



# Strategies for Health Promotion: Healthy Dietary Habits

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*This Rapid Evidence Report was prepared by the Newfoundland & Labrador Centre for Applied Health Research (NLCAHR), Memorial University. It was developed through the analysis, interpretation and synthesis of scientific research and/or health technology assessments conducted by other parties. It also incorporates selected information provided by expert consultants in the subject area. This document may not fully reflect all the scientific evidence available at the time this report was prepared. Other relevant scientific findings may have been reported since completion of this synthesis report.*

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# About This Report

## About NLCAHR

The Newfoundland and Labrador Centre for Applied Health Research, established in 1999, contributes to the effectiveness of health and community services in Newfoundland and Labrador and to the physical, social, and psychological wellbeing of its population. NLCAHR accomplishes this mandate by building capacity in applied health research, supporting high-quality research, and fostering the effective use of research evidence by decision makers and policy makers in the provincial healthcare system.

## *Rapid Evidence Reports*

NLCAHR designed *Rapid Evidence Reports* to provide support for evidence-based decision making in the Newfoundland and Labrador healthcare system on an expedited basis as compared to the lengthier '*Evidence in Context*' reports issued through the Contextualized Health Research Synthesis Program. Through these expedited reports, NLCAHR provides a succinct review of recent research evidence on a high-priority research topic selected by decision makers in the province.

*Rapid Evidence Reports* include:

- a clear statement of the issue and the background to the issue/problem;
- a description of the scope and nature of the pertinent English-language scientific literature from the past five years<sup>1</sup>;
- a summary of the principal features of the available evidence – points of consensus, points of disagreement, areas of uncertainty or silence on some or all of the following issues: effectiveness of interventions, potential benefits and harms, risks, costs, and cost-effectiveness; and
- a brief analysis of the types of issues that might affect the applicability of the evidence to the local context.

It is important to note that, unlike an '*Evidence in Context*' report, a *Rapid Evidence Report* is not a comprehensive and systematic synthesis of the literature on the topic. The rapid report provides neither critical appraisal of included articles nor a full analysis of the contextual issues involved in applying evidence to the Newfoundland and Labrador healthcare setting. Rather, a *Rapid Evidence Report* provides decision makers with a summary of the scope and nature of the recent scientific literature on the topic in question, an initial assessment of the strengths and gaps in this literature, and a review of the key points of agreement and disagreement among researchers.

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<sup>1</sup> We have made an exception to this guideline in this RER and extended the time window to 10 years so as to be able to include a body of research of particular interest to our health system partners.

## Researchers and Consultants

For this report, researchers from the Newfoundland and Labrador Centre for Applied Health Research included: Pablo Navarro, Research Officer, Contextualized Health Research Synthesis Program (CHRSP) and Dr. Stephen Bornstein, Director of NLCAHR. Our team benefitted from the advice and expertise of Dr. Jennifer O’Loughlin, Professor, Department of Social and Preventive Medicine, School of Public Health, University of Montreal and Canada Research Chair in the Early Determinants of Adult Chronic Disease. Dr. O’Loughlin’s credentials are included in the Appendix to this report.

## Background

The province’s health decision makers have an interest in maximizing the impact of their health promotion initiatives. Knowing the research-based evidence on the effectiveness of the range of available health promotion strategies can help them attain that objective.

The increasing prevalence of chronic disease in Canada in general, and in Newfoundland and Labrador in particular, underscores the importance of health promotion and the determinants of health model. Despite advances in medical and drug technologies, the prevalence of hypertension, diabetes, cardiovascular disease and certain cancers continues to increase. An estimated 80% of heart disease, diabetes and respiratory disease and up to 40% of some cancers can be prevented by eliminating the four most common risk factors: unhealthy diets, lack of physical activity, and alcohol and tobacco use (1).

