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Cost-effectiveness and return on investment of school-based health promotion programmes for chronic disease prevention

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Background: While school-based health prevention programmes are effective in addressing unhealthy diet and physical inactivity, little is known about their economic implications. We conducted an economic evaluation of the programmes that were previously identified as feasible, acceptable, and sustainable in the Canadian context. **Methods:** This study builds on a meta-analysis of the effectiveness of feasible, acceptable, and sustainable school-based health promotion programmes. A micro-simulation model incorporated intervention effects on multiple risk factors to estimate incremental cost-effectiveness and return on investment (ROI) of comprehensive school health (CSH), multicomponent, and physical education (PE) curriculum modification programmes. Cost-effectiveness was expressed as the programme costs below which the programme would be cost-effective at a CA$50 000 threshold level. **Results:** The estimated costs below which interventions were cost-effective per quality-adjusted life year gained were CA$682, CA$444, and CA$416 per student for CSH, multicomponent, and PE curriculum modification programmes, respectively. CSH programmes remained cost-effective per year of chronic disease prevented for costs of up to CA$3384 per student, compared to CA$1911 and CA$1987 for multicomponent and PE curriculum modification interventions, respectively. If the interventions were implemented at total discounted intervention costs of CA$100 per student, ROI through the avoidance of direct healthcare costs related to the treatment and management of chronic diseases would be 824% for CSH, 465% for multicomponent interventions, and 484% for PE curriculum modification interventions. **Conclusions:** Whereas each examined intervention types showed favourable economic benefits, CSH programmes appeared to be the most cost-effective and to have the highest ROI.

Introduction

Inadequate physical activity, sedentary behaviour, and unhealthy diet are the major risk factors for childhood overweight and obesity. The rates of childhood overweight and obesity in the past few decades have been particularly concerning.[1] Childhood overweight and obesity are linked to a number of consequent chronic diseases and conditions that pose a heavy burden on the healthcare systems. Given that both the establishment of lifelong lifestyle behaviours[2] and the development of chronic diseases (e.g. obesity[3]) start early in life, childhood provides an opportune window for health promotion initiatives. To improve lifestyle behaviours and curb rising childhood overweight and obesity rates, school-based prevention programmes have been lauded as an effective approach since schools have direct and intensive contact with a wide range of children and youth over a prolonged period of time.[4] A recent systematic review of all overweight and obesity prevention interventions from around the world concluded that school-based interventions with combined diet and physical activity components and a home element were the most promising for childhood obesity prevention.[5] The evidence on other population-based approaches such as community- and home-based interventions is limited.[5]

Although the evidence on the effectiveness of school-based obesity prevention interventions has been synthesized in several systematic reviews,[6–8] this is but only one piece of information required for informed decision-making. Evidence on feasibility, acceptability, sustainability, cost-effectiveness, and return on investment (ROI) of these interventions is scant,[9] but is also needed to justify the choice of school-based obesity prevention interventions and resources needed for their implementation. To circumvent this knowledge gap, we conducted a systematic review and meta-analysis of the effectiveness of school-based obesity prevention interventions that were deemed feasible, acceptable, and sustainable by the key stakeholders in health and education sectors in Canada.[10] These stakeholders had identified and prioritized eight types of school-based obesity prevention interventions as feasible, acceptable, and sustainable. These included (i) interventions based on the Comprehensive School Health (CSH), a holistic approach to promoting healthy eating and active living through changes to the school culture and environment,[11] (ii) interventions involving modifications of the existing physical education (PE) classes delivered by PE specialists, in terms of their duration and quality, and (iii) multicomponent interventions involving combinations of the interventions identified and prioritized by the key stakeholders[10] (see Supplementary material for a full description of these intervention types). With the establishment of feasibility, acceptability, sustainability, and effectiveness of these intervention, evidence on cost-effectiveness and ROI is the remaining information needed for decision-makers to justify their choices for type of intervention and resources required for their implementation.

The present study estimates the incremental cost-effectiveness and ROI of school-based obesity prevention interventions deemed feasible, acceptable, sustainable, and effective in terms of the following outcomes: (i) person-years with consequent chronic diseases, (ii) quality-adjusted life years (QALYs), and (iii) chronic disease-related healthcare costs. This approach may serve as a roadmap for other investigators seeking to provide relevant and actionable evidence for decision-makers.

