁷¹, Contento 1995⁹). The use of an educational model to impart age-appropriate nutrition knowledge and change attitudes has only inconsistent results in this age group. However, a series of studies have suggested aspects of food experience which appear to influence dietary quality and quantity. While these studies provide useful insight into the determinants of food-related behaviour, important limitations exist. Because much of the data in this area has been contributed by a single research group, the generalizability of results is important. In addition, many studies have not been replicated to confirm or refute their validity.

Strategies to influence dietary choice are addressed in several school-based studies and reviewed in 6 studies. Positive outcomes defined by changes in food-related behaviours, were identified in both studies which focused on knowledge enhancement and strategies for behaviour change. Many of the studies in these reviews reported positive outcomes associated with the intervention. The measure used to evaluate outcome varied significantly between studies, ranging from self-report to direct observation. Therefore, while these positive outcomes are encouraging, the results must be viewed critically when outcomes are measured using methods subject to significant error or bias. In many of the reviews, studies could not be definitively classified according to model underlying the intervention. As these interventions were school-based, classroom instruction was a constant feature, but was supplemented by a variety of other interventions (e.g., modifications to school lunch programs, enhanced physical activity, parental participation). In the only review which specifically compared outcomes according to model, outcomes appeared to favor the behavioural approach; Contento⁹ reported positive outcomes in 8/17 knowledge-based interventions and 18/23 behavioural interventions.

Conclusion

Based on evidence presented in 2 systematic reviews of fair quality, there is insufficient evidence to support the benefit of specific strategies to change food-related behaviours in preschool-aged children. Based on evidence presented in 6 systematic reviews of fair quality, there is *good evidence* to support the use of school-based interventions to improve dietary behaviour, with the evidence somewhat in favor of behaviourally-based approaches over knowledge-based approaches.

Recommendation #17

- It is *strongly recommended* that studies describing effective strategies for behaviour change in preschool-aged children be replicated and expanded to provide evidence upon which to base population-wide feeding guidelines.
- The implementation of school-based nutrition programs aimed at changing nutrition related behaviour is *recommended*, and a behavioural approach *should be considered*.

D. Clinical Practice Guidelines and ‘Reviews of Reviews’ - Summary

One of the “deliverables” identified for this project was to provide a comparison of the recommendations derived from this review with existing recommendations and clinical practice guidelines. The following documents were derived from a variety of different processes, but all provide recommendations regarding prevention or treatment of obesity, increasing physical activity and/or improving dietary intake in children. The pertinent recommendations are summarized below to facilitate comparison with those derived from this review.

1. **Author:** Jepson³⁵

Year: 2000

Title: The effectiveness of interventions to change health-related behaviours: a review of reviews.

Document Type: Review of reviews

Summary: Document reviews the evidence regarding 6 behaviours impacting long-term health: smoking, alcohol consumption, physical exercise, diet, sexual risk taking and illicit drug use.

Conclusions/Recommendations:

- Interventions for increasing physical activity in the general population have a moderately large effect.
- Recommend the use of exercise in combination with diet for obesity treatment, but further research needed.
- Recommend promotion/education around healthy eating in schools using multifaceted, behaviourally based approaches.
- Recommend additional research to evaluate preventive strategies.
- Require additional research regarding promotion of healthy eating in preschool children.

2. **Author:** Centers for Disease Control and Prevention⁷

Year: 1997

Title: Guidelines for school and community programs to promote lifelong physical activity among young people

Document Type: Recommendations

Summary: Document provides recommendations based on in-depth review of research, theory and current practice. Developed by CDC with broad collaboration.

Conclusions/Recommendations:

- Policies: Review of policies which would be useful in supporting physical education and health education in schools.
- Environment: Establishment of safe and pleasant environments and opportunities for physical activity.