The theory and practice of health promotion have evolved considerably over the past 40 years. Previously, many health promotion efforts consisted of short-to-medium duration health communication efforts, e.g., World AIDS Day (established 1987), National Non-Smoking Week (1977), and Breast Cancer Awareness Month (1985). Many local and regional organizations in Canada still follow the “Calendar of Health Promotion Days” developed by Health Canada (2) which is intended to promote synchronicity and consistency of messaging among and between provinces and health authorities.

Health communication is a critical component of effective health promotion. However, there is now considerable skepticism that it can produce sustained effects on complex health behaviors in the absence of a broader program of change (3). Health promotion strategies that take the characteristics of the targeted individuals, groups and communities into account are widely believed to be more effective than health communication programs alone (4).

The goal of this Rapid Evidence Review (RER) is to provide a brief summary of the research-based evidence on health promotion strategies that compare health communication efforts

and more complex tailored programs, and to consider these strategies in the context of Newfoundland and Labrador.

In order to make the scope of this RER manageable, one particular area of health promotion is studied as an exemplar, rather than attempting to synthesize the evidence across multiple areas of health promotion. We have consulted with Central Health, the original proponent of this study, and our external expert and decided to focus on health promotion initiatives that aim to increase healthy eating habits. As such, the research question is:

“What health promotion strategies have been shown to be effective for improving dietary habits in settings and populations like those of Newfoundland and Labrador?”

## Scope and Nature of the Scientific Literature

For this RER, we searched for systematic reviews (including meta-analyses, meta-reviews and health technology assessments) published in any language since 2004. We searched for articles that are indexed in PubMed, CINAHL and Embase, and we used Google Scholar for secondary searching. Our search criteria included the following: <sup>2</sup>

- **Population:** Studies that included samples that were representative of the general population, and not selected for a health condition or particular risk factor.
- **Intervention:** Health promotion-based interventions to improve dietary habits, with a focus on increasing the consumption of fruits and/or vegetables.
- **Comparator:** A control group from the same population.
- **Outcome:** Any behavioral outcomes related to fruit and vegetable consumption.
- **Setting:** Any setting, including pre-school, school, work and community including in the home.

Our initial search results yielded 421 articles, of which 28 were selected for full-text review. Of these, 20 articles were included in our synthesis. We also included six additional articles

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<sup>2</sup> Exclusion criteria included studies in which: (i) the outcome was change in body weight, blood sugar, or another physical health measure like blood pressure; (ii) the intervention aimed to treat a health problem or to change a health risk factor; (iii) ‘healthy eating’ was one of several indicators of a complex behavioural outcome such as parenting skills; and (iv) studies focused on frameworks for evaluation methods rather than on the evaluation of interventions.

from a reverse citation search of our included articles.<sup>3</sup> Our final results included five reviews of systematic reviews (or 'meta-reviews'), four meta-analyses and 17 systematic reviews for a total of 26 articles and reports.

We have organized the findings by the type of intervention that was the primary focus of the systematic review:

- Awareness campaigns
- Multi-component interventions
- Interventions using behavior change techniques
- Interventions using messaging
- Interventions using financial incentives
- Interventions designed for specific settings
- Theory-based interventions

A quick note about how this research relates to National Nutrition Month as prescribed in Health Canada's Calendar of Health Promotion Days. These kinds of health promotion calendar events were not explicitly described either as interventions being studied, as control variables or as variables used to define a comparison group in any of the research we identified. However, most if not all health promotion/healthy eating research carried out in North America and Europe over the past 20 years would have taken place with such a calendar operating in the background. In Canada, the Canadian Dietetic Association has organized National Nutrition Month (March) since at least 1994. The same is the case in the United States and Europe, where most of the health promotion research is carried out. As such, we can assume that both the intervention groups and control groups examined in the studies covered by the various systematic reviews were similarly exposed to healthy eating awareness campaigns.

## Strategies to Promote Healthy Dietary Habits

The systematic review evidence for the effectiveness of health promotion strategies to improve dietary habits incorporates findings based on both qualitative and quantitative methods. In the former, authors use expert opinion to summarize qualitatively results across primary research studies. This approach is helpful when individual research studies are very heterogeneous to the extent that direct comparison between studies is precluded.