Methods

This study constitutes the third step in a three-step approach. Details of the first step that reported on focus groups to prioritize feasible, acceptable, and sustainable school-based health promotion interventions are available elsewhere.[12] In brief, 45 Canadian stakeholders in health and education sectors were invited to participate in open-ended surveys and world café-style focus group, as part of a community-based participatory research, with deliberative group processes to identify (i.e. through the think/pair/share activity) and prioritize (i.e. through dotmocracy) school-based intervention types based on whether they were research/evidence-based, sustainable, equitable, feasible, and whole school/comprehensive. The intervention types identified and prioritized by stakeholders included: (i) interventions based on the CSH approach,[11] (ii) interventions based on modifications of school nutrition policies, (iii) universal school food programmes, (iv) interventions that increase provision of healthy foods in schools, (v) interventions involving modifications of the existing PE classes, (vi) promotion of physical activity outside of PE classes, (vii) interventions changing foods/drinks sold and/or served in schools, and (viii) multicomponent interventions (i.e. interventions with one or more of the other prioritized types and/or additional intervention components).[10]

Details of the second step, a systematic review and meta-analysis of the effectiveness of each of these eight intervention types, are available elsewhere.[10] In short, the work included a search in PROSPERO, OVID Medline, OVID EMBASE, OVID PsycINFO, OVID ERIC, Cochrane Database of Systematic Reviews <2005>, EBSCO CINAHL, Proquest Dissertations, and Theses Global databases, using controlled vocabulary (e.g. MeSH, Emtree) and key words representing the concepts 'obesity' and 'school based interventions' that identified 10 871 publications. This included 83 and 80 high quality comparative (i.e. with a control group, such as no intervention or usual activities) studies that examined school-based health promotion interventions, published up to 28 January 2020, to be included in the systematic review and meta-analysis, respectively. Given that school age varies from country to country, the prespecified age range was 4–18 years old. Cluster randomized controlled trial design was employed most commonly, with school and classroom as the units of randomization (except for one study where students were randomized into intervention and control groups). The results of the meta-analysis showed beneficial effects of CSH, multicomponent, and PE curriculum modifications intervention types on at least one of the outcomes of interest: CSH intervention type showed positive effects on fruit intake [0.13, 95% confidence interval (CI): 0.04, 0.23 (servings per day)], body mass index (BMI) (−0.26, 95% CI: −0.40, −0.12), and step-count per day (1155.76, 95% CI 449.77, 1861.75), while multicomponent and modifications to PE curriculum intervention types showed positive effect in BMI only: −0.18 (95% CI: −0.29, −0.07) and −0.16 (95% CI: −0.3, −0.02), respectively.

The current paper constitutes the third (final) step and estimates the incremental cost-effectiveness and ROI of the prioritized intervention types. Out of eight prioritized intervention types, only three—CSH, multicomponent, PE curriculum modifications—intervention types could be considered because they had adequate data, defined as having at least two effect estimates for a certain exposure-outcome relationship. The duration of these intervention types varied, as detailed in ref.,[10] with about a two-third lasting more than one academic year. The present study was approved by the Human Research Ethics Board of the University of Alberta (Pro00049436).

Cost-effectiveness and return on investment analyses

For the estimation of cost-effectiveness and ROI, we conducted a micro-simulation model based on a recently developed enhanced methodological approach that incorporates health promotion programme effects on four risk factors for chronic diseases.[13] These four risk factors are inadequate vegetables consumption, inadequate fruit consumption, inadequate physical activity, and excess body weight. The enhanced approach is less likely to underestimate the economic benefits of interventions relative to the commonly applied methods that consider only the intervention effect on a single risk factor (i.e. excess body weight).[13]

In brief, the enhanced approach considers the joint distribution of the abovementioned four risk factors in a Markov model with 793

