

Addressing Obesity in Children and Youth:

Evidence to Guide Action for Ontario

Summary Report



September 2013

Public Health Ontario

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1. Introduction

The increasing prevalence of obesity in children and youth is a serious public health problem requiring immediate action. Presently, almost one-third of Canadian children and youth are overweight or obese (1). Childhood obesity is associated with both proximate immediate and long-term health risks, as well as an economic burden to the health care system. This issue is not unique to Canada or Ontario. There is evidence that the prevalence of obesity in children and youth is increasing worldwide, causing both international and local governments to take action (2).

Obesity in Children and Youth: Ontario's Response

In 2010, the Minister of Health in Ontario endorsed a federal, provincial and territorial framework for action to promote healthy weights, signalling a commitment to work with other provinces and sectors toward a sustained response to childhood obesity (3). In January 2012, the government released *Ontario's Action Plan for Health*, where reducing childhood obesity by 20% over five years was identified as a goal (4). In this plan, it was also outlined that the government would convene a panel of content area experts, advocates, health care leaders, non-profit organizations and industry to inform and advise the Minister of Health and Long-Term Care (MOHLTC) on the best way to achieve its childhood obesity reduction target. The Healthy Kids Panel, the expert panel comprised of 18 members, conducted its deliberations between May and December 2012 and released the report *No Time to Wait: The Healthy Kids Strategy* outlining its recommendations in March 2013 (5).

Evidence to Guide Action: Report Context

In preparation for the panel's deliberations, MOHLTC requested that Public Health Ontario (PHO) create an evidence primer to serve as a foundational reference document to inform the work of the panel. This document was to present a synthesis of the evidence on the trends, causes and risk factors of obesity in children and youth, the effectiveness of interventions to prevent and treat overweight and obesity, and the actions that other jurisdictions and public health units (PHU) are taking. PHO initiated a project that led to this report in response to a request made at the end of March 2012, with the report delivered at the beginning of July 2012. The main goal of this project was to deliver, within this short timeline, a high-quality and rigorous product that would provide the panel with evidence to inform its recommendation for action in Ontario. Systematic searches with critical appraisal of the literature were used to ensure the full scope of the literature base was reviewed and that the syntheses produced were of high quality. The population of focus for this report was children and youth under 19 years of age. This report also focused on anthropometric outcomes (e.g., changes in weight, BMI, waist circumference, prevalence of overweight or obesity) to measure effectiveness. However, many studies on obesity prevention and healthy weights measure effectiveness as changes in obesity-related risk factors or determinants, such as physical activity and healthy eating. A complete synthesis of the effectiveness of interventions to change obesity-related behaviours was out of scope for this report,