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<sup>3</sup> After completing our initial searches on PubMed, CINAHL and Embase, we used Google Scholar to find any systematic reviews that had cited any of our included articles, which is known as a 'reverse citation search'. Systematic reviews often reference previous systematic reviews, and reverse citation searches are becoming a common secondary search strategy for review papers.

The results from studies that are methodologically homogeneous may be directly combined using meta-analytic techniques. In these quantitative reviews, effectiveness is often reported as a standardized difference between the means of an intervention and control group. The measure<sup>4</sup> that is used to describe this difference is usually Cohen's *d* or Hedge's *g*. The magnitude of both measures can be interpreted using "Cohen's convention" as: small = 0.2; medium = 0.5; or large = 0.8 (6).

## Awareness Campaigns

This review originated because of an interest among decision makers in Newfoundland and Labrador in comparing healthy eating awareness campaigns to other health promotion strategies that are tailored to specific audiences. Most awareness campaigns comprise "the development and communication of generic healthy eating messages directed at the public at large", with the intention of raising awareness of the importance of healthy eating (7). Typically, multiple modes of communication are deployed at the same time. Awareness campaigns are widely used in Europe and North America (7).

Assessing the impact of such campaigns is technically difficult and resource intensive. Most research on health promotion strategies for healthy eating evaluates interventions implemented by researchers, and not public- or private- sector awareness campaigns. The available evidence indicates that campaigns sponsored by governments or non-governmental organizations (NGOs) that promote fruit and vegetable consumption have small, non-significant effects in increasing healthy eating (7), although one review concluded that sustained, focused media and education campaigns using multiple channels are 'likely' to be effective (8). A World Health Organization (WHO) report indicated that within the realm of all food promotion efforts directed at children and youth (not just health promotion campaigns), healthy eating campaigns constitute a very small percentage of the total. Rather, the vast majority of food promotion campaigns are advertising paid for by private interest food producers that endorse foods that are energy dense, high in fat, sugar and/or salt, and are "in sharp contrast to national and international dietary guidelines" (9). In other words, the vast majority of food 'promotion' is undertaken to sell junk food, not fruits and vegetables.

The area of research that most closely aligns with evaluation of healthy eating awareness campaigns is school-based studies that compare nutrition education to other types of healthy eating promotion interventions. Nutrition education interventions for very young children were found to increase knowledge about, but not consumption of, fruits and vegetables (10,11). A systematic review of 29 studies including grey literature found "limited evidence" that education alone can improve dietary intake in school-aged children (12). One

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<sup>4</sup> Both measures are based on the difference of the means divided by the standard deviation of the pooled data. Both are positively biased, i.e., they tend to overestimate effectiveness. However, the bias is negligible for medium and large sample sizes. Hedge's *g* includes a correction factor for small sample sizes that are more likely to bias Cohen's *d* (5).

meta-review of three systematic reviews found limited evidence that workplace nutrition education programs influence employees' dietary behavior (13). The Food and Agriculture Organization (FAO) commissioned a comprehensive meta-review and reported that nutrition education has limited effectiveness when used alone, is less effective than other types of interventions, and is most effective when integrated into a multi-component intervention (7).

## Multi-component Interventions

Within healthy eating research, the evidence for multi-component interventions that combine several strategies is relatively positive. Van Cauwengerghé and colleagues (2010) found "strong evidence" that multi-component interventions combining increased availability of fruit and vegetables, school-based nutrition education and parental involvement can increase fruit and vegetable intake (12). A review of 15 primary studies concluded that multi-component interventions "could be considered effective" in improving healthy eating among children and youth (14). Another review of 17 studies found multi-component school-based interventions to be the most effective among all interventions for children and youth investigated.