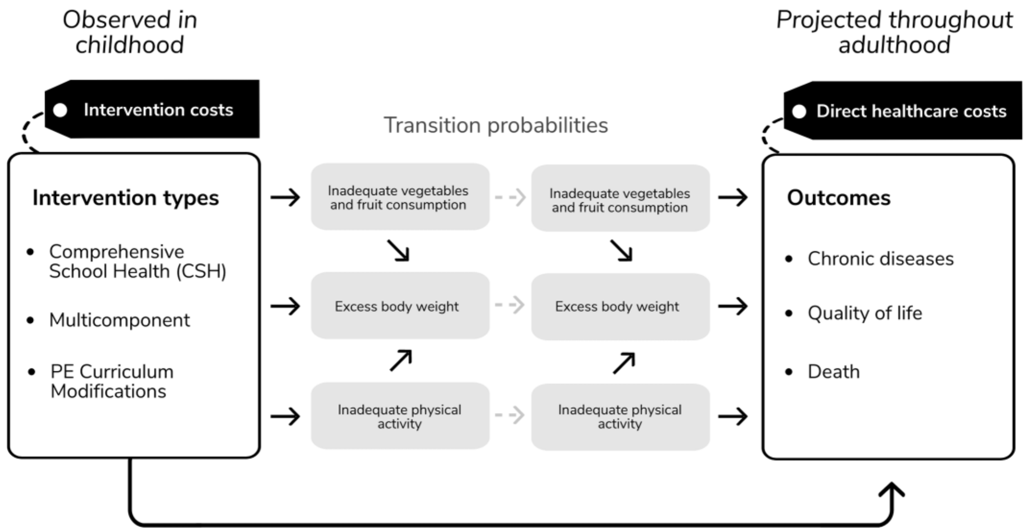

Figure 1 A conceptual visualization of the enhanced simulation model that estimates the cost-effectiveness and return on investment of the comprehensive school health (CSH), multicomponent, and physical education (PE) curriculum modifications intervention types for the prevention of chronic diseases

states: two states for adequate versus inadequate consumption of each of vegetables and fruit; two states for adequate versus inadequate physical activity; three weight status states (normal weight, overweight, and obesity); 33 chronic disease states (i.e. no chronic disease and 32 chronic diseases); and an absorbing state (i.e. death). The 32 chronic diseases in this model are those that the Global Burden of Disease study (GBD) had linked to the abovementioned four risk factors.[14] Figure 1 depicts the micro-simulation model which starts with the short-term effects of the three intervention types on the four risk factors (inadequate vegetables and fruit consumption; inadequate physical activity; excess body weight) that were obtained from the systematic review and meta-analysis as part of the aforementioned second step.[10] Using the transition probabilities of the joint distribution of the risk factors in the general population, the model propagates the short-term effects into a lifetime course (i.e. a 84 years' timeframe considered in this model).[13] In every age and sex category and model state, the model considers the established effects of the risk factors on chronic diseases to incorporate the probabilities of developing chronic diseases, as well as the established effects of the risk factors and chronic diseases on mortality to incorporate the probability of death. The model estimates person-years lived with the 32 chronic diseases, quality-adjusted life years (QALYs), and healthcare costs associated with the 32 chronic diseases. We considered costs for physicians, drugs, hospitals and other institutions for the treatment and management of chronic diseases as direct healthcare costs at one point—in 2016. These costs were extracted from the Canadian Institute for Health Information National Health Expenditure Trends data[15] and proportionally allocated to the diagnosis categories based on the proportions obtained from the Economic Burden of Illness in Canada online tool.[16] To estimate the number of prevalent cases and subsequently the attributable annual costs per case, we used estimates of the prevalence of chronic diseases[17] and the total population of Canada in 2016[18] (for more details see ref.[13]). For the calculation of QALYs, the model made use of a decrement in health utility scores for every year lived with excess weight or a chronic disease, as estimated by Schultz and Kopec[19] and Jia and Lubetkin[20] (see ref.[13] for details). Decrements in health utility scores were based on population preferences for health states on a scale from 0 (death) to 1 (full health). For each given combination of weight status and chronic diseases, the highest of the two QALYs decrement estimates, weight status or chronic diseases, was used.