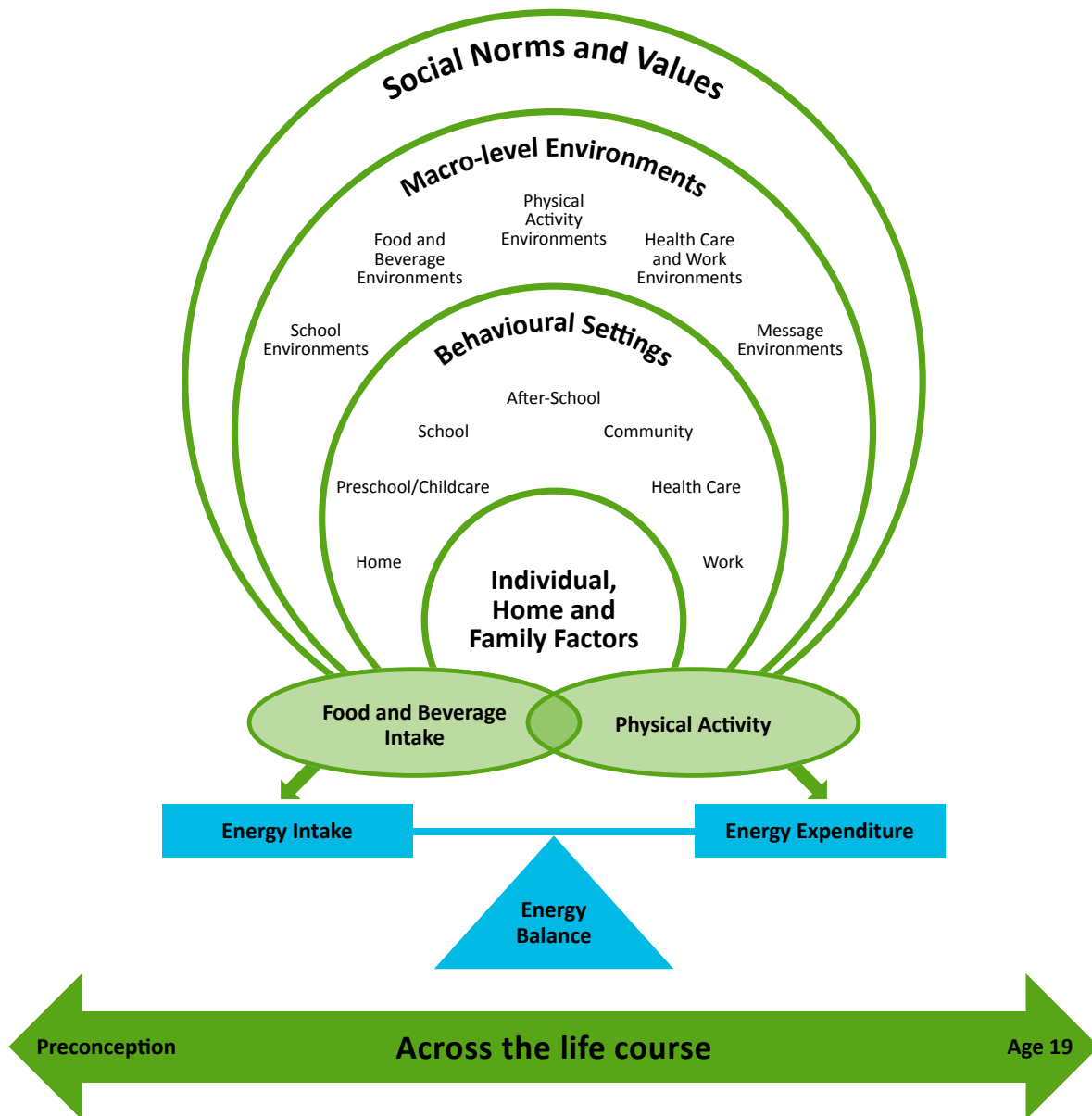
although these will likely be a beneficial part of obesity prevention efforts. Additionally, even though it would have been ideal to assess the primary literature for each evidence synthesis, it was not always possible due to the short timeline and the rapidly growing literature base on childhood obesity. In these instances, secondary literature sources, including narrative reviews, systematic reviews and meta-analyses, were synthesized.

Evidence Review Framework

Adopting both a socio-ecological and a life course perspective, an integrated framework was developed to describe the causal factors that contribute to childhood obesity and to identify leverage points for prevention and treatment of childhood obesity throughout the report. This model acknowledges the role of energy imbalance (i.e., energy intake is greater than energy expenditure) over a long period as a

fundamental cause of obesity. Energy intake refers to the energy or calories that are consumed when eating and drinking, and energy expenditure takes the form of physical activity. However, this seemingly simple relationship is underpinned by a complex web of factors that modifies how much children eat and move, and some of these relationships begin before birth. The socio-ecological theory hypothesizes that one's behaviours are not only affected by individual factors, but also by interactions with the larger social and environmental context (6). The Institute of Medicine (IOM) presents a socio-ecological framework depicting these relationships for the issue of childhood obesity, and we have adapted its model for the purpose of synthesizing evidence in this report (Figure 1.1) (7). Our framework also integrates a life course approach, emphasizing the importance of early-life risk factors, the accumulation of behaviours and excess weight through growth and development leading to obesity, and the high risk of obese youth becoming obese adults.

Figure 1.1: Evidence Review Framework



Source: Adapted with permission from: IOM (Institute of Medicine) 2012. Accelerating Progress in Obesity Prevention: Solving the Weight of the Nation. Washington, DC: The National Academies Press. Figure 3.2, page 90.

The innermost layer of the framework depicts individual, home and family factors, including genetic, ethnic identity, psychosocial (e.g., beliefs, attitudes, knowledge), skills, lifestyle and health status factors. This level is surrounded by the key behavioural settings or micro-level environments that affect eating and physical activity behaviours, such as home, preschool, school, after-school, community and health care. These settings often provide focal points for interventions.

The macro-level environment stratum encompasses policies, messaging, marketing, regulation, taxation and other sector-level controls. The IOM Committee

on Accelerating Progress in Obesity Prevention identified five intersecting macro-level environments for change to prevent obesity: (1) physical activity; (2) food and beverage; (3) message; (4) health care and work; and (5) school (7). Although the “work” component of “health care and work environments” may be less relevant for prevention in children, it is maintained in the current report, where appropriate, to capture workplace policies that affect children indirectly or directly (i.e., policies to make workplaces breastfeeding friendly). Where there was no evidence of these types of policies or interventions, this

environment's title was abbreviated to "health care environments". The outermost layer of the framework represents social norms and values. This layer is the pattern of ideology and organization that can reinforce behaviours that promote obesity, as it has a cascading effect through the other layers of influence in the model.