- Physical education: Promote development of knowledge, attitudes, skills and confidence to maintain physically active lifestyle.
 - Health education: Implement health education curricula to support.
 - Extracurricular activities: Provide activities to meet needs/interests of all students.
 - Parental involvement: Include parents in instruction and encourage support of physical activity.
 - Personnel training: Training for school and community personnel to promote lifelong physical activity.
 - Health services: Assess, counsel, refer and advocate for health promoting physical activity.
 - Community: Provide a range of sports and recreation programs.
 - Evaluation: Of community and school physical activity programs and facilities.
3. **Author:** Task Force on Community Preventive Services⁷⁰
- Year:** 2002
- Title:** Recommendations to increase physical activity in communities
- Document Type:** Recommendations
- Summary:** Recommendations for communities, policymakers and public health providers. Some recommendations aimed broadly at communities, some directed primarily at children. Based on a systematic review process.
- Conclusions/Recommendations:**
- Classroom-based health education focused on information provision: insufficient evidence.
 - School-based Physical Education: strongly recommended.
 - Classroom-based health education focused on reducing television viewing and video game playing: insufficient evidence.
 - Family-based social support: insufficient evidence.
 - Individually-adapted health behaviour change programs: strongly recommended.
 - Creation of or enhanced access to places for physical activity combined with informational outreach activities: strongly recommended.
4. **Author:** Barlow²
- Year:** 1998
- Title:** Obesity evaluation and treatment: expert committee recommendations
- Document Type:** Clinical practice guideline
- Summary:** Recommendations developed by a committee of pediatric obesity experts convened by the Maternal and Child Health Bureau, Health Resources and Services Administration and the Department of Health and Human Services in the United States.

Conclusions/Recommendations:

- Recommend referral to pediatric obesity treatment center for children with co-morbidities, massive overweight or obese children under the age of 2 years.
- Recommend assessment of readiness to change in children and families. Families unready for change may benefit from counseling or deferral of treatment.
- Recommended specific treatment goals with regard to behaviour, medical outcomes and weight.
- Recommend early intervention - as soon as identified in children 3 years of age and older.
- Recommend involvement of all caregivers in treatment.
- Recommend strategies to increase physical activity by reduction of sedentary behaviour, incorporation of activity into daily routine and addition of vigorous activity.
- Recommend adoption of healthy eating patterns by gradual elimination of high calorie foods, “stoplight diet” and use of the food guide.

5. **Author:** Dobbins¹³**Year:** 2002**Title:** 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**Document Type:** Review of reviews**Summary:** Evaluation of existing reviews designed to evaluate the effect of school-based strategies on obesity prevention and promotion of physical activity and nutrition.**Conclusion/Recommendations:**

- Interventions should be multi-faceted including classroom instruction and changes in school environment.
- Interventions should be behaviourally focused.
- Longer lasting interventions and/or frequent booster sessions improve effectiveness.
- Age, gender and ethnicity may affect outcomes and require further study.

6. **Author:** Scottish Intercollegiate Guidelines Network⁶³**Year:** 2003**Title:** Management of obesity in children and young people**Document Type:** Clinical practice guideline**Summary:** Developed by multidisciplinary groups of practicing clinicians using a standard methodology and based on systematic evidence review.

Conclusions/Recommendations:

- Should consider school, family and societal interventions for obesity prevention, but require large, well-designed prevention studies.
- Should consider treatment if child and family exhibit readiness to change.
- Weight maintenance is an acceptable goal for most children.
- Behavioural change is necessary to achieve weight maintenance/loss.
- Referral to obesity treatment center should be considered if co-morbidities, suspected underlying medical disorder, age is less than 24 months or BMI is greater than 99th percentile.
- Weight loss of no more than 0.5 kg/month is acceptable in children greater than 7 years of age who have demonstrated weight maintenance.

7. **Author:** World Health Organization⁷⁷**Year:** 2000**Title:** Obesity: preventing and managing the global epidemic**Document Type:** Report of a WHO consultation**Summary:** Describes strategies for implementing prevention and treatment in different health service systems. Includes recommendations by obesity experts to be used to develop new policies to address obesity.**Conclusions/Recommendations:**

- Priority requirement for research regarding dietary factors, physical activity patterns, societal and cultural factors and genetic and biological factors.
- Recommend that action be taken to develop effective strategies of universal, selective and targeted prevention, and current prevention program be evaluated and improved.
- Schools should promote physical activity and healthy eating.
- Public health strategies should be adopted to reduce obesity-promoting aspects of the environment.
- Obesity treatment should occur at primary health care level, with specialist services available for high-risk treatment.
- Priority requirement for treatment strategies in children with replicated outcomes.