Information on intervention costs is rarely presented in the literature. As a measure of cost-effectiveness, we therefore estimated the intervention costs below which intervention types were cost-effective at a threshold of CA$50 000 per QALY or years with chronic disease. The higher the intervention cost below which an intervention is cost-effective at a given threshold, the more cost-effective this intervention is. Likewise, in the absence of sufficient information on intervention costs, we estimated the ROI for a range of assumed intervention costs. Cost-effectiveness and ROI estimates were calculated in terms of total intervention costs per student after discounting at a rate of 1.5%.[21] We also provide estimates based on 1.0%, 2.0%, and 3.0% discounting rates to assess whether the estimates are sensitive to the discounting rates used, i.e. as part of sensitivity analyses.

The enhanced approach[13] incorporated probabilistic sensitivity analysis to simultaneously account for uncertainties in all model parameters.[22] Prevalence and incidence were assumed to follow a beta distribution, relative risks and mortality rate ratios to follow log-normal distributions, and parameters of the multinomial model used to estimate risk factor transitions to follow a normal distribution.[13] To obtain relatively stable estimates, we carried out 20 million simulations, where all model parameters were assigned random values drawn from their respective distributions. Results from these simulations were used to calculate the 95% CIs. The micro-simulation model was implemented in Python. All other analyses were carried out using SAS 9.4.[23]

Results

The estimated total intervention costs below which intervention types are cost-effective at a CA$50 000 threshold and discounting rates of 1.5%, as well as 1.0%, 2.0%, and 3.0%, are presented in tables 1 and 2. CSH intervention type was the most cost-effective: at a 1.5% discounting rate, this intervention type remained cost-effective per QALY gained for intervention costs of up to CA$682 per student, compared to CA$444 per student for multicomponent and CA$416 per student for modification of the existing PE curriculum intervention types (table 1). This cost-effectiveness gradually increased with lower discounting rates for each of the intervention types. CSH intervention type would remain cost-effective per year of chronic diseases prevented for intervention costs up to CA$3384 per student, compared to CA$1911 per student for multicomponent and CA$1987 per student for PE curriculum modification intervention types (table 2).

Table 3 presents the estimated cost savings and ROI for assumed total intervention costs ranging from CA$20 to CA$500 per student.

Table 1 Incremental effect (QALYs[a] gained) and total intervention cost per student (in present value) below which intervention types are cost-effective at a threshold of CA$50 000 per QALY gained by intervention type and discounting rate

Discounting rate	Intervention type	Incremental effect (QALYs gained)		Total intervention cost per student below which an intervention type is cost-effective at CA$50 000	
		Effect	95% CI[b]	Cost	95% CI
1.0%	Comprehensive School Health approach	0.015	0.014 to 0.015	729	699 to 761
	Multicomponent interventions	0.009	0.009 to 0.011	473	472 to 535
	Modifications of the existing PE[c] curriculum	0.009	0.009 to 0.010	444	442 to 505
1.5%	Comprehensive School Health approach	0.014	0.013 to 0.014	682	655 to 712
	Multicomponent interventions	0.009	0.009 to 0.010	444	442 to 500
	Modifications of the existing PE curriculum	0.008	0.008 to 0.009	416	413 to 470
2.0%	Comprehensive School Health approach	0.013	0.012 to 0.013	641	615 to 667
	Multicomponent interventions	0.008	0.008 to 0.009	418	416 to 469
	Modifications of the existing PE curriculum	0.008	0.008 to 0.009	391	388 to 439
3.0%	Comprehensive School Health approach	0.011	0.011 to 0.012	568	547 to 591
	Multicomponent interventions	0.007	0.007 to 0.008	372	370 to 415
	Modifications of the existing PE curriculum	0.007	0.007 to 0.008	348	343 to 387

a: Quality-adjusted life-year.
b: Confidence interval.
c: Physical education.

Table 2 Incremental effect (years with chronic disease prevented) and total intervention cost per student (in present value) below which the type of intervention is cost-effective at CA$50 000 per year living with chronic disease prevented by intervention type and discounting rate

Discounting rate	Intervention type	Incremental effect (years with chronic disease prevented)		Total intervention cost per student (in present value) below which the intervention is cost-effective at CA$50 000	
		Effect	95% CI[a]	Cost	95% CI
1.0%	Comprehensive School Health approach	0.073	0.059 to 0.079	3674	2954 to 3928
	Multicomponent interventions	0.041	0.033 to 0.053	2075	1653 to 2631
	Modifications of the existing PE[b] curriculum	0.043	0.033 to 0.052	2155	1662 to 2625
1.5%	Comprehensive School Health approach	0.068	0.054 to 0.072	3384	2721 to 3619
	Multicomponent interventions	0.038	0.030 to 0.048	1911	1521 to 2423
	Modifications of the existing PE curriculum	0.040	0.031 to 0.048	1987	1531 to 2418
2.0%	Comprehensive School Health approach	0.062	0.050 to 0.067	3124	2511 to 3342
	Multicomponent interventions	0.035	0.028 to 0.045	1764	1403 to 2237
	Modifications of the existing PE curriculum	0.037	0.028 to 0.045	1836	1413 to 2233
3.0%	Comprehensive School Health approach	0.054	0.043 to 0.057	2679	2153 to 2870
	Multicomponent interventions	0.030	0.024 to 0.038	1512	1201 to 1921
	Modifications of the existing PE curriculum	0.032	0.024 to 0.038	1577	1211 to 1918

a: Confidence interval.
b: Physical education.

CSH would lead to a total cost saving of CA$824 per student. This is CA$465 per student for multicomponent and CA$484 per student for PE curriculum modification intervention types. If the interventions were implemented at discounted intervention costs of CA$100 per student, the ROI would be 824% for CSH, compared to 465% for multicomponent and 484% for PE curriculum modification intervention types. For discounted intervention costs of CA$500 per student, the return on investment would be 165% for CSH, compared to 93% for multicomponent and 97% for PE curriculum modification intervention types.

Discussion

This study demonstrated that all three of the examined intervention types (i.e. CSH, multicomponent, and those involving modifications of the existing PE curriculum) were cost-effective and had a high return on investment. Out of these three intervention types, CSH was the most cost-effective and had the highest ROI: the cost per QALY for intervention costs was up to CA$682 per student. An investment in CSH of CA$100 per student will avoid CA$824 in future direct healthcare costs for the treatment and management of chronic diseases, meaning that each CA$invested in the CHS will bring CA$8.24 in return.

Evidence on programme effectiveness such as from systematic reviews and meta-analyses is only one piece of information required for informed decision-making. The evidence on feasibility, acceptability, sustainability, cost-effectiveness, and ROI is also needed, though often overlooked by researchers. We therefore took a three-step approach starting with focus groups comprising key stakeholders in health and education sectors who identified and prioritized school-based health promotion programmes as feasible, acceptable, and sustainable. Secondly, we conducted a systematic review and meta-analysis of the effectiveness of these programmes. And thirdly, captured in the present study, we estimated the cost-effectiveness and ROI of these programmes. Herewith we gathered all important pieces of information to guide programme decisions and planning. For example, when decision-makers: (i) consider what programme costs are reasonable and justifiable, (ii) compare costs of different programmes, and (iii) plan a programme below a certain cost threshold level.

It has been previously estimated that CSH interventions could result in cost savings of CA$150 to CA$330 million dollars per year due to avoided healthcare services in Canada.[24] The results of the present study further underscore the promise and benefits of CSH interventions, and to some extent, of other investments in school health. The public funding for the Annapolis Valley Health

Table 3 Cost savings and return on investment by intervention type and intervention cost

Total intervention cost per student (in 2016 value)	Intervention type	Cost savings	95% CI[a]	ROI[b]	95% CI
CA$20	Comprehensive School Health approach	824	662 to 881	4120%	3312% to 4406%
	Multicomponent interventions	465	370 to 590	2326%	1852% to 2950%
	Modifications of the existing PE[c] curriculum	484	373 to 589	2419%	1863% to 2944%
CA$30	Comprehensive School Health approach	824	662 to 881	2747%	2208% to 2937%
	Multicomponent interventions	465	370 to 590	1551%	1235% to 1967%
	Modifications of the existing PE curriculum	484	373 to 589	1612%	1242% to 1963%
CA$50	Comprehensive School Health approach	824	662 to 881	1648%	1325% to 1762%
	Multicomponent interventions	465	370 to 590	931%	741% to 1180%
	Modifications of the existing PE curriculum	484	373 to 589	967%	745% to 1178%
CA$100	Comprehensive School Health approach	824	662 to 881	824%	662% to 881%
	Multicomponent interventions	465	370 to 590	465%	370% to 590%
	Modifications of the existing PE curriculum	484	373 to 589	484%	373% to 589%
CA$200	Comprehensive School Health approach	824	662 to 881	412%	331% to 441%
	Multicomponent interventions	465	370 to 590	233%	185% to 295%
	Modifications of the existing PE curriculum	484	373 to 589	242%	186% to 294%
CA$300	Comprehensive School Health approach	824	662 to 881	275%	221% to 294%
	Multicomponent interventions	465	370 to 590	155%	123% to 197%
	Modifications of the existing PE curriculum	484	373 to 589	161%	124% to 196%
CA$400	Comprehensive School Health approach	824	662 to 881	206%	166% to 220%
	Multicomponent interventions	465	370 to 590	116%	93% to 147%
	Modifications of the existing PE curriculum	484	373 to 589	121%	93% to 147%
CA$500	Comprehensive School Health approach	824	662 to 881	165%	132% to 176%
	Multicomponent interventions	465	370 to 590	93%	74% to 118%
	Modifications of the existing PE curriculum	484	373 to 589	97%	75% to 118%

The estimates are based on a 1.5% discounting rate.
a: Confidence interval;
b: Return on investment;
c: Physical education.

Promoting Schools programme, a CSH programme, was estimated to be CA$22.67 per student per year, or approximately CA$136 per student throughout the 6 years of elementary school.[25] By avoiding the estimated CA$824 per student (table 3) in future direct healthcare costs for the treatment and management of chronic diseases, this investment of CA$136 comes with a return of approximately 600% (824/136 times 100%). Unlike the Annapolis Valley Health Promoting Schools programme that was a grassroots programme that gradually gained momentum, another Canadian CSH programme, APPLE Schools, was researcher-initiated and started with an investment of CA$284 per student per year over a 2-year period to implement CSH.[4,26] These first 2 years of implementation were followed by years of maintaining CSH for an estimated CA$20 per student per year. Over the 12 years, the programme has been operational, the average cost in the first ten schools was estimated at CA$256 per student while in elementary school. This investment comes with an approximately 320% return by avoiding the estimated CA$824 per student (table 3) in future direct healthcare costs. Other programmes have reported programme costs of AUS$394 (CA$377) per student per 24 months[27] and AUS$65 (CA$62) per student per year.[28] When deriving ROI estimates using table 3, caution is warranted as these estimates are based on Canadian healthcare data and thus do not fully apply to settings with different healthcare systems.

For the cost analyses in the present study, we took a healthcare prospective and considered all direct healthcare costs associated with the treatment and management of chronic diseases. If we had taken a societal perspective, we should have also considered indirect costs, i.e. costs associated with production loss due to chronic diseases and death caused by chronic diseases. Clearly, if we had taken a societal perspective our ROI estimates had been higher. Lieffers *et al.*[29] estimated the ratio of direct to indirect costs for chronic diseases in Canada to be 1–1.7. Hence, if we had taken a societal perspective, ROI estimates that include indirect costs would be 2.7 times the ROI estimates based on direct healthcare costs only (i.e. the return of investment of the APPLE Schools programme would be approximately 860% when taking a societal perspective instead of 320% when taking a healthcare perspective). One may further argue that the actual ROI is higher when considering the following: (i) promotion of healthy lifestyles also has benefits to mental health[30] and thus avoid healthcare costs associated with the treatment and management of mental illness, (ii) healthy lifestyles also benefit academic achievement[31] which in turn provides better future job prospects and avoidance of poverty and food insecurity, and (iii) it may not only be the students who benefit but to some extent also some of their household members, peers, school staff, and community members.[32]

Whereas each of the three examined intervention types showed favourable economic benefits, CSH appeared the most cost-effective and to have the highest ROI. This may be attributable to the holistic nature of CSH that aims to address four inter-related components: teaching and learning, physical and social environments, partnerships and services, and healthy school policies.[11] The key factor underlining the success of CSH is an extensive collaboration between agencies in the health and education systems that ensures sustainable changes in school culture. As opposed to CSH, interventions involving modifications of the existing PE curriculum target physical inactivity as an isolated risk factor. Examples of such interventions include introducing additional PE classes,[33] additional high-intensity aerobic and impact exercises to target both metabolic and musculoskeletal health,[34] and PE classes being led by specialized teachers.[35] The multicomponent intervention type comprised a heterogeneous group of interventions that include two or more of the seven prioritized types of interventions and/or additional intervention components. For example, Nutrition and Enjoyable Activity for Teen Girls intervention included enhanced school sport sessions, lunchtime physical activity sessions, nutrition workshops, interactive educational seminars, pedometers for self-monitoring, and other components.[36] Another example is the Avall intervention that included providing equipment to promote PA during breaks and education on healthy food.[37]

Our study has important strengths. One of the major strengths is that this study is part of a three-step process for identifying comprehensive, relevant, and actionable information required by decision-makers. Since this process was built with the engaged scholarship principles in mind (e.g. engaging key stakeholders in shaping the research question, prioritizing intervention types), we anticipate a better uptake of the knowledge gleaned from this study. The only drawback of this approach is that it requires commonly omitted data (e.g. cost of interventions), thus potentially limiting its use. Another strength is that cost-effectiveness analyses are commonly based on the intervention effect on body weight only, whereas we also considered the effects on diet and physical activity, and herewith less likely to underestimate the economic benefits of the interventions. Several limitations warrant consideration. Although our approach accounted for the intervention effects on vegetables and fruit consumption, physical activity, and body weight, our results may still be underestimated. We could not account for other risk factors that have been shown to predispose to other chronic diseases and conditions and drive healthcare costs (e.g. whole grains, nuts and seeds, milk, processed meat, red meat, and sugar sweetened beverages,[29] inadequate sleep[38]) because this information is rarely reported in school-based intervention studies. Moreover, we did not consider the spillover effects to families for the same reason: as noted by Bjelland *et al.*,[39] evaluation of school-based interventions rarely include outcome assessment among guardians/parents. Due to insufficient data on the effectiveness of other intervention types, we evaluated three of the eight intervention types that were prioritized by the stakeholders. It is possible that other intervention types (i.e. those based on modifications of school nutrition policies, universal school food programmes, interventions to increase provision of healthy foods in schools, promotion of PA outside of PE classes, and those based on changing foods/drinks sold and/or served in schools) might be cost-effective and have favourable ROIs. To enable comparisons across these intervention types, we therefore recommend better coordination in terms of data collection and reporting of outcomes in health promotion studies.

In brief, in our three-step approach, we provided comprehensive information to guide decisions related to investments in school health. We identified eight programme types that are feasible, acceptable, and sustainable (Step 1). Out of these eight, CSH, multicomponent, and PE modification intervention types were effective (Step 2) and had favourable economic benefits, albeit CSH interventions appeared to be the most cost-effective and to have the highest ROI (Step 3). Decision-makers should anticipate CSH implementation costs ranging from CA$23 to CA$256 per student per year. They can gain insights into specific programmes by accessing the scientific papers captured in our systematic review[10] and insights into implementation methods and outcomes by accessing the National Cancer Institute sponsored Evidence-Based Cancer Control Programs website that includes a searchable database of evidence-based programmes.[40]

Supplementary data

Supplementary data are available at *EURPUB* online.

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Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

Key points

- Public health decision-makers consider feasibility, acceptability, and sustainability when deciding on school-based prevention programmes but need guidance on effectiveness and cost-effectiveness.
- We conducted an economic evaluation of school-based prevention programmes that are deemed feasible, acceptable, and sustainable and revealed that Comprehensive School Health programmes are more cost-effective and come with a better return on investment compared to other programmes.
- Investments in Comprehensive School Health and other school-based health promotion programmes are needed to improve health and wellbeing of children and youth, and to alleviate the healthcare burden associated with treatment and management of chronic diseases.

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