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Nutrition and Schools Knowledge Summary
Nutrition et sommaire des connaissance scolaires

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Article abstract

This review examined 117 research articles using a policy framework generated in previous research. Findings include: students are experiencing both food insecurity and an "epidemic of obesity"; policymakers remain focused on achievement; provinces address nutrition in isolation; poverty is a significant contributor; restriction of food is not an effective treatment; nurses and training may strengthen health literacy; costs offer barriers to implementation and sustainability; teacher training, funding, nutritious foods, and health professionals are important; the impact of "one-off" programs is small; and there is limited implementation and evaluation of comprehensive approaches to school health.

NUTRITION AND SCHOOLS KNOWLEDGE SUMMARY

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ABSTRACT. This review examined 117 research articles using a policy framework generated in previous research. Findings include: students are experiencing both food insecurity and an "epidemic of obesity"; policymakers remain focused on achievement; provinces address nutrition in isolation; poverty is a significant contributor; restriction of food is not an effective treatment; nurses and training may strengthen health literacy; costs offer barriers to implementation and sustainability; teacher training, funding, nutritious foods, and health professionals are important; the impact of "one-off" programs is small; and there is limited implementation and evaluation of comprehensive approaches to school health.

NUTRITION ET SOMMAIRE DES CONNAISSANCE SCOLAIRES

RÉSUMÉ. Cette revue de la littérature fait l'examen de 117 articles de recherche utilisant un canevas de politiques créé lors de recherches précédentes. On retrouve parmi les découvertes que les étudiants vivent à la fois une insécurité alimentaire et une épidémie de l'obésité. On découvre aussi que les responsables d'élaborer les politiques ciblent encore les réalisations et que les provinces traitent la nutrition de manière isolée. Il est aussi révélé que la pauvreté est un facteur signifiant et que la restriction alimentaire n'est pas une solution efficace. Il ressort par ailleurs que le travail des infirmières et un enseignement peuvent améliorer les connaissances en santé de la population visée. L'article explique également que les coûts érigent une barrière à la mise sur pied et à la survie des programmes et que la formation des enseignants, le financement, l'exposition à des aliments nutritifs et à des professionnels de la santé est importante. Finalement, on y apprend que l'impact des programmes non répétés est marginal et que peu d'écoles procèdent à la mise sur pied et à l'évaluation d'approches globales en santé.

INTRODUCTION

Recent reports suggest that Canadian children – like children across North America – are experiencing an epidemic of overweight and obesity. Because children spend a large amount of their waking hours in school, and may

consume up to two meals (plus snacks) while at school, researchers and policy-makers have begun to look closely at school nutrition policy as an important foci for intervention. While the recent high-profile nature of obesity reports have brought this issue to national prominence, it is important to inform these discussions with a solid research base that covers not only nutrition but the place nutrition policy has in the broader school health context. This review of research was conducted to support an evidence-based dialogue around school nutrition status, policy, and interventions.

METHODOLOGY

This paper is organized around an expanded ten-question framework for review similar to work previously completed by the School Health Research Network (Doherty, M., & McCall, undated). The ten questions are:

1. What is the current health status of Canadians regarding nutrition, and what are the information and research needs with regard to nutrition and schools?
2. What are the connections between nutrition, health status, and learning?
3. How does the social and physical environment of the school affect nutrition?
4. What approaches to promotion, prevention, preventive services, and rehabilitation are most effective in addressing these nutritional issues?
5. What are the realistic and sustainable health and learning outputs that are achievable through school-based and school-linked interventions?
6. Which interventions are effective, cost-effective, and cost-beneficial?
7. How can multiple school-agency-home interventions be coordinated?
8. How can the capacity of professionals, local agencies, and systems be strengthened to deal with these nutritional issues in a sustainable and realistic manner?
9. What are the Canadian and other culturally relevant examples of policies, programs, and training models that might best fit the current research evidence?
10. What considerations would support changes in policies, programs, and practices that can be made based on rigorous evidence?

Once the general research framework was established, a systematic review of research articles, governmental documents, and professional publications was begun. A search of 147 on-line article databases resulted in 10,180 articles containing the key words "school" and "nutrition." The search was next refined

to focus on the five databases that returned more than 100 article references, accounting for 99% of the initially identified articles. These databases were each searched for the combined keyword "school nutrition," resulting in 8,470 articles, which were narrowed to 3,152 articles across three databases after adding the keyword "research." Because this review was focused on nutrition within a broad educational framework, "school health," was added to the search, resulting in a final body of 2,256 articles. Each of these databases was then individually searched using the specified keywords but limiting articles to those submitted to peer review processes resulting in 257 articles. After eliminating duplicate articles, the final data set was 122 peer-reviewed and research-based articles.

In addition to peer-reviewed research, the web sites of governmental bodies and professional organizations were searched for resources, resulting in the addition of another 74 relevant documents. After all sources were added to the database, feedback was sought from an informal survey of Canadian education and nutrition researchers, who recommended another 58 articles and resources. After eliminating duplicate entries, the final body of research examined for this review was 213 research articles, government publications, and professional resources.