8. **Author:** World Health Organization⁷⁶**Year:** 2003**Title:** Diet, Nutrition and the Prevention of Chronic Disease**Document Type:** Report of a joint WHO/FAO expert consultation**Summary:** Consultation to examine and develop recommendations for diet and nutrition in prevention of chronic diseases.

Conclusions/Recommendations:

- Specific recommendations regarding nutrient intake goals including fat, carbohydrate, protein, cholesterol, sodium chloride, fruit and vegetables, dietary fibre and non-starch polysaccharides. These are not specific to children.
- Recommend one hour per day of moderate-intensity activity, which may be accomplished in several short bouts.
- Recommend strategies to prevent obesity including exclusive breastfeeding, child-regulated energy intake, promotion of active lifestyle including limitation of television viewing, promoting intake of fruits and vegetables, restriction of energy-dense, nutrient-poor foods and sugar-sweetened drinks. In addition, it is recommended that the environment be modified to enhance physical activity.

Chapter 4 - Summary and Conclusions

Table 17: Summary of All Recommendations

Research

Area	Recommendation
Prevention of obesity	Studies of prevention strategies with the following objectives and attributes are strongly recommended: <ul style="list-style-type: none">• Explicitly define prevention of obesity in populations of children unselected by weight as objective.• Utilize obesity prevalence as critical outcome measure.• Adequately powered to identify significant differences in prevalence between intervention and control groups.• Utilize methods to ensure comparability between intervention and control groups.• Include follow up assessment of sufficient duration to elucidate the intervention characteristics associated with long-term success.
Treatment of Obesity	
Diet vs. Diet and Exercise	<ul style="list-style-type: none">• It is recommended that protocols for the treatment of childhood obesity include a component of exercise intervention.• It is strongly recommended that follow-up of treatment outcomes include measures of change in dietary and physical activity behaviour as well as measures of adiposity to enhance understanding of the influence of exercise interventions on long-term outcomes.
Reinforcement	Assessment of the effect of period reinforcement of behaviour change is recommended in future protocols evaluating obesity treatment.
Dietary Interventions	It is strongly recommended that the efficacy of dietary interventions be evaluated in the context of childhood obesity. Information gleaned from nutrition education studies in other contexts may provide some useful direction (see section C. 2 Strategies to Promote Dietary Change).
Setting	It is strongly recommended that interventions based in the school and community settings be further developed and evaluated to provide a model for service delivery which facilitates widespread accessibility to children and their families.

Area	Reccomendation
Duration of Treatment	It is strongly recommended that existing evidence be examined in a systematic and detailed fashion, controlling for possible confounding factors, to examine the effect of treatment duration on outcome.
Age	It is strongly recommended that existing evidence be examined in a systematic and detailed fashion, controlling for possible confounding factors, to examine the relationship between age of intervention and outcome.
Pharmacologic Treatments	It is recommended that existing and future evidence be systematically reviewed to clarify the evidence for the use of pharmacologic therapy in childhood obesity.
Surgical Treatments	It is recommended that existing and future evidence be systematically reviewed to clarify the evidence for the use of surgical therapy in childhood obesity.
Minorities	It is strongly recommended that existing and future literature be evaluated by systematic review to determine appropriate and effective treatment approaches for implementation among ethnic minority groups, particularly Canadian aboriginal populations.
Diet and Physical Activity or Behaviour Change Outcomes	
1. Strategies which promoted increased physical activity	<ul style="list-style-type: none"> • Analysis of existing and future data to evaluate the effect of enhanced physical education classes on physical activity outside of school is recommended. • It is strongly recommended that future intervention studies include long-term follow-up to clarify the relationship between physical activity in childhood and adolescence, and adult activity.
2. Strategies which promoted dietary change	<ul style="list-style-type: none"> • It is strongly recommended that evidence describing effective strategies for behaviour change in preschool-aged children be replicated and expanded to provide evidence upon which to base population-wide feeding guidelines.