The interventions, strategies, initiatives and activities identified through the prevention and treatment effectiveness literature searches and jurisdictional

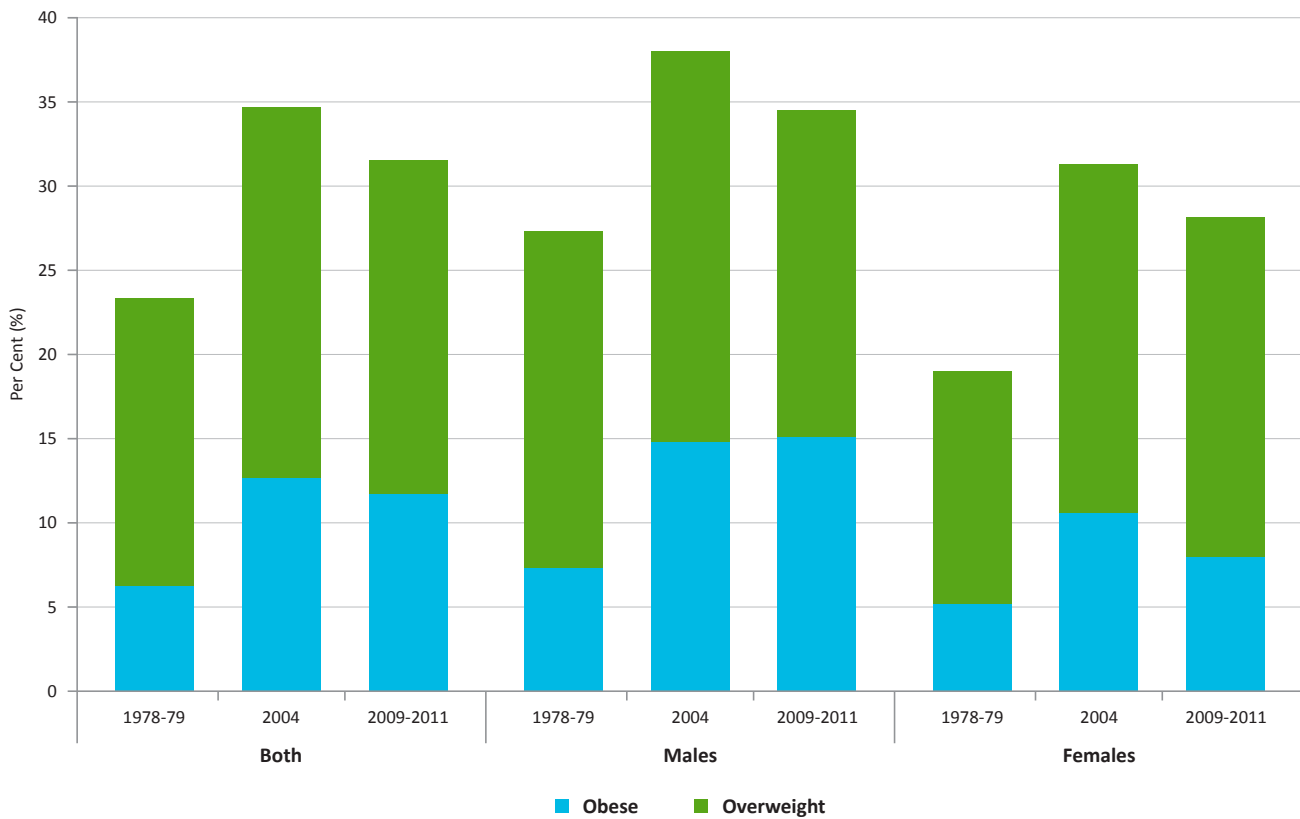
scans are further classified as either policy and environmental interventions, social and behavioral interventions, or clinical interventions. The distinction between policy and environmental interventions and social and behavioral interventions has been previously used by the U.S. Task Force on Community Preventive Services when describing physical activity interventions (8).

2. Trends, Causes and Risk Factors

Nearly one-third of Canadian children and youth were overweight or obese in 2009–2011, according to the Canadian Health Measures Survey (CHMS) (1). Furthermore, the prevalence of obesity among Canadian children and youth increased significantly from 6.3% in 1978–1979 to 12.7% in 2004 based on measured height and weight, while the prevalence of

overweight increased from 17% to 22%, representing an increase of 102% and 29% respectively (Figure 2.1). While comparable measured data for Ontario using similar BMI-for-age definitions are not available, 27.1% of youth aged 12 to 17 self-reported a BMI considered overweight or obese in 2009–2010.