Several reviews quantified the magnitude of the effect. For example, one study estimated that a multi-component intervention including curriculum components, school meal modification, marketing, as well as parental and community activities, increased fruit and vegetable intake by 0.2 to 1.68 portions per day<sup>5</sup>. The most effective multi-component intervention, which incorporated among other components, peer-modeling and increased distribution of foods increased fruit and vegetable intake by 2.18 to 2.54 portions per day during the intervention (15). A meta-review of 30 systematic reviews by Greaves and colleagues (2011) using study designs the authors claim can determine causality (as opposed to correlation) found that intervention effectiveness was increased by combining multiple components, in particular social support, targeting both physical activity and healthy eating simultaneously, and integrating established behavior change techniques, such as teaching self-monitoring and relapse prevention methods (16).

The evidence for multi-component interventions to promote healthy eating is compelling. However, multi-component interventions often incorporate a diverse range of individual interventions such as nutrition education, access to fruits and vegetables, training in cooking skills and food handling, teaching behavior change techniques, financial incentives, social support and individual assessment and feedback mechanisms. In other words, the category of "multi-component intervention" includes a high level of variability in the mix of the constituent components, with some combinations being more effective than others. Accordingly, one systematic review based on seven randomized controlled trials (RCTs)

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<sup>5</sup> A single portion size is 125mL of solid food, approximately the amount of a medium-sized apple or one large carrot.



could not find any evidence for the effectiveness of multi-component interventions in general in primary schools (17).

Overall, the literature suggests that efforts to change eating behavior are more likely to be effective if multiple levers for change are engaged at the same time. Although not conclusive, this observation does have the benefit of addressing the original issue that motivated this study. Awareness campaigns deployed in isolation are thought to have, at best, a negligible effect in changing eating habits. However, the effect of awareness campaigns may be enhanced if they are integrated within a multi-component intervention. A follow-up question for health promotion practitioner and decision makers concerns how to design multi-component interventions for maximum impact and cost-effectiveness. Multi-component interventions may include different intervention design strategies, knowledge or skill transfer modules, and implementation methods, as well as different techniques to change behavior, modes of messaging, financial incentives, environmental changes, theories and settings for delivery. The research we have reviewed can provide some guidance to policy makers for making these design choices.

Several intervention design features have been shown to increase the effectiveness of interventions almost universally. These include increased frequency of exposure to the intervention, increased length of time of the intervention, and implementation of distinct change and maintenance phases (16). These findings are not unique to healthy eating interventions and have been found in a wide range of health promotion areas. More specifically, the effectiveness of health promotion efforts may depend on dose of exposure which is influenced by the frequency and length of the intervention. The need for a distinct maintenance phase reflects that improving eating habits is a multi-phase process that requires an ongoing intervention or boosters to sustain effects (18).

## Behavior Change Techniques

The most consistent finding in the evidence for health promotion strategies to improve healthy eating is that behavioral change techniques are generally effective. In RCTs, consistent and significant improvements are detected in groups exposed to behavioral change techniques as compared both to control groups with no intervention and to groups exposed to environmental<sup>6</sup> or policy interventions (15,16,19,20).

In their 2010 meta-analysis of 30 systematic reviews, Greaves and colleagues found that the effect of healthy eating interventions increased if they augmented contact frequency with the intervention and used “a specific cluster of ‘self-regulatory’ behavior change techniques (e.g. goal-setting, self-monitoring)”. These techniques assist participants in establishing realistic objectives that, when met, increase their sense of self-efficacy and confidence to continue improving their eating habits. The techniques teach self-monitoring skills which are

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<sup>6</sup> Environmental interventions change the availability of foods by increasing exposure and access to healthy foods and diminishing or eliminating the availability of unhealthy foods.

crucial to supporting new eating habits, and perhaps more importantly, to protecting against recidivism. The meta-analysis found positive changes at both the 6 and 19-month follow-ups in three medium- to low-quality reviews (16). These findings have been replicated in several reviews, stressing the need for goal setting and self-monitoring, sometimes in combination with other behavioral change techniques such as motivational strategies, self-assessments and feedback (15).