Prevention

Area	Reccomendation
Treatment of Obesity	
Overall Treatment Effect	It is strongly recommended that treatment be advised for obese children, as treatment confers significantly increased chance of improvement or resolution of obesity.
Exercise Strategies	It is recommended that exercise incorporated into childhood obesity treatment be adapted to the needs and preferences of the individual children without emphasis on a particular exercise strategy or approach to motivation.
Parental Involvement	It is recommended that childhood obesity programs focus resources toward interventions directed at the child. This does not imply a lack of parental involvement, but rather parental involvement directed toward the critical tasks of supporting and reinforcing the child's emerging behaviour change, without being directly responsible for directing it.
Behaviour Modification Strategies	It is strongly recommended that obesity treatment interventions include behavioural components, both to support the development of adaptive behaviours around diet and physical activity and to facilitate the maintenance of those changes.
Initial Weight Status	It is recommended that treatment for obesity be undertaken as soon as possible after recognition, based on the circumstances of the child and family, but without regard for the degree of obesity.

Area	Reccomendation
Diet and Physical Activity or Behaviour Change Outcomes	
Strategies which Promoted Increased Physical Activity	Interventions to increase physical activity in the school setting are strongly recommended.
Strategies which Promoted Dietary Change	The implementation of school-based nutrition programs aimed at changing nutrition related behaviour is recommended, and a behavioural approach should be considered.

Conclusion

It is clear that many factors have contributed to the development of the current obesity “epidemic” with its associated health implications. It is also clear that no single approach or strategy will effectively address all issues in all populations. This report provides a summary of evidence, which has been scrutinized by a systematic process, as a foundation upon which to prioritize research needs and strategies for intervention. This document does not propose a specific approach to action, but merely provides the tools with which to develop an approach uniquely suited to the population for whom it is developed. It is likely that effective change will: require both prevention and treatment approaches; take place in a variety of settings including homes, day cares, schools, and the community at large; and, use a variety of strategies to achieve change. Populations from specific ethnic and cultural backgrounds may benefit from specially-tailored approaches. Strategies may have varying effectiveness based on age or degree of obesity. To address these questions, additional information may be gleaned from high quality studies not yet evaluated by systematic review.

This research summary highlights the striking imbalance in the existing literature between prevention and treatment approaches. Despite the current consensus that prevention will be the most important and successful approach to addressing obesity in Canadian society, the vast majority of evidence focuses on treatment. While the treatment studies may provide some insight into possible prevention strategies, studies designed to address prevention as a primary outcome represent possibly the most urgent need. The absence of systematically reviewed evidence on obesity prevention can be viewed either as a limitation or an opportunity. While it may be inappropriate to proceed with prevention “programs” in this context, there is an urgent need for the development, implementation and evaluation of prevention initiatives appropriate for large populations. These initiatives may have a population health focus, but careful design and evaluation must be included from the outset, thus integrating intervention and research. As Canadian society takes steps to reverse the “obesity epidemic”, we must carefully evaluate our successes and challenges and share the resulting information, so that we learn from the collective experience across Canada. In this way, the speed of progress is greatly enhanced, to the benefit of Canadian children, and Canadian society as a whole.

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70. Task Force on Community Preventive Services. Recommendations to increase physical activity in communities. *Am J Prev Med* 2002, 22(Suppl 4), 67-72.
71. Tedstone A, Aviles M, Shetty P, Daniels L. Effectiveness of interventions to promote healthy eating in preschool children aged 1 to 5 years. London, Health Education Authority, 1998.