Figure 2.1: Measured Overweight and Obesity Using WHO BMI-For-Age Cut-Offs in Children and Youth, by Sex, Canada, 1978-79 (Ages 2-17), 2004 (Ages 2-17), 2009-11 (Ages 5-17)



Sources: 1) Shields M, Tremblay MS. Canadian childhood obesity estimates based on WHO, IOTF and CDC cut-points. *Int J Pediatr Obes* 2010 May 3;5(3):265-273; 2) Roberts KC, Shields M, de Groh M, Aziz A, Gilbert JA. Overweight and obesity in children and adolescents: results from the 2009 to 2011 Canadian Health Measures Survey. *Health Rep.* 2012 Sep;23(3):37-41.

Determining the causes of childhood overweight and obesity requires consideration of a complex web of behavioural, social, environmental and biomedical risk and protective factors that begin before birth and continue throughout the life course at the individual, family, community and societal levels. Genetics also play a role in the risk of children and youth becoming overweight and obese. Nevertheless, there is consistent evidence that the following modifiable risk factors are causally associated with childhood and youth overweight and obesity:

- Maternal smoking (14)
- High birthweight (15)
- Rapid infant weight gain, associated with low birthweight (16)
- Consumption of sugar-sweetened beverages (17)
- Physical inactivity and sedentary behaviour (18,19)
- Inadequate sleep (20)

Similarly, the following protective factors are causally associated with childhood and youth overweight and obesity:

- Breastfeeding
- Breakfast consumption

There is less consistent evidence that additional factors may play a causal role. There is some evidence that gestational diabetes (23), exposure to advertising for high-calorie foods (11,24,25), childhood depression and higher levels of psychosocial stressors (11,26-28), low socioeconomic status (11,29,30) and a poorly designed built environment (11,31,32) increase the risk of overweight and obesity in children and youth. There is some evidence that milk and dairy consumption decreases the risk (33-35).

A substantial number of Ontario's children and youth do not get enough daily physical activity. Many engage in sedentary behaviours for a large part of their day, which tends to increase in older age groups (36). Additionally, only half of youth consume the recommended number of vegetable and fruit servings per day, and many children and youth are consuming too many calories from sugar-sweetened beverages (37,38).

3. Measuring and Monitoring

Assessing success in achieving any obesity reduction goal relies on the ability to establish baseline measurements for childhood obesity and related risk factors, and monitor these over time to account for the investment in obesity reduction and prevention programs. Body mass index (BMI)-for-age is the indicator that is broadly utilized across international jurisdictions and within Ontario public health units to monitor childhood overweight and obesity. Measured BMI is a more accurate indicator of overweight and obesity than self-reported BMI (39). BMI-for-age is defined as weight divided by height squared and is assessed relative to other children of the same age and gender. There are different BMI-for-age systems in use around the world, which result in variations in overweight and obesity rates in children and youth. A number of Canadian organizations, including Dietitians of Canada, have recommended that WHO growth charts be utilized as the Canadian standard for measuring BMI-for-age (40).

Within Ontario, there are challenges in finding opportunities to systematically measure childhood height and weight and related risk factors, whether during physician visits, on entry to the school system, during schooling or at home. While there are substantial limitations to existing data sources, there are 10 surveys in Canada and Ontario collected in the community and school settings that could be used to monitor the prevalence of overweight and obesity in children and youth. Although some systems monitor the health of First Nations, Inuit and Métis children and youth, most have limitations in terms of providing data concerning specific geographic, ethnic or other sub-populations of interest. Most of the existing systems collect self- or parent-reported height and weight, as opposed to measured height and weight, and, as a result, may under- or overestimate overweight and obesity on a population level. Existing data collection systems that could be leveraged as they compile measured height and weight include the nutrition-focused survey of the Canadian Community Health Survey (CCHS), Canadian Health Measures Survey and electronic medical/health record (EMR/EHR) data from primary care physicians.

4. Prevention of Overweight and Obesity in Children and Youth: A Review of Reviews on the Effectiveness of Interventions

A review of reviews was conducted to assess the effectiveness of interventions to prevent obesity in children and youth under 19 years, where effectiveness was determined by changes in direct or self-reported anthropometric measures (e.g., change in weight, BMI, waist circumference). Prevention interventions targeted the general population of children and youth unselected by weight status (i.e., populations comprised of children and youth with healthy weights, as well as those who were already overweight or obese). A total of seven meta-analyses, two reviews of reviews, 22 systematic reviews and nine literature reviews were synthesized.