Each article or resource was then reviewed individually, and 117 articles judged to be relevant for this review were entered into a database organized around the ten-question analysis framework. When articles included findings relevant to more than one of the strands, they were entered into each strand.

FINDINGS

Current health status

There is a wide variety of research examining the link between childhood nutrition, schools, learning, and health across local, regional, national, and international contexts. Recent research has focused in particular on the relationships among nutrition policy, schools, and childhood obesity. In general, there is agreement across studies that overweight and obesity is a significant problem that may be considered an epidemic in North America and a serious health concern globally. There is also evidence that the rate of overweight and obesity has been increasing over the past decade, particularly for low SES children (Romon, Duhamel, Collinet, & Weill, 2005; O'Loughlin, Paradis, Meshefedjian, & Gray-Donald, 2000). Studies estimating the overweight prevalence identify a range of from 20% - 33% and an obesity rate between 8% and 10% (Lewis, Meyer, Lehman, Trowbridge, Bason, Yurman, & Zenong, 2006; Shields, 2005; Veugelers, & Fitzgerald, 2005a); however, the risk of overweight varies considerably based on geographic location and economic status. Canadians in high poverty areas are at significantly greater risk of obesity

than Canadians at other SES levels (Raine, 2004; O'Loughlin, et al., 2000), even as research suggests that they may also be at risk of malnourishment and inadequate access to nutritious foods (Center on Hunger and Poverty & Food Research and Action Center, 2003; Kirkpatrick & Tarasuk, 2003). In fact, research looking at the food habits of Canadians has found that students are likely to consume high-energy foods of low nutrient value (Phillips, Jacobs, & Gray-Donald, 2004), skip breakfast (Cohen, Evers, Manske, Bercovitz, & Edward, 2003), and generally fail to consume enough fruits, vegetables, and milk products (Fitzpatrick, 2006).

Schools are identified as an important venue for intervention, although access to current data varies considerably across contexts, and much of the available research focuses on schools in other countries with established monitoring systems. In general, students have broad access to low nutrient snack foods, energy-dense foods, and sugar-rich beverages, more so than they do fruits and vegetables (Parsad & Lewis, 2006; Kann, Grunbaum, McKenna, Wechsler, & Galuska, 2005; Sanigorski, Bell, Kremer, & Swinburn, 2005; Bell & Swinburn, 2004). This is particularly true for students in alternative schools (Kubik, Lytle, & Fulkerson, 2004). Many students do not eat breakfast regularly (O'Dea, & Abraham, 2001), which can negatively affect school success (Kleinman, Hall, Green, Korzec-Ramirez, Patton, Pagano, & Murphy, 2002). Despite a strong body of research supporting school breakfast programs – particularly for low SES students – implementation has been sporadic and seldom fully supported by provincial governments (Breakfast for Learning, 2006).

Food availability at home and in school plays a key role in eating habits. Food insecurity (uncertain access to nutritious food and beverages) in particular is an important issue in Canada, most notably for low SES populations (Broughton, Janssen, Hertzman, Innis, & Frankish, 2006; Centre on Hunger and Poverty & Food Research and Action Center, 2003). Access to energy rich but nutrient poor food combined with limited access to nutrient rich food has resulted in undernourished, but not necessarily underweight students in low SES areas (Centre on Hunger & Poverty, undated), illustrating the complexity of food and nutrition issues.

In addition to a focus on nutrition, researchers also emphasize the connections among food and beverage intake, physical activity, and mental health when examining overweight and obesity issues (Kumanyika, Jeffery, Morabia, Ritenbaugh, & Antipastis, 2002; Health Evidence Network, 2005). The shift in focus in many school systems to academic improvement has proven a distracter (Brown, Akintobi, Pitt, McDermott, Berends, Agron, & Purcell, 2004; Hyunyi & Nadow, 2004), and many systems have responded by replacing recess and physical activity opportunities with academic enrichment programs (Laitsch, 2006), despite research suggesting that students need at least 90 minutes of moderate to vigorous physical activity each day (Andersen, Harro, Sardinha, Froberg, Ekelund, Brage, & Anderssen, 2006).

Despite recent improvements in health data gathering and reporting (Glouberman & Millar, 2003), there are still serious gaps in Canada, particularly with regard to children and youth (Power, 2005; Raine, 2004; Taylor, Evers, & McKenna, 2005), as well as for Aboriginal and low SES populations (Willows, 2005). The lack of information related to the environmental determinants of health status and physical activity, as well as little national planning, greatly complicates policy responses, as well as the monitoring and evaluation of interventions and surveillance of basic trends.