72. Tremblay MS, Katzmarzyk PT, Willms JD. Temporal trends in overweight and obesity in Canada, 1981-1996. *Int J Obes Relat Metab Disord* 2002, 26(4), 538-543.
73. U.S. Preventive Services Task Force. Behavioural counseling in primary care to promote physical activity, recommendation and rationale. *Ann Intern Med* 2002, 137(3), 205-7.
74. Weiss EH, Kien, CL. A synthesis of research on nutrition education at the elementary school level. *J Sch Health* 1987, 57(1), 8-13.
75. White M, Carlin L, Rankin J, Adamson A. Effectiveness of interventions to promote healthy eating in people from minority ethnic groups: a review. London, UK: Health Education Authority. *Health Promotion Effectiveness Reviews*, 1998.
76. World Health Organization. Diet, nutrition and the prevention of chronic disease. Geneva: World Health Organization, 2003. (WHO Technical Report Series, 916).
77. World Health Organization. Obesity, preventing and managing the global epidemic - Report of a WHO consultation. Geneva: World Health Organization, 2000. (WHO Technical Report Series, 894).
78. Zakus G, Chin ML, Cooper H Jr, Makovsky E, Merrill C. Treating adolescent obesity, a pilot project in a school. *J Sch Health* 1981, 51(10), 663-6.

Appendix 1 - Oxman and Guyatt's Index of the Scientific Quality of Research Overviews

The purpose of this index is to evaluate the scientific quality (i.e. adherence to scientific principles) of research overviews (review articles) published in the medical literature. It is not intended to measure literary quality, importance, relevance, originality, or other attributes of overviews.

The index is for assessing overviews of primary ("original") research on pragmatic questions regarding causation, diagnosis, prognosis, therapy or prevention. A research overview is a survey of research. The same principles that apply to epidemiologic survey apply to overviews: a question must be clearly specified, a target population identified and assessed, appropriate information obtained from that population in an unbiased fashion, and conclusions derived, sometimes with the help of formal statistical analysis, as is done in "meta-analyses". The fundamental difference between overviews and epidemiologic surveys is the unit of analysis, not the scientific issues that the questions in this index address.

Since most published overviews do not include a methods section it is difficult to answer some the questions in the index. Base your answers, as much as possible, on the information provided in the overview. If the methods that were used are reported incompletely relative to a specific item, score that item as "partially". Similarly, if there is no information provided regarding what was done relative to a particular question, score it as "can't tell", unless there is information in the overview to suggest either that the criterion was or was not met.

1. **Were the search methods used to find evidence (primary studies) on the primary question(s) stated?**

Yes is given to meta-analysis reporting categories of sources, including years (e.g., databases-medline) used, and whether these categories were explained. Partial points are given for the category of sources and how many of the categories (e.g., electronic, hand, register) are named.

- No
- Partially
- Yes

Comments:

2. **Was the search for evidence reasonably comprehensive?**

Yes is given if at least three categories, one of which must be electronic with key words stated, and any two others (e.g., hand, register) are reported. Key words and/or MESH terms must be stated.

- No
- Partially
- Yes

Comments:

3. **Were the criteria used for deciding which studies to include in the review reported?**

- No
- Partially
- Yes

Comments:

4. **Was bias in the selection of articles avoided?**

Yes is given if at least two reviewers independently assess for inclusion. A consensus must be reached.

- No
- Partially
- Yes

Comments:

5. **Were the criteria used for assessing the validity of the studies that were reviewed reported?**

It was felt that the issues relating to publication bias should not be included in the assessment of this. Yes is given to those meta-analysis reporting “a priori” methods of validity assessment.

- No
- Partially
- Yes

Comments:

6. **Was the validity of all of the studies referred to in the text assessed using appropriate criteria (either in selecting studies for inclusion or in analysing the studies that are cited)?**

This item relates to validity assessment. Yes is given if there is a description of any criteria (either internal or external) used.