Overall, the obesity prevention interventions reviewed appear to have a modest effect on anthropometric outcomes, particularly among children aged six to 12 (41-44). However, from a public health perspective, what appears as a small effect on the individual level may be important at the population level (41). The majority of interventions were set primarily within the school environment and targeted physical activity and diet. Home-, community- or Internet-based activities were often included as components of these school-based interventions. There was some evidence of effect for interventions conducted within the home and community, especially for children under five years of age.

Results from the included reviews suggested that interventions were more likely to be effective if they:

- Targeted both physical activity and healthy eating (41-43,45,46);
- Involved parents (41-43,46-52);
- Were designed to be culturally sensitive (42,46,49,53,54);
- Had effective staff training and sustainability (42,46);
- Used participatory activities and training in behaviour techniques (e.g., self-monitoring, goal setting) or coping skills (42);
- Were done in collaboration with community programs or facilities (55);
- Increased number, intensity and duration of physical activity sessions throughout the school week (41,42);
- Modified the food environment of schools to improve nutritional quality of school foods (41,42);

- Were set within environments and cultures that supported healthy eating and physical activity, and combined education with modifications to the school environment (41,56);
- Were universal (e.g., did not select children or youth based on weight or risk factors for obesity) (43);
- Were delivered by teachers who were supported by, or worked in collaboration with, specialists (41,43);
- Were longer in duration rather than short term (43,44,47,48,55);
- Were integrated into the school curriculum (44,57,58).

Limitations of this synthesis are that all reviews published in languages other than English and before January, 2009, were excluded; nevertheless, it was felt that the primary literature was well represented through this review of reviews. In addition, the search was limited to meta-analyses and systematic reviews, which tend to focus on interventions amenable to experimental trials, such as short-term programmatic interventions in the school setting. Furthermore, there was considerable heterogeneity within reviews — that is studies varied in terms of the populations studied, interventions employed (e.g., their focus and content) and outcomes measured. Such heterogeneity made it challenging to summarize and synthesize results across all reviews to identify key components of effective interventions.

A number of gaps in the literature on obesity prevention in children and youth were identified. Within published reviews, there was little or no information on how to effectively address risk factors associated with urban, rural and remote locations, the built environment, socioeconomic status or other structural barriers to health. Additionally, most of the studies concerning minority children and youth were conducted in the U.S. and may not be applicable to Ontario's population. Finally, few reviews looked at, or were able to assess, the potential of inadvertent or adverse outcomes of weight-focused interventions.

5. Treatment Approaches for Overweight and Obese Children and Youth: A Review of Reviews on the Effectiveness of Interventions

Although obesity preventive efforts are important, treatment efforts are also needed to help children and youth who are overweight or obese manage their weight and minimize complications. Identifying effective treatment approaches to support weight management among overweight and obese children and youth is an important element to improving chronic disease outcomes in Ontario and Canada. A review of reviews was conducted to determine the effectiveness of treatment approaches designed to help children and youth under age 19 who are already overweight and obese reach a healthy weight. Effectiveness was determined by changes in anthropometric outcomes (e.g., changes in weight, BMI, waist circumference). Three approaches to the treatment of overweight and obesity in children and youth were assessed within the 15 reviews, of which five were meta-analyses and 10 were systematic reviews.

Nine reviews assessed the effectiveness of lifestyle initiatives, which targeted behavioural modifications through diet, physical activity and behavioural therapy. The effectiveness of pharmaceutical approaches (sibutramine, orlistat and metformin) was assessed in four reviews. Surgical approaches, such as gastric bypass surgery, were assessed in one

systematic review. The remaining review assessed the effectiveness of all three approaches in reducing overweight and obesity among children and youth. Results showed that lifestyle (59,60), pharmaceutical (60-63) and surgical treatment approaches (64) could result in decreases in anthropometric outcomes. Lifestyle approaches had better results when they combined several components, such as dietary and physical activity change, behavioural therapy and parental involvement (45,54,59,60,65). Although both pharmaceutical and surgical approaches also resulted in reductions in anthropometric measures, several adverse effects were reported with the use of pharmaceuticals, such as nausea, vomiting and gastrointestinal discomfort. In addition, revisional surgeries were frequently needed in those undergoing surgery.

Limitations of this synthesis are that all reviews published in languages other than English and prior to 2009 were excluded. Studies evaluated within the reviews had varying sample sizes, consisted mainly of Caucasian populations, and were heterogeneous in their reporting of outcomes and treatment protocols. Despite these limitations, the literature was concisely summarized with a high degree of methodological rigour.