### Interventions Using Messaging

A quite different approach to changing eating behaviors is to induce change through messaging. Messaging communications by definition do not include face-to-face encounters, but may include counseling, automated generic messages or tailored messages delivered via print mail, telephone, email or cell phone text messages. The appeal of these health promotion strategies lies in their relative cost-effectiveness and their capacity to reach a broad audience (in settings where appropriate communication infrastructure exists).

Goode and colleagues (2012) reviewed nine interventions that used telephone messaging in at least half of the contacts with participants. They found small but consistent effect sizes that appeared to be dose-dependent “up to a point” (21). Six of ten studies found evidence for behavior change during the intervention, while three of ten reported maintenance of those changes at follow up in at least 50% of the study participants. The authors concluded that the issue of effectiveness rests more on the integration of these interventions into healthcare and population health delivery systems than on the method itself (21).

Broekhuizen and colleagues (2012) updated a 2006 review of computer-tailored dietary interventions that included promoting healthy foods and discouraging unhealthy eating. These interventions are described as mimicking interpersonal counseling through a computerized system that can incorporate “individualized feedback and advice on personal behavior, personal motivation, outcome expectations, self-efficacy, social and physical environmental opportunities, and other behavioral determinants” (22). Their review combined the findings from 26 studies published prior to 2004 and 34 studies published after. The overall results indicated small but consistent effect sizes at short-and medium-term follow-up compared to generic information or no information.

Krebs and colleagues (2010) studied a range of health promotion interventions including healthy eating (i.e., 25 studies on increasing fruit and vegetable consumption; 26 studies on reducing dietary fat intake). Their focus was on computer-based interventions that included ‘dynamic tailoring’. Unlike ‘static tailoring’ that is based on one initial assessment of the participant, dynamic tailoring is responsive to feedback from the participant throughout the intervention and continuously adjusts the messaging strategies and content. Dynamic tailoring interventions for both types of studies showed small but significant effects compared to generic tailoring ( $g=0.22$  for reduced fat intake,  $g=0.16$  for increasing fruit and vegetable consumption). Their findings indicated that there were no differences in

effectiveness according to the mode of delivery of messages (i.e., print, computer or automated phone).

## Interventions Using Financial Incentives

Another strategy to improve healthy eating is to use financial incentives to induce consumers to change their spending habits and thus their eating patterns. Interventions that are based on financial incentives generally fall into two categories: taxing unhealthy foods and subsidizing healthy foods. Most, but not all, of the available evidence is based on simulations of consumer behavior and not actual trials.

Eyles and colleagues (2012) reviewed 30 simulation studies of the effects of taxes, subsidies or combinations of both on diet. Based on their meta-analysis, they estimated that a 10% increase in the price of carbonated beverages would decrease consumption by 0.6% to 24.3%, while a 10% subsidy could increase fruit and vegetable consumption by 2.1% to 7.7% (23).

Thow and colleagues (2014) reviewed 38 studies published between 2009 and 2012. Two of the included studies were RCTs, which showed that price changes in the store itself (in the form of subsidies for healthy foods) and up-stream in the form of taxes on unhealthy foods were effective. The results from the remaining 36 simulation studies found that taxes were most effective if the foods had readily available substitutes. The authors concluded that a combination of taxes and subsidies is likely to be effective (24). However, a review including two RCTs that evaluated subsidized or free fruits and vegetables did not find a similar effect (17).

## Interventions Designed for Specific Settings

A body of research-based evidence focuses on the promotion of healthy eating in specific settings, mainly school settings targeting children and youth and work settings targeting adults.

### School Settings

It should be noted at the outset that the evidence on interventions to promote healthy eating that are delivered in schools is based primarily on researcher-led interventions rather than on programs initiated by government or the private sector (7). This evidence, mainly from Europe and North America, has been subject to numerous systematic reviews comparing the effectiveness of education-only interventions with other types of interventions, the results of which have been discussed above in the section on awareness campaigns.