- No
- Partially
- Yes

Comments:

7. **Were the methods used to combine the findings of the relevant studies (to reach a conclusion) reported?**

No
Partially
Yes

Comments:

8. **Were the findings of the relevant studies combined appropriately relative to the primary question the review addresses?**

For question 8, if no attempt was made to combine findings, and no statement is made regarding the inappropriateness of combining findings, check “no”. If a summary (general) estimate is given anywhere in the abstract, the discussion or the summary section of the paper, and it is not reported how the estimate was derived, mark “no” even if there is a statement regarding the limitations of combining the findings of the studies reviewed. If in doubt mark “can’t tell”.

No
Partially
Yes

Comments:

9. **Were the conclusions made by the author(s) supported by the data and/or analysis reported in the review?**

For an overview to be scored as “yes” on question 9, data (not just citations) must be reported that supports the main conclusions regarding the primary question(s) that the overview addresses.

No
Partially
Yes

Comments:

10. **Overall, how would you rate the scientific quality of this review?**

The score for question 10, the overall scientific quality, should be based on your answers to the first nine questions. The following guidelines can be used to assist with deriving a summary score. If the “can’t tell” option is used in one or more times on the preceding questions, a review is likely to have minor flaws at best and it is difficult to rule out major flaws (i.e., a score of 4 or lower). If the “no” option is used on question 2, 4, 6 or 8, the review is likely to have major flaws (i.e., a score of 3 or less, depending on the number and degree of the flaws).

Extensive Flaws		Major Flaws		Minor Flaws		Minimal Flaws
1	2	3	4	5	6	7

Comments:

Appendix 2 - Table of Excluded Studies

Study	Reason for Exclusion
AACE/ACE Position Statement On the Prevention, Diagnosis, and Treatment of Obesity (1998 Revision). <i>Endocrine Practice</i> 1998, 4(5), 297-299.	Adults
Anderssen SA, Haaland A, Hjerman I, Urdal P, Gjesdal K, Holme I. Oslo diet and exercise study: a one-year randomized intervention trial. Effect on hemostatic variables and other coronary risk factors. <i>Nutr Metab Cardiovasc Dis</i> 1995, 5, 189-200.	Single study
Armstrong N, Simons-Morton B. Physical activity and blood lipids in adolescents. NHS Centre for Reviews and Dissemination, <i>Pediatric Exercise Science</i> 1994, 6(4), 381-405.	No defined outcome from objectives
Ashenden R, Silagy C, Weller D. A systematic review of the effectiveness of promoting lifestyle change in general practice. <i>Family Practice</i> 1997, 14, 160-176.	Adults
Atkinson RL, Nitzke SA. School-based programmes on obesity: increase knowledge but do not change eating habits much. <i>BMJ</i> 2001, 323, 1018-1019.	Editorial
Ball GDC, Marshall JD, Roberts M, McCargar LJ. Adiposity and sex-related differences in physical activity, aerobic fitness and self-esteem among 6-10 year old children. <i>Avante</i> 2001, 7(2), 14-26.	Single study
Braet C, van Winckel M, van Leeuwen K. Follow-up results of different treatment programs for obese children. <i>Acta Paediatrica</i> 1997, 86, 397-402.	Single study
Bray GA. Low-carbohydrate diets and realities of weight loss. <i>JAMA</i> 2003, 289(14), 1853.	Editorial, adults
Canino E, Cardona R, Monsalve P, Acuna FP, Lopez B, Fragachan F. A behavioural treatment program as a therapy in the control of primary hypertension. <i>Acta Cientifica Venezolana</i> 1994, 45, 23-30.	Not relevant
Detournay B, Fagnani F, Phillippo M, Pribil C, Charles MA, Sermet C, Basdevant A, Eschwege E. Obesity morbidity and health care costs in France: an analysis of the 1991-1992 Medical Care Household Survey. <i>International Journal of Obesity</i> 2000, 24, 151-155.	Single study, adults
Dunshea-Mooij C, Ni Mhurchu C, Bennett D, Rodgers A. Chitosan for overweight or obesity (protocol). <i>The Cochrane Library</i> (1). 2003.	Adults
Glasgow RE, Wagner EH, Kaplan RM, Vinicor F, Smith L, Norman J. If diabetes is a public health problem, why not treat it as one? A population-based approach to chronic illness. <i>Ann Behav Med</i> 1999, 21(2), 159-170.	Not relevant
Goldfield GS, Epstein LH, Kilanowski CK, Paluch RA, Kogut-Bosler B. Cost-effectiveness of group and mixed family-based treatment for childhood obesity. <i>International Journal of Obesity</i> 2001, 25, 1843-1849.	Single study
Gortmaker SL, Must A, Perrin JM, Sobol AM, Dietz WH. Social and economic consequences of overweight in adolescence and young adulthood. <i>N Engl J Med</i> 1993, 329(14), 1008-1012.	Single study
Haddock CK, Poston WSC, Dill PL, Foreyt JP, Ericsson M. Pharmacotherapy for obesity: a quantitative analysis of four decades of published randomized clinical trials. <i>International Journal of Obesity</i> 2002, 26(2), 262-273.	Adults
Harvey EL, Glennly A, Kirk SF, Summerbell CD. Improving health professionals' management and the organization of care for overweight and obese people. <i>Cochrane Database Syst Rev</i> 2001;(2):CD000984.	Adults
Heshka S, et al. Weight loss with self-help compared with a structured commercial program. <i>JAMA</i> 2003, 289(14), 1792-1798.	Adults
Hitchcock Noel P, Pugh JA. Management of overweight and obese adults. <i>BMJ</i> 2002, 325, 757-761.	Adults