Political and policy indicators and interventions

School health policy has had difficulty rising to the political and policy agenda because of its placement between the fields of education and public health (Laitsch, Vamos, & McCall, 2006). The result has been that school health issues, such as nutrition, are embraced as secondary issues within each professional body. Recently, however, policy attention has been focused on the issues of nutrition and physical activity because of growing public health concerns related to obesity. Although an over-emphasis on issues of overweight and obesity risks obscuring other important issues related to school health and nutrition, the estimated long-term costs associated with overweight and obesity have opened a policy window that could result in significant political intervention and resource allocation. Overweight and obesity is associated with increased risk for chronic diseases (such as heart disease, type 2 diabetes, hypertension, stroke and cancer), and societal costs associated with absence from work and use of health services, as well as the personal costs of psychosocial problems – including clinical depression, lowered self-esteem, discrimination, and social stigmatization. One conservative estimate of the cost of obesity to the Canadian health care system put the annual cost at $1.8 billion in 1997 – more than 2% of all health care expenditures (Kumanyika, et al., 2002).

Within the context of overweight and obesity dialogues, many national, governmental, and international organizations have made nutrition, physical activity, and health interventions important parts of their institutional priority. In 2004, the members of World Health Organization (WHO) adopted a resolution to encourage mobilization of all concerned social and economic groups, including scientific, professional, nongovernmental, voluntary, private-sector, civil society, and industry associations, and to engage them actively and appropriately in implementing the [Global Strategy on Diet, Physical Activity and Health]" (WHO, 2004). The Global Strategy has a strong emphasis on the role of schools in this effort, with a particular focus on nutrition and physical activity education, as well as media literacy training. The WHO specifically states:

> [Schools] should protect [student] health by providing health information, improving health literacy, and promoting healthy diets, physical activity, and other healthy behaviours. Schools are encouraged to provide students with

> daily physical education and should be equipped with appropriate facilities and equipment. Governments are encouraged to adopt policies that support healthy diets at school and limit the availability of products high in salt, sugar and fats. Schools should consider, together with parents and responsible authorities, issuing contracts for school lunches to local food growers in order to ensure a local market for healthy foods. (p. 49)

National and governmental bodies in North America have also begun to focus on schools and nutrition, physical activity, and weight policy, and both countries have regularly updated national food guides (Minister of Public Works and Government Services Canada, 1997; United States Department of Health and Human Services and the Department of Agriculture, 2005). The American Dietetic Association (ADA), Society for Nutrition Education (SNE), and American School Food Service Association (ASFSA) have jointly released a call for comprehensive nutrition services in schools – preschool through grade 12 – supported by sequential nutrition education programs, student nutrition programs, school environments that model healthy food and beverage choices, and the building of community partnerships (ADA, SNE, ASFSA, 2003). The European Childhood Obesity Group has highlighted six areas for policy intervention (family – child, parents, siblings, etc; schools; health professionals; governments; industry; and media) and called for an emphasis on evidence-based health promotion programs (Flodmark, Lissau, Moreno, Pietrobelli & Widhalm, 2004).

In the United States, the Centers for Disease Control has identified reduction in overweight and obesity as a public health priority (CDC, 2005) and published school nutrition and healthy eating policy guidelines (CDC, 1996). These guidelines focus on curricula, instruction, integration of food services and nutrition education, faculty and staff training, and family and community involvement. Australia's National Public Health Partnership has released similar guidance highlighting health gain through better nutrition and by addressing barriers to safe and healthy food; building capacity through a focus on human capacity, research, and intervention effectiveness; improving public communication and strategic management; development of nutrition policy; and monitoring of progress (National Public Health Partnership, 2001). In Canada, at least two provinces (British Columbia and Ontario) have documents providing schools with nutrition guidelines (BC Ministry of Education and Health, 2005; Ontario Ministry of Children and Youth Services, 2005).

In Canada, more than 30 national organizations signed on to the recently revised Canadian Consensus Statement on Comprehensive School Health, which highlights the importance of "food and nutrition policies that promote healthy eating including access to healthy foods as well as safe and supportive eating environments" (Canadian Association for School Health, 2007). The Dieticians of Canada also works at the national level to promote school nutrition activities and Health Canada has worked with a variety of educational

organizations interested in nutrition issues. Despite these efforts, however, school nutrition policy lacks a strong national framework, particularly with regard to school meals (Breakfast for Learning, 2006). Rather, much more policy work is accomplished at the provincial levels and on an *ad hoc* basis (Henry, Allison, & Garcia, 2003).

While this may be the result of political realities within Canada, it also results in a somewhat fragmented approach to policymaking and data collection, often resulting in each province reinventing unique policy and monitoring systems. The local approach may be changing, however; in early 2007, Olivia Chow, the NDP children's advocate, put forth a proposal for the Children's Health and Nutrition Initiative (CIHI) which would establish a Federally-funded program that would ensure "a nutritious breakfast, snack or lunch to be available to any Canadian child under eighteen years of age" (Chow, 2007). The initiative is supported by Chow and three national groups: Breakfast for Learning (BFL), Foodshare, and the Center for Science in the Public Interest. Breakfast for Learning, established in 1992, has an extensive community network that helps provide breakfasts, lunches, and snacks to children across Canada. BFL is also active in nutrition research dissemination. Foodshare is a Toronto-based organization founded in 1985 that works to address hunger issues through individual and community based capacity building. The Center for Science in the Public Interest has been active in advocating for improved school nutrition programs – particularly in the United States – and works to promote nutrition reforms through public reporting, data and research dissemination, and distribution of model legislation (CSPI, 2006).