A review by Knai and colleagues (2006) found that interventions that focused on fruit and vegetable consumption and involved parents were effective for children aged one year and

older. Van Cauwengergh and colleagues (2010) published similar findings for young children, showing that multi-component interventions that combined increased availability of fruit and vegetables, nutrition education and parental involvement increased fruit and vegetable consumption. The authors concluded that this showed “strong evidence” of effectiveness (10). However, a Cochrane review of similar studies (with an age cut-off of 5 years) found mixed or no effects (11). A review of 27 studies on interventions delivered in primary schools (age 6 to 12 years) reported improvement of 0.24 servings of fruit (0.05-0.43) and 0.07 servings of vegetables (0.03-0.16) for multi-component interventions (25). The authors acknowledged a potential publication bias but noted that their findings were consistent with past research.

One meta-review of 42 review papers studied combined health promotion programs for youth that addressed substance abuse, sexual behavior and nutrition (26). The authors reported that interventions that used theory in the design of interventions, addressed social influences (particularly social norms), included cognitive-behavioral skills and used trained facilitators could be effective in improving healthy eating.

### Work Settings

Evaluations of worksite interventions to promote healthy eating among adults suggest small but consistent effects. A meta-review of three systematic reviews concluded that employees’ dietary behavior could be influenced most effectively by multi-component interventions that included nutritional education and increased availability of fruits and vegetables (27). A systematic review based on 29 studies found that improving healthy eating was possible, although effect sizes were small, through interventions based on theoretical frameworks that combined social influence with nutrition education (13).

### Low Income Settings

Since socio-economic status is strongly related to overweight and obesity, there have been attempts to develop healthy eating promotion programs targeted specifically to populations with low incomes. One systematic review of 13 studies found that the evidence for interventions designed for such settings was inconclusive (28).

### Theory-Based Interventions

The literature on health promotion, in general, includes a hard-to-define category of systematic reviews that assess the contributions that specific theoretical models or frameworks make to a range of behavior change outcomes. This is problematic, since, to some degree virtually all health promotion interventions involve a theoretical basis. This is particularly the case for those interventions discussed above in the sections on behavioral change techniques and financial incentives which are explicitly predicated on scientific theories. Nonetheless, some reviewers have investigated whether specific theoretical models are more effective than others or than ‘no model’, while others have focused on

whether an intervention's fidelity to a theoretical model improves its effectiveness. The evidence from reviews that focus on self-identified theory-based interventions is mixed.

We noted in our search results a body of research published before or at the beginning of our time window focused on the trans-theoretical model of behavior change. This well-known model posits six stages of change that are instrumental in achieving a change in behaviors such as quitting smoking or changing diet. In a systematic review by Bridle et al. (2005), the authors synthesized the evidence from 37 RCTs testing the trans-theoretical model, five of which dealt with changing eating behaviors (18). They concluded that the evidence is mixed that there was no improvement in eating habits associated to the "better methodological studies", i.e., those interventions that were the most rigorous in adhering to the model.

Cerin and colleagues (2009) studied the 'mediating variable model'<sup>7</sup> among youth, including attitudes, norms, perceived benefits and barriers, and self-efficacy, and found very small to no impact at follow up (29).

Cushing and colleagues (2014) studied interventions based on an 'ecological framework' which posits synergistic effects created by targeting youth at different ecological levels ranging from individual to family, school and community. They found a small but significant impact of "leveraging multiple ecological systems to help children and adolescents self-regulate their own behavior" ( $g=0.71$ , 0.36-1.01). These effects were significant at the one-year follow up, and the authors calculated that 30,816 null studies would be needed to nullify the findings (30).

Two reviews focused on interventions that were based on environmental theories of eating behavior which hypothesized that the food environment, e.g., portion size, access, etc., can be a determining factor in eating habits. Driessen and colleagues (2014) reviewed 18 studies and concluded that there was some evidence for small positive effects, but that the quality of the evidence was low (31). Ganann and colleagues reviewed 23 studies in mixed populations with a focus on children in school. They found that local school food policies appeared to be the most 'promising' in changing eating behavior, but noted that the studies had a high risk of bias (32).