6. Cost-Effectiveness of Interventions to Prevent or Treat Obesity in Children and Youth: A Review

Childhood obesity is considered a major public health problem, and action is needed to reduce current obesity rates and prevent future cases. However, there is a scarcity of funds for public health interventions and, thus, the results of cost-effectiveness analyses are important to guide decision-making. Cost-effectiveness analysis is a form of economic evaluation in which the costs and health benefits of two interventions are compared (66). A literature review was conducted to determine the cost-effectiveness of interventions to prevent or treat child and youth overweight and obesity. The literature search yielded a total of 22 cost-effectiveness evaluations of obesity interventions which were conducted within four main environments: one in the message, ten in the school, two in the physical activity (67,68) and nine within the health care. Two additional studies assessed how much could be invested in childhood obesity interventions in general.

The results suggest that there are both prevention and treatment interventions that meet acceptable cost-effectiveness thresholds, as suggested by WHO's Choosing Interventions that are Cost-Effective Collaboration (WHO-CHOICE) (69), and these interventions occur in a variety of settings:

- **Cost saving:** ban on TV advertising of high-fat/high-sugar foods (70), education to reduce TV viewing (71-73), education to reduce soda consumption (71-73), a multifaceted school-based peer-led program (71-73), a multifaceted school-based program with active physical education (71-73), family-based therapy with general practitioner (GP) follow-up (4-6) and group therapy (74)

- **Highly cost-effective:** three multifaceted school-based programs (CATCH (75), Planet Health (76) and a program without active physical education (71-73)), bariatric surgery (77), drug therapy (71-73) and a GP-mediated targeted intervention (LEAP) (78)
- **Cost-effective:** active transport education program (TravelSMART) (79) and physical activity-based Active After-School Community Program (68)
- **Not cost-effective:** active transport to school (Walking School Bus) (80)
- **More costly with no benefits:** two GP-mediated targeted interventions (LEAP (81) and LEAP2 (82))

Assessments of obesity interventions showed that, given the high costs of obesity-related diseases and probability of progression from childhood obesity to adulthood obesity, a large investment in childhood obesity prevention is cost-effective. The major limitation of included studies was the lack of conclusive evidence on the effectiveness of obesity interventions evaluated, which has led to inconclusive results on the cost-effectiveness of interventions such as GP-mediated interventions. The results should be interpreted with caution, as there was often a high degree of uncertainty around the costs and effects of interventions. Additionally, no economic evaluations were performed on obesity interventions for children and youth within Canada, so it is difficult to comment on the transferability of the summarized results to the Canadian context.

7. Jurisdictional Scan of Obesity-Related Strategies and Initiatives

To understand how other jurisdictions have addressed childhood obesity, a scan of strategies and initiatives adopted in several states and provinces, countries and WHO regions was completed. The search yielded 28 documents describing government strategies, as well as jurisdiction-wide initiatives such as childhood obesity prevention programs. The strategies and initiatives seek to reduce obesity in children or the whole population by influencing these environments, either through policy and environmental changes or through social and behavioural interventions. Most jurisdictions are engaged in activities to influence the broader food and beverage environments, physical activity environments or both simultaneously. These interventions include community education programs on healthy eating and physical activity, encouraging the food industry to reformulate products to be healthier, and adopting urban planning policies that promote active transportation.

Many jurisdictions have identified school environments as important settings for childhood obesity prevention. Interventions targeting these settings include improving nutrition and physical education in schools, increasing active play in child care settings and increasing access to drinking water in schools. Health care and work environments have also been identified as important settings for supporting healthy eating and physical activity for infants, children and youth, and adults. Interventions in these settings include promoting supportive workplaces for breastfeeding, and providing weight screening and management services through the health care system. Jurisdictional strategies and initiatives also often included efforts to influence the

broader message environments. Common interventions include voluntary and regulatory means to reduce the marketing of unhealthy foods to children, and social marketing campaigns to promote healthy eating and physical activity.

In addition to these interventions, most jurisdictions are engaged in a number of leadership, capacity-building and other enabling activities to support an overall obesity prevention strategy. These activities include providing funding, developing multi-sectoral and multi-level partnerships, and surveillance and monitoring systems.

The documents reviewed represented a wide range of jurisdictions and approaches for addressing obesity in children and youth. However, because the literature search sought to capture initiatives focused specifically on obesity prevention, initiatives that focused solely on improving obesity risk and protective factors, such as healthy eating and physical activity, may have been overlooked. In addition, only English- and French-language documents were reviewed, further limiting results.

Although Ontario does not yet have a comprehensive childhood obesity strategy, the province is already engaged in some of the strategies and initiatives that were frequently supported by jurisdictions included in this scan. Various initiatives across several provincial ministries are currently in place, and the knowledge, expertise and leadership from these and other stakeholders can help inform the development and implementation of future childhood obesity reductions strategies.

8. Ontario Public Health Unit Scan of Obesity-Related Initiatives

A web-based survey was administered to gather information from all 36 Ontario public health units (PHUs) regarding the healthy weight promotion and obesity prevention initiatives in which they were involved, including programs, policy interventions and communications campaigns. For each initiative, respondents were asked to provide a brief description of the initiative, including type of initiative, population targeted, setting and key action areas. The survey was analyzed using descriptive statistics for quantitative data and thematic analysis for qualitative data. A response rate of 100% was achieved, with all 36 PHUs in Ontario responding. Overall, 433 initiatives, several with multiple components, were submitted.

The interventions described in this scan target the promotion of healthy weights and the reduction of obesity in children or the whole population through policy and environmental changes or through social and behavioural interventions. PHUs reported being engaged in activities to influence the broad food and beverage environments, physical activity environments or both simultaneously. These interventions include food and nutrition policies that influence the environment in which children live and play, and urban planning policies that promote active transportation.

Many PHUs identified school environments as important settings for the promotion of healthy weights. Interventions targeting these settings include improving nutrition and physical education in schools, and implementing nutrition guidelines and increasing active play in child care settings. PHUs also identified health care and work environments as an important setting for supporting healthy eating and physical activity for infants, children and youth, and adults. Interventions in these settings include promotion of and support for breastfeeding, and education sessions that promote healthy weights. Ontario health unit initiatives also included efforts to influence the broader message environments. Among common interventions are community campaigns and media sources that include print materials, such as pamphlets, posters and newsletters.

Frequently reported initiatives:

- 90% of the policy and environmental interventions reported by Ontario PHUs pertained to the creation of supportive food environments
- 75% of Ontario PHUs report multi-sectoral planning on healthy eating/food and nutrition in community design and the built environment
- 75% of Ontario PHUs reported that they planned to achieve or already had the Baby-Friendly Initiative (BFI) designation
- 72% of Ontario PHUs report multi-sectoral planning on physical activity in community design and the built environment
- Approximately 81% of Ontario PHUs reported providing parenting programs and support groups
- Half (50%) of the 433 initiatives reported by Ontario PHUs were offered within the school setting
- 70% of Ontario PHUs reported offering initiatives within the daycare setting

This survey did not capture all initiatives related to healthy weights and the prevention of childhood obesity provided by Ontario PHUs. Dependent upon the survey respondent, the categorization of the initiative and the level of detail provided for each initiative varied substantially.

9. Conclusion

This report was developed to serve as an evidence primer on the issue of child and youth overweight and obesity for a panel convened to advise the Ministry of Health and Long-Term Care on the best ways to achieve its obesity reduction target. Determining the primary factors associated with childhood obesity is a starting point to understanding how to reduce and prevent obesity. Overweight and obesity is a result of a complex web of risk and protective factors that begin before birth and continue throughout the life course at the individual, family, community and societal levels. Although there is a genetic component, many modifiable risk factors are associated with overweight and obesity in children and youth. These include maternal smoking, high birthweight, rapid infant weight gain, consumption of sugar-sweetened beverages, physical inactivity, sedentary behaviour and inadequate sleep. Additionally, there are factors that have been shown to be protective against child and youth overweight and obesity, such as breastfeeding, breakfast consumption and physical activity. Although there is limited information about obesity risk factors among children and youth in Ontario, it has been shown that a substantial number of Ontario's children and youth do not get enough physical activity, and many engage in sedentary behaviours for long periods of the day, a trend that increases with age. Only half of youth consume the recommended number of vegetable and fruit servings per day, and many children and youth are consuming too many calories from sugar-sweetened beverages.

Despite these multi-factorial causal pathways, research on the effectiveness of interventions to prevent obesity evaluated with anthropometric outcomes has primarily focused on interventions set in the school environment, and these have been consistently shown to be effective at producing small, but clinically and statistically significant, reductions in measured anthropometric outcomes in children and youth. These were most often social and behavioural interventions that aimed to increase healthy eating and physical activity behaviours, and reduce sedentary behaviours. More effective interventions tend to address both sides of the energy balance equation, engage parents, have a longer duration, are designed to be culturally sensitive, and use both educational and environmental activities. There is also some evidence of effectiveness for interventions conducted

within home, community, preschool and health care settings, and those that are web- or computer-based.

This review identified three approaches to treatment interventions that have been assessed for efficacy and effectiveness: lifestyle, pharmaceutical and surgical. Lifestyle approaches were found to be more effective when they included behavioural therapy, addressed several risk factors and included parental involvement. Pharmaceutical and surgical interventions for the treatment of obesity in youth can be effective, but there is limited evidence regarding their long-term safety. As treatment approaches generally target individuals rather than populations, the potential population impact is low when compared to prevention initiatives. However, in order to prevent the complications of obesity in individual children and youth, obesity treatment approaches may play a complementary role. Fortunately there are both prevention and treatment approaches that meet acceptable cost-effectiveness thresholds, and these interventions can occur in a variety of settings (e.g., message environment, school and after-school setting, and within the health care system).

Although there is limited evidence on the effectiveness of prevention interventions outside of the school environment, international, national, provincial jurisdictions and local Ontario public health units are moving forward with comprehensive multi-level strategies based on the causal pathway evidence. These include policies and capacity-building activities to facilitate the creation of environments in which healthy eating and physical activity behaviours are fostered, such as in home, community, workplace, daycare, after-school, school and health care settings. Various jurisdictions and settings, including PHUs, have also focused their efforts beyond risk factors related to healthy eating and physical activity. For example, some organizations have established programs or policies to increase breastfeeding, which may be protective against childhood obesity.

Evaluating the success of efforts to achieve the Ontario government's obesity reduction goal relies on the ability to establish baseline measurements for childhood obesity and related risk factors, as well as the monitoring of these measures over time. Measured BMI-for-age is most commonly used for monitoring overweight and obesity in children and

youth at the population level. There are several growth charts to define healthy growth ranges and related percentiles of BMI relative to age and sex. Recently, a number of Canadian organizations have recommended WHO growth charts for the standard. Within Ontario, there are a number of surveys that collect height and weight data, and although all have limitations, there are opportunities to leverage existing surveys to measure progress on meeting Ontario's obesity reduction goal.

For the purpose of this report, intervention effectiveness was measured as a reduction in anthropometric outcomes, given the focus on childhood obesity reduction. However, many interventions focus on obesity prevention target risk factors for obesity and, therefore, measure effectiveness as changes to these risk factors, such as increases in physical activity or improved dietary intake. Measuring behavioural changes that result from an intervention is often more feasible, due to the shortened follow-up time required. While a change in behaviour may be observed soon after a programmatic intervention or when an environmental or policy change is implemented, anthropometric changes occur over a long time period and a study's duration may not be sufficient to capture the change. Additionally, it is unknown if reductions in weight/BMI and behaviour changes are sustained in the long term.

Given the tight timeline to deliver this report and the rapidly growing literature base on childhood obesity, it was not possible to assess the primary literature on prevention and treatment interventions. The systematic review literature privileges experimental design studies, which are less conducive to assessing the effectiveness of policy and environmental

interventions. Despite this, there was some evidence of effectiveness, based on anthropometric outcomes for policy and environmental interventions in schools (e.g., changes to the types of food available in cafeterias/vending machines and increased opportunities for physical activity), although the evidence of effect on behaviour change, when included, was generally more conclusive. Overall, this report shows a divide between the current evidence and the action taken by jurisdictions and PHUs. Both scans demonstrated that there is strong support for policy and environmental interventions, but evaluations of these actions are largely missing from the literature examined. It is possible that these interventions have not yet been evaluated or that they are currently in progress. However, jurisdictions have moved forward with the development of strategies that are not only based on the effectiveness literature, but also on what is known from the epidemiologic literature and by extrapolation from other public health issues, such as tobacco control.

In conclusion, for children and youth, the dynamic relationships between individual and environmental factors across a variety of settings are important for obesity causality and these relationships represent important opportunities for intervention. Given these complex pathways, successful reduction of overweight and obesity in children and youth will require a comprehensive approach. This is especially imperative, as no single intervention emerged from the literature as a silver bullet to the problem of childhood obesity, and the accumulation of small effects from a variety of interventions that target all relevant environments and settings will likely contribute to an overall solution.

List of Acronyms

BFI – Baby-Friendly Initiative

BMI – Body mass index

CATCH – Coordinated Approach to Child Health

CHMS – Canadian Health Measures Survey

EHR – Electronic health record

EMR – Electronic medical record

GP – General practitioner

IOM – Institute of Medicine

IOTF – International Obesity Task-Force

LEAP – Live, Eat and Play

MOHLTC – Ministry of Health and Long-Term Care

PHO – Public Health Ontario

PHU – Public health unit

WHO – World Health Organization

WHO-CHOICE – World Health Organization’s Choosing Interventions that are Cost-Effective Collaboration

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