Food security – reliable access to nutritious foods – is an important policy concern in North America, and professional groups in both Canada and the United States have focused on strengthening the food safety net, particularly for at-risk populations and children. As with the broader trend in nutrition research, recommendations related to food security also emphasize a comprehensive approach to intervention (ADA, 2003; Dieticians of Canada, 2005a).

Nutrition, health status, and learning

The relationship between nutrition, health, and learning is complex, but well established. Research has found that generally poor nutrition can negatively affect cognitive ability, concentration, and activity levels in the short term (Sorhaindo & Feinstein, 2006), and has been associated with poor academic performance and behaviour issues in the longer term (Alaimo, Olson, & Frongillo, 2001). These findings hold even after controlling for poverty and other indicators associated with poor nutrition. Research into specific nutritional deficiencies has been less conclusive, finding that while dietary supplements may benefit children with iron deficiency, population-wide vitamin or mineral supplements have no impact on academic performance (Taras, 2005).

School meal programs, which are discussed in more detail later in the paper, do seem to have a consistent and positive impact on student behaviour and academic performance (Taras, 2005; Cohen, et al., 2003; Wesnes, Pincock, Richardson, Helm, & Hails, 2003; Kleinman, et. al., 2002; Wahlstrom & Begalle, 1999; and Murphy, Pagano, Nachmani, Sperling, Kane, & Kleinman, 1998). Much of the research suggests that these programs are particularly successful because the provision of food increases attendance and reduces negative behaviours in food insecure populations, which then results in concomitant academic benefits. However, one study that compared students in schools with breakfast programs to similar schools with comparable breakfast consumption rates found no difference in achievement (Bernstein, McLaughlin, Crepinsek, Daft, & Murphy, 2002).

Addressing issues of poor nutrition and food insecurity through school meal programs may have positive academic and behavioural outcomes; however, obesity may also affect academic performance. A recent review of multiple studies looking at obesity and academic performance concluded that obesity and overweight are associated with lower levels of achievement, although links to attendance (for example health related absences) are less clear (Taras & Potts-Datema, 2005).

Social and physical environments

While nutritional issues may affect learning through interactions with mal- or under-nourishment, food security, and obesity, the factors that influence student food and beverage choices, and the environments in which those choices are made, are an important component of school nutrition programs and policies. Researchers have identified four major determinants of eating behaviours: family and peers; physical environments and access; economic and marketing environments; and social status and environments (Raine, 2005).

While researchers have linked the current increase in obesity to specific food and beverage consumption, particularly as relates to soft drinks and fast foods (Ludwig, Peterson, & Gortmaker, 2001; St-Onge, Keller, & Heymsfield, 2003), researchers have also identified a trend in increasingly poor beverage intake as children age (Striegel-Moore, Thompson, Affenito, Frank, Obarzanek, Barton, et al., 2006). Policy programs and incentives designed to address the factors driving those consumption patterns frequently lack the support and authority needed to drive change (McGinnis, Gootman, & Kraak, 2006; Pateman, McKinney, Kann, Small, Warren, & Collins, 1995).

The role of family and peers in the dietary choices and health outcomes of students is significant. Research has found that while parents are concerned about diet and weight, there is a significant gap between parent perception of the weight and exercise pattern of their children, and the reality. While as many as 27% of students may be overweight, and half may get insufficient

exercise, Canadian parents believe that only 12% are overweight and 92% get enough exercise (Dieticians of Canada & Kraft Canada, 2005).

Family access to food is also important in influencing the choices their children make. Families with low incomes can find it difficult to purchase healthy foods. Where a family of four with one average income would spend about 29% of their monthly income on food, the same family on welfare would be spending 41% on food. When additional fiscal burden of housing is added to the estimate, families in poverty face significantly less flexibility accessing healthy foods (Dieticians of Canada, 2005a; 2005b). Low-income neighbourhoods are also less likely to have stores with adequate food selection, and families with access to fewer appliances, or poor cooking skills are more likely to experience food insecurity (Broughton, et al., 2006).

On the other hand, children who help prepare meals and who frequently eat meals with their families are more likely to eat healthy foods (Fulkerson, Neumark-Sztainer, & Story, 2006; Larson, Story, Eisenberg, & Neumark-Sztainer, 2006). Some parental behaviour, however, has been linked to poor eating habits, particularly when parents use coercive feeding practices, restriction, or pressure (Birch, 2000). In families where meals are eaten in front of the TV, children are more likely to eat less nutritious foods (Con, Goldberg, Rogers, & Tucker, 2001), and children who watch television are more likely to have greater intake of high energy sweet and salty foods and beverages, and less intake of fruit and vegetables (Marquis, Filion, & Dagenais, 2005; Coon & Tucker, 2002; Coon, Goldberg, Rogers, & Tucker 2001).