## Potentially Relevant Contextual Issues

The reviewed evidence suggests several potentially relevant contextual issues for health promotion strategies for healthy eating in Newfoundland and Labrador. One potentially key contextual variable for this province is the availability and affordability of fruits and

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<sup>7</sup> A mediating variable is one that plays a direct role in the pathway from the intervention to an outcome. It causes variation in the outcome and is itself caused to vary by the intervention.

vegetables. The evidence tends to indicate that increased exposure and access to fruits and vegetables are effective components of multi-component strategies. However, in this province, many types of store-bought produce are imported and thus more expensive and harder to find outside large population centers. Interventions that promote consumption of local and/or indigenous fruit and vegetables (i.e., from community or school gardens, incentives for indigenous fruit harvesting) may be more effective at increasing availability and affordability in rural and remote areas than interventions promoting produce that is imported and available mainly from larger retailers.

Another potentially key contextual variable is the distribution of the population over a vast geographical area. Interventions that rely on face-to-face interactions are less feasible in settings with low population densities. School and workplace settings may offer some of the best opportunities for promoting healthy eating, as they concentrate an area's population. Messaging-based interventions may also be effective in this province, since the communications infrastructure is well developed in most parts, and the population has high adoption rates of telephone, cell phone and internet technologies.

A final contextual issue concerns policy options and financial incentives. The province already has several subsidies for healthy foods, e.g., for local milk and egg production, and some policies to restrict unhealthy foods, e.g., healthy food guidelines for schools and recreation venues. This means that the principle of policies and financial incentives aimed at healthy eating has been accepted at the policy and perhaps the population levels to some degree. Developing such policies further, for example by subsidizing fruit and vegetable importation and/or by taxing unhealthy food imports, may be more acceptable to the population of Newfoundland and Labrador than is generally the case among populations where the reviewed research was carried out.

## Summary of Key Points

Public awareness campaigns, used on their own, to promote healthy eating are not supported as effective by the available research evidence. Public awareness campaigns may provide benefits, but only if they are part of a multi-dimensional health promotion initiative.

School-based, work-based and messaging-based interventions have the benefit of economies of scale, but have demonstrated only small effect sizes to date. So-called 'theory-based' interventions to promote healthy eating have not demonstrated consistent or significant effect sizes.

The evidence does support multi-component interventions that focus on eating behavior, address multiple ecological levels (e.g., at the individual, group and community level) and include some form of behavior change technique. That being said, even the most effective interventions show only small increases in fruit and vegetable consumption.

The research evidence on improving dietary habits is, overall, consistent: health promotion efforts are most effective when they incorporate multiple mechanisms and levels of engagement as well as structured behavior change and management techniques. However, the effects overall are modest and sustained support is needed for long-term benefit. Because eating is a complex behavior, simple or single dimension health promotion strategies are unlikely to be effective in creating or sustaining change.

## Articles Included in the Review

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# Appendix

## About Our Consultant

Dr. Jennifer O'Loughlin is a Professor at the Centre de recherche CHUM and in the Department of Social and Preventive Medicine at the University of Montreal. She is a Canada Research Chair in the Early Determinants of Adult Chronic Disease and she is also a consultant to the Tobacco Control Research Team at the Institut national de sante publique du Quebec. She heads a CTCRI-funded Interdisciplinary Capacity Enhancement (ICE) Team "Strengthening the links between research, practice, and public policy to reduce the burden of tobacco", which includes 17 investigators with expertise in tobacco control research spanning genetics to public policy. Areas of research expertise include population-based longitudinal cohort studies in youth, studies on the acquisition of tobacco use in children and adolescents, school-based research, analysis of longitudinal data, validation of methods to measure smoking, diet, insulin resistance, obesity and physical activity in youth, and evaluation of public health interventions and policy.

(Source: <http://ndit.crchum.qc.ca/main.php?p=2>)