Study	Reason for Exclusion
Hyndman B, Libstug A, Giesbrecht N, Hershfield L, Rootman I. The use of social science theory to develop health promotion programs. 4, 1-119. 1993. Toronto, ON, Centre for Health Promotion. Issues in Health Promotion Series.	Not on topic
Johnson WG, Hinkle LK, Carr RE, et al. Dietary and exercise interventions for juvenile obesity: long-term effect of behavioural and public health models. Obesity Research 1997, 5(3), 257-261.	Single study
Katzmarzyk PT, Malina RM. Obesity and relative subcutaneous fat distribution among Canadians of First Nation and European ancestry. International Journal of Obesity 1998, 22, 1127-1131.	Single study
Kris-Etherton PM, Kris-Etherton PM, Binkoski AE, Zhao G, Coval SM, Clemmer KF et al. Dietary fat: assessing the evidence in support of a moderate-fat diet; the benchmark based on lipoprotein metabolism. Proc Nutr Soc 2002, 61(2), 287-298.	Adults
LeMura LM, Maziekas MT. Factors that alter body fat, body mass, and fat-free mass in pediatric obesity. Med Sci Sports Exerc 2002, 34(3), 487-496	Single study
Maggio CA, Pi-Sunyer FX. The prevention and treatment of obesity: application to type 2 diabetes. Diabetes Care 1997, 20(11), 1744-1766.	Adults
Martin L, Robinson A, Moore B. Socioeconomic issues affecting the treatment of obesity in the new millennium (Provisional record). Pharmacoeconomics 2000, 18(4), 335-353.	Adults
Martin LF, Tan TL, Horn JR, Bixler EO, Kauffman GL, Becker DA et al. Comparison of the costs associated with medical and surgical treatment of obesity. Surgery 1995, 118(4), 599-606.	Adults
Mehta KC, Specker BL, Bartholmey S, Giddens J, Ho ML. Trial on timing of introduction to solids and food type on infant growth. Pediatrics 1998, 102(3), 569-573.	Single study
Meyers AW, Graves TJ, Whelan JP, Barclay DR. An evaluation of a television-delivered behavioural weight loss program: are the ratings acceptable? J Consult Clin Psychol 1996, 64(1), 172-178.	Adults
O'Meara S, Riemsma R, Shirran L, Mather L, ter Riet G. A rapid and systematic review of the clinical effectiveness and cost-effectiveness of orlistat in the management of obesity. Health Technol Assess 2001, 5(18), 1-81.	Adults
O'Meara S, Riemsma R, Shirran L, Mather L, ter Riet G. The clinical effectiveness and cost-effectiveness of sibutramine in the management of obesity: a technology assessment. Health Technol Assess 2002, 6(6), 1-97.	Adults
Parsons TJ, Power C, Logan S, Summerbell CD. Childhood predictors of adult obesity: a systematic review. Intl J Obes 1999, 23(Suppl 8), S1-S107.	No prevention or therapy
Poston WSC, Haddock CK, Dill PL, et al. Lifestyle treatments in randomized clinical trials of pharmacotherapies for obesity. Obesity Research 2001, 9(9), 552-563.	Adults
Raynor HA, Kilanowski CK, Esterlis I, Epstein LH. A cost-analysis of adopting a healthful diet in a family-based obesity treatment program. J Am Diet Assoc 2002, 102(5), 645-656.	Single study
Resnick LM, Nicholson JP, Laragh JH. Alterations in calcium metabolism mediate dietary salt sensitivity in essential hypertension. Can J Physiol Pharmacol 1986, 64(6), 313-321.	Not relevant
Rossner S, von Zweigbergk D, Ohlin A, Rytting K. Weight reduction with dietary fibre supplements. Results of two double-blind randomized studies. Acta Med Scand 1987, 222(1), 83-88.	Adults
Sahota P, Rudolf MCJ, Dixey R, Hill AJ, Barth JH, Cade J. Evaluation of implementation and effect of primary school-based intervention to reduce risk factors for obesity. BMJ 2001, 323, 1-4.	Single study