When researchers asked children about their soft drink consumption patterns and preferences, they found taste preferences, the soft drink consumption habits of parents and friends, soft drink availability, and television viewing were the strongest predictors of consumption (Grimm, Harnack, & Story, 2004). Researchers suggest that eating and drinking associated with TV viewing may be due to advertising exposure and the habit of consuming foods and beverages while watching TV and have recommended shifting advertising to more healthy choices (Flodmark, et al., 2004). Researchers have also expressed concern about the recent blending of TV advertising, fast food toys, and now food related Internet games for children (Henry J. Kaiser Family Foundation, 2006).

Schools are an important point of intervention for supporting healthy nutritional practice, and research has found that many schools frequently support unhealthy practices related to increasing body mass, including frequent snacking, consumption of high calorie and low nutrient foods and beverages, the use of food as a reward or incentive, the use of unhealthy foods in fundraising, and provision of energy dense foods in vending machines (Kann, et al., 2005; Kubik, Lytle, & Story, 2005; Baxter, 1998). Access to food, eating environment, and exposure to marketing are also important aspects of consumption in schools. Research has found that when students are given access

to unhealthy food choices they will frequently choose those foods (Cullen & Zakeri, 2004). Students also tend to choose foods and beverages based on taste (Grimm, Harnack, & Story, 2004; Shannon, Story, Fulkerson, & French, 2002); however, such choice can be mitigated based on comparable price and nutritional labelling (French, 2005; Shannon, et al.). Some data suggests that the cafeteria environment can have an important impact on student choice to consume meals at school verses meals at nearby fast food providers (Dieticians of Canada, 2006). Many students are also subjected to extensive advertising and media messages in schools, particularly for soft drinks and foods of minimal nutritional value (Molnar, Garcia, Boninger, & Merill, 2006). While schools frequently sign agreements that result in income from vending sales, recent research suggests that soft drink contracts are less beneficial to schools than they initially appear and that more money leaves the community through such contracts than schools actually receive (Pinson, 2006). Largely due to increased public pressure, three major soft drink companies (Cadbury Schweppes PLC, Coca-Cola Co., PepsiCo Inc.) and the American Beverage Association recently signed an agreement to limit the amount of soda and other sugary beverages, such as fruit drinks, in school vending machines, although diet soft drinks may continue to be sold in high schools (Mayer, 2006). In Canada, some provinces have attempted to address concerns related to vending machine foods and beverages (BC Ministry of Education, 2005; Ontario Ministry of Education, 2004).

Promotion, prevention, preventative services, and rehabilitation

School-based programs provide a critical entry point for intervention to improve child and youth nutritional standards and health (WHO, 1998); however, because nutritional habits are largely established prior to entry into school, and closely related to parent and family characteristics, school-based interventions should be viewed within the broader family and community context. While research has found that programs frequently result in short term behavioural change or health improvements (see, *Policies, programs, and training models* below), there is currently not enough research available to determine the extent to which programs result in the longer-term prevention or reduction of overweight (CDC, 2005). Schools can engage in the delivery of nutrition services in a variety of ways, including educative services and curriculum delivery, delivery of preventative services, identification of students at risk for overweight and/or obesity, and through referral for further treatment.

Because students spend much of their time outside of school, school-based nutrition programs often focus on changing behaviour patterns so that children and youth can make healthy lifestyle choices related to food and beverage consumption and physical activity. Students with high dietary self-efficacy tend to make healthier food and beverage choices (Parcel & Edmundson, 1995) and research suggests that dietary self-efficacy can be strengthened through school-

based interventions (Auld, Romaniello, Heimendinger, Hambidge & Hambidge, 1999). Successful school-based programs have also focused on combining nutrition and physical activity, increasing physical activity and non-competitive sports, and helping students decrease sedentary behaviour, such as watching TV (CDC, 2005; Doak, Visscher, Renders & Seidell, 2006).

As highlighted previously, the school environment is an important component of nutrition programs and preventative services. School environmental characteristics that support students in making healthy choices include provision of healthy nutritional options, access to nutritional data through labelling, opportunities to choose and engage in physical activity, and pleasant eating environments. Collaborative agreements and activities with food and beverage companies, community leaders, nutrition educators, parents, and students can affect social change target toward healthy student outcomes (Marr, 2004).

Because policymakers have increasingly accepted the threat of obesity as a public health issue, schools have also been used as an intervention point for identification of children who are overweight or obese. In the United States, parents of children in Arkansas receive a regular report on the body mass index of their child. The report gives parents their child's body mass index – which is calculated based on a child's height, weight, age, and gender – and interprets the BMI to suggest whether the child is underweight, a healthy weight, at risk for overweight, or overweight. While offering basic suggestions related to healthy diet and nutrition, the report also refers parents to their family doctor for advice if the child may be overweight. In 2005, 15 other states considered legislation requiring measurement of student body mass index, although only Tennessee enacted legislation requiring that reports be sent home to parents. As of 2005, five states had adopted BMI-related laws (National Conference of State Legislatures, 2005). Such programs are not without controversy, both because of concerns that the use of such data could stigmatize students and because there is debate as to how accurate such calculations are for children. Politically, BMI programs are difficult to enact and sustain – the law in Arkansas has been regularly challenged legislatively and Governor Beebe recently expressed support for legislation amending or repealing the law (Moritz, 2007a).

