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Original quantitative research

Correlates of perceived success of health-promoting interventions in elementary schools

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Abstract

Introduction: School-based health-promoting interventions (HPIs) aim to support youth development and positively influence modifiable lifestyle behaviours. Identifying factors that contribute to or hinder the perceived success of HPIs could facilitate their adaptation, improve implementation and contribute to HPI sustainability. The objective of this study was to identify factors in three domains (school characteristics, characteristics of the HPI and factors related to planning and implementing the HPI) associated with perceived success of HPIs among school principals in elementary schools.

Methods: Data were drawn from Project Prome*SS*, a cross-sectional survey of school principals and/or nominated staff members in a convenience sample of 171 public elementary schools in Quebec, Canada. School board and school recruitment spanned three academic school years (2016–2019). Data on school and participant characteristics, HPI characteristics, variables related to HPI planning and implementation and perceived success of the HPI were collected in two-part, structured telephone interviews. Descriptive statistics were used to characterize schools and study participants. Twenty-eight potential correlates of perceived HPI success were investigated separately in multivariable linear regression modelling.

Results: Participants generally perceived HPIs as highly successful. After controlling for number of students, language of instruction, school neighbourhood and school deprivation, we identified five correlates of perceived success, including lower teacher turnover, higher scores for school physical environment, school/teacher commitment to student health, principal leadership and school being a developer (vs. adopter) of the HPI.

Conclusion: If replicated, these factors should be considered by HPI developers and school personnel when planning and implementing HPIs in elementary schools.

Keywords: *health-promoting schools, interventions, cross-sectional study, perceived success*

Highlights

- Participants generally perceived health-promoting interventions (HPIs) as highly successful.
- Four of 11 school characteristics were associated with perceived success of the HPI, including lower teacher turnover, school physical environment, school/teacher commitment to student health and principal leadership.
- None of the eight characteristics of the HPI was associated with perceived success.
- Of the nine factors related to HPI planning or implementation, only being a developer (vs. an adopter) of the HPI was associated with perceived success.

Introduction

School