Study	Reason for Exclusion
Sahota P, Rudolf MCJ, Dixey R, Hill AJ, Barth JH, Cade J. Randomised controlled trial of primary school-based intervention to reduce risk factors for obesity. <i>BMJ</i> 2001, 323, 1-5.	Single study
Schneider W. Alberta Heritage Foundation for Medical Research, Laparoscopic adjustable gastric banding for clinically severe (morbid) obesity. <i>HTA 7: Series B</i> . 2000.	Adults
Schwimmer JB, Burwinkle TM, Varni JW. Health-related quality of life of severely obese children and adolescents. <i>JAMA</i> 2003, 289(14), 1813-1853.	Single study
Seidell JC. The impact of obesity on health status: some implications for health care costs. <i>Int J Obes Relat Metab Disord</i> 1995, 19(Suppl 6), S13-S16	Single study
Serdula MK, Khan LK, Dietz WH. Weight loss counseling revisited. <i>JAMA</i> 2003, 289(14), 1747-1750.	Adults
Shaw K, Del Mar C, O'Rourke P, Tito F. Exercise for obesity (protocol). <i>The Cochrane Library</i> (1). 2003.	Adults
Shaw K, Kenardy J, O'Rourke P, Del Mar C. Psychological interventions for obesity (protocol). Oxford, UK: Update Software, 2003.	Adults
Stafford RS, Farhat JH, Misra B, Schoenfeld DA. National patterns of physician activities related to obesity management. <i>Arch Fam Med</i> 2000, 9, 631-638.	Adults
Strattmann D, Wabitsch M, Leidl R. Adiposity in childhood and adolescence: approaches toward an economic analysis. <i>Monatsschrift Kinderheilkunde</i> 2000, 148(8), 786-792.	Not prevalence or therapy
The Commission on the Future of Health Care in Canada. Canadian population health initiative brief. Ottawa, ON: Canadian Institute for Health Information, 2002. URL: http://secure.cihi.ca/cihiweb/en/downloads/cphi_policy_romanowbrief_e.pdf	Not prevalence or therapy
Vlassov VV. Weight reduction for reducing mortality in obesity and overweight (protocol). <i>The Cochrane Library</i> (1). 2003.	Adults
Wake M, Hesketh K, Waters E. Television, computer use and body mass index in Australian primary school children. <i>Journal of Paediatrics and Child Health</i> 2003, 39, 130-134.	Single study
Wang GJ, Dietz WH. Economic burden of obesity in youths aged 6 to 17 years: 1979-1999. <i>Pediatrics</i> 2002, 109(5), E81-1.	Not prevalence or therapy