While Canadian provinces have not embraced the use of BMI report cards, the Calgary Health Region recently announced a pilot project to work with Calgary school boards to measure and track the BMI of some grade 5 students beginning in the Fall of 2006 (Lang, 2006). Dietitians of Canada, Canadian Pediatric Society, the College of Family Physicians of Canada, and Community Health Nurses Association of Canada have approved the use of the CDC BMI chart as appropriate for Canadian children and defined overweight and obesity standards (DC, CPS, CFPC, & CHNAC, 2004).

Health and learning outcomes

Because of the complex nature of childhood nutrition and health, the extent to which specific changes in health-related outcomes can be attributed to school-based interventions is limited, particularly over the long term. Measurable change in school programs, staffing, curriculum, and student knowledge is possible, and basic student characteristics can be monitored and reported, but separate research and policymaking streams at the federal and provincial levels, as well as the separation between the fields of public health and education, has made systematic collection and analysis of national data difficult (Picard & Alphonso, 2007). Improved data collection processes could help define and measure current nutrition and other health outcomes.

Because there has been little investment in building the capacity of schools to engage in nutrition activities (and in some cases resources have been cut or reallocated to academic activities), strengthened monitoring and data collection related to current school-centered activities is important. In 2004, the Public Health Agency of Canada released the results of research looking at the effects of school experiences on the health outcomes of children, and made a variety of school centered and public policy recommendations that could be measured as outcome variables for efforts to address school nutrition and health-related issues. The Agency's findings and recommendations include:

> • Targeting female students to ... increase the amount of physical activities, have breakfast regularly, reduce feelings of helplessness, alleviate worries about body image, develop positive self-esteem and improve physical and mental health.
>
> • Influencing peer groups and creating positive peer environments since peer groups can significantly influence watching display screens (TVs, computers, etc.), physical activity, food intake and worrying about body image.
>
> • Work with school nurses and nutrition experts to develop healthy menus in school (including snacks).
>
> • Restore school health education curriculum to develop adequate health literacy among students.
>
> • Provide adequate training for school staff on health promotion and intervention.
>
> • Create (at least) mobile school nurses positions to provide guidance and assistance to school health promotion and intervention.
>
> • A school health strategy (with strong commitment of school staff) is needed to utilize school experiences (e.g. circles of friends, sense of belonging to school, extracurricular activities, and academic press) to influence health outcomes and behaviours.
>
> • Provide professional resources to assist parents and schools in their use of family and school experiences to influence health outcomes and behaviours of students. (Xin & Yanhong, 2004)

Program costs

While researchers and policymakers have identified significant long-term societal and health care costs associated with poor nutritional habits (Kumanyika, et al., 2002), little research has been done looking at the costs of systematic changes in or implementations of school-based nutrition programs. A recent review of thirty-two school-health promotion studies found that only 14.8% looked at issues of program adoption while only 37% looked at implementation. The focus instead has been on intervention efficacy and reach (Estabrooks, Dzewaltowski, Glasgow, & Klesges, 2003). Although some research suggests that seed funding can initially get programs started, outcome sustainability is difficult without broader outreach and community and family engagement (Hyunyi & Nadow, 2004).

Because many nutritional interventions involve new personnel and increasing existing professional development structures and opportunities, cost has been identified as a significant barrier to program implementation (Xin & Yanhong, 2004; Auld, et al., 1999). Canadian policymakers face the additional problem of limited infrastructure. As one of only a few industrialized nations not to have a nationally supported nutrition program for children, the country has relied on local and provincial programs, which are themselves generally based on grants and uncertain funding streams (Henry, Allison, & Garcia, 2003). The recently proposed Child Health and Nutrition Initiative proposed in 2007 would have provide more than $250 million annually, which would only cover about 30% of meal costs, and still rely on significant contribution from volunteers, fund raising, charitable contributions and cafeteria facilities (Chow, 2007).

Coordinated nutrition programs

Rather than focusing on controlling the school environment, research and policy statements have focused on changing eating and physical activity behaviours, so that children and youth will make healthy choices in the school, at home, and in the broader community. To get such integrated outcomes, coordination across programs and communities is needed. Consequently, national, international, and global research and policy statements consistently envision school nutrition programs as just one part of a broader coordinated effort to improve the health and welfare of children (CASH, 2006; CDC, 2005; World Health Organization, 1998, 2004).

Frequently these programs are envisioned within the framework of a coordinated or comprehensive school health program (CSHP). While a thorough review of CSHP programs is beyond the scope of this paper, CSHPs generally include a focus on four components: teaching and learning, health and other support services, supportive social environment and a healthy physical environment (CASH, 2006). The CDC in the U.S. separates these four general

components into eight more specific interventions: health education, physical education, health services, nutrition services, counseling and psychological services, healthy school environment, health promotion for staff, family/community involvement (CDC, undated). Comprehensive programs that address mental health, healthy eating, and physical activity, and that are long-term, whole school, and high intensity, have been found to be effective in promoting change (Health Evidence Network, 2005; Veugelers & Fitzgerald, 2005b; Keirle & Thomas, 2000).

Within a specific focus on nutrition, recommendations include a focus on changes in education, environment, community, and industry, although as with much of the research, these recommendations fall within the context of addressing overweight and obesity (Koplan, Liverman, & Kraak, 2005; Kumanyika, et al., 2002; Coleman, Tiller, Sanchez, Heath, Sy, Milliken, & Dzewaltowski, 2005). Specifically, the Institute of Medicine within the U.S. National Academies has put forth ten recommendations:

1. Government at all levels should provide coordinated leadership for the prevention of obesity in children and youth.
2. Industry should make obesity prevention in children and youth a priority by developing and promoting products, opportunities, and information that will encourage healthful eating behaviors and regular physical activity.
3. Nutrition labeling should be clear and useful so that parents and youth can make informed product comparisons and decisions to achieve and maintain energy balance at a healthy weight.
4. Industry should develop and strictly adhere to marketing and advertising guidelines that minimize the risk of obesity in children and youth.
5. [Appropriate government agencies] should develop and evaluate a long-term national multi-media and public relations campaign focused on obesity prevention in children and youth.
6. Local governments, public health agencies, schools, and community organizations should collaboratively develop and promote programs that encourage healthful eating behaviors and regular physical activity, particularly for populations at high risk of childhood obesity. Community coalitions should be formed to facilitate and promote cross-cutting programs and community-wide efforts.
7. Local governments, private developers, and community groups should expand opportunities for physical activity including recreational facilities, parks, playgrounds, sidewalks, bike paths, routes for walking or biking to school, and safe streets and neighborhoods, especially for populations at high risk of childhood obesity.
8. Pediatricians, family physicians, nurses, and other clinicians should engage in the prevention of childhood obesity. Health-care profes-

sional organizations, insurers, and accrediting groups should support individual and population-based obesity prevention efforts.

9. Schools should provide a consistent environment that is conducive to healthful eating behaviors and regular physical activity.

10. Parents should promote healthful eating behaviors and regular physical activity for their children. (Koplan, et al., 2005)

Despite such calls for coordination, change has been difficult because implementation is typically left to provincial governments and localities. In Canada there is no coordinated national plan to address a variety of population health issues, including poverty, obesity, early childhood development, and aboriginal health (Glouberman & Millar, 2003).

Capacity and sustainability

As highlighted earlier, cost issues create a serious capacity and sustainability problem in the current context. Over the past 15 years, the policy dialogue in Canada has largely focused on cost control and efficient delivery of services, rather than building government capacity or investment in infrastructure (Glouberman & Millar, 2003; Inwood, 2004). Gaps exist in curriculum, staffing and staff development (CDC, 2006; Xin & Yanhong, 2004), teacher preparation (O'Dea & Abraham, 2001), and meal programs and facilities (Henry, Allison, & Garcia, 2003). A recent survey in the U.S. found that curriculum coverage is frequently incomplete and that less than half of the health education teachers surveyed had received recent professional development in nutrition and physical activity (CDC, 2006). A survey of teachers in training (in home economics and physical education) found that the future teachers had a simplistic and inaccurate views of nutrition and health needs and issues, and themselves exhibited poor eating behaviours (O'Dea & Abraham, 2001). A comparison between nutrition programs in Canada and the U.S. found that many Canadian programs lack the stable funding sources found in the U.S. (Henry, Allison, & Garcia, 2003).

Policies, programs, and training models

Despite the siloed nature of nutrition policy, data collection, and programming in Canada, researchers have found that school-based efforts to respond to nutrition issues can be successful (Doak, et. al., 2006; Canadian Population Health Initiative, 2006), although as with previous sections, much of the research base is focused on addressing issues of obesity and includes programs in both Canada and the United States. Research looking at school-based programmatic interventions falls into four general change foci: administrative (which involves coordination, assessment, planning, and environmental interventions); curricular (focusing on instructional activities); policy (which looks at setting policies beyond schools); and institutional (changing the structure and function of the institution, as in the addition of meal programs).

There are a large number of administrative interventions that have resulted in improvement in student and system indicators. When compared to a control group, students who took part in Give Me 5 – a programmatic intervention focused on a school-based media campaign, classroom workshops, meal modifications, and parental engagement – were found to have increased consumption of fruits and vegetables as well as improved their general nutritional knowledge and awareness on nutritional issues (Nicklas, Johnson, Myers, Farris, & Cunningham, 1998). The CATCH program (Coordinated Approach to Child Health), which focuses on promotion of physical activity and healthy food choices, has also proven effective at slowing the increase in overweight and obesity in both boys and girls. Overweight and obesity rates in all schools examined in the study increased; however, the increase was much smaller for students in CATCH schools (Coleman, et. al., 2005). Together 4 Health, is a similar program that involves a tool kit containing information to help schools evaluate the school environment and target changes to promote physical activity and healthy eating (Begley, 2006). A program that included curriculum delivery by trained special resource teachers was also found to be effective in changing student knowledge, self-efficacy, and eating behaviours (Auld, et al., 1999).

When nutrition information was posted at the point of selection, students were found to be more satisfied with food quality and with nutrition services and staff (Cranage, Conklin, & Lambert, 2006). Cost subsidies resulting in lower prices for healthy foods have also been found to increase sales of healthy foods (French, 2005). Programs focused at reducing consumption of carbonated beverages have also shown both reduced consumption and a decrease in the percentage of overweight and obese students (James, Thomas, Cavan, & Kerr, 2004). The use of trained peer leaders has been found to increase healthy eating as well (Story, Lytle, Birnbaum, & Perry, 2002).

A wide variety of curricular interventions were found to improve the knowledge base and behaviour of students (Casazza & Ciccazzo, 2006; Powers, Struempler, Guarino, & Parmer, 2005; Raby, Struempler, Guarino, & Parmer, 2005; Auld et al., 1999; Ellis, 2007); however, few of the curricular interventions included longitudinal evaluations and in many cases, improvement in eating habits and reductions in overweight were found to be short term. One study in particular highlighted the importance of careful implementation, as positive feelings decreased for unhealthy foods and for healthy foods as well (Ellis).

Districts have undertaken a variety of policy efforts to improve child health, including the renegotiation of food and beverage contracts to emphasize healthier options; however, one of the more innovative efforts to improve the availability and consumption of fresh fruit and vegetables is the Michigan farm-to-school program. The program is designed to support the local economy by building a supply chain that brings local farm produce to schools. Food

service directors expressed strong interest in the program, although there were serious implementation barriers that included cost, procurement regulations, reliable supply and seasonal availability, and food safety concerns (Izumi, Rostant, Moss, & Hamm, 2006).

Interventions designed to change institutional practices and structures have also been shown to be effective. Although controversial, evaluations of the Arkansas BMI Report Cards have found the program to be an effective intervention that has changed school practices (improving cafeteria offerings, reducing the use of food as a reward, reducing the use of vending machines) and parental practices (awareness, meals together, healthier meals, and identification of child risk status), while not exacerbating teasing or anti-social behaviour related to overweight or obese identification (Moritz, 2007b; Raczynski & Phillips, 2005). As highlighted earlier, school breakfast programs have also been proven effective at increasing academic achievement, attendance and student behaviour (Bernstein et al. 2002; Kleinman, et al. 2002; Terry & Kerry, 2000; Wahlstrom & Begalle, 1999; Minnesota Department of Children, Families, & Learning, 1998; Murphy, et al., 1998) although some research found an increase in overweight after introduction of a school lunch program (Canadian Population Health Initiative, 2006).

Considerations for supporting changes to policies, programs, and practices

While researchers are constantly working to expand the amount of knowledge related to school health and nutrition, as well as honing the nuance of such research, a number of important trends can be identified and findings advanced that may significantly support the nutritional welfare of students within the current system. It is important to recognize, however, that such recommendations cannot (and should not) be implemented without careful consideration of the local context in which policymakers, practitioners, families and communities, are operating.

CONCLUSIONS AND RECOMMENDATIONS

1. While the recent emphasis on obesity has opened an important window for change, adequate nutrition for all children and youth, as well as addressing issues of food insecurity, are critical components of comprehensive nutrition policies.

2. Researchers and policymakers may want to adopt the language of malnutrition, which is defined to include issues associated with obesity and overweight as well as nutritional deficiencies or under-nutrition that impair health, activity, or well-being.

3. Nutrition programs and interventions should be included as one important component of a comprehensive school health program

focusing on the mental, physical, intellectual, and social health of Canadian students. The placement of nutrition within the revised Canadian Consensus Statement on Comprehensive School Health should be strengthened.

4. Policymakers must invest in building the system-wide capacity to address school health needs (with a particular focus on nutrition services, programs, and activities, as well as physical education), if implementation of change efforts is to be sustained. The Children's Health and Nutrition Initiative may be one way to build such capacity.

5. Appropriate measures for overweight status and obesity should be determined. In particular, stakeholders should determine the accuracy, relevance, and appropriate use of BMI for measuring youth and adolescent overweight and obesity.

6. Future research should look at both program outcomes as well as the general costs for implementation, evaluation, and maintenance. Research into obesity and school-based interventions should also collect data on underweight prevalence, to identify possible unintended consequences that could prove harmful to participants.

7. While this article presented an overview of the current state of nutrition research, additional work should follow that presents a detailed examination of the issues highlighted here.

8. Much of the available data on nutrition and schools are generated in the United States and so lack contextual variables important for Canadians. Strengthened monitoring and data gathering systems should be established and supported so that policymakers can access timely and accurate data to strengthen policymaking decisions.

Adequate nutrition plays a key role in student health and development; however, despite the strong findings focusing on nutrition broadly, much of the recent research and policy development has focused on childhood overweight, significantly narrowing the public policy dialogue around nutrition programs and interventions. These policy dialogues must be refocused to emphasize the important role of appropriate nutrition (adequate provision and accessibility of nutritional foods) in child development, rather than emphasizing the nutritional aspects of overweight. Generally stated, nutritional programs and interventions should be included as one important component of a comprehensive school health program focusing on the mental, physical, intellectual, and social health of Canadian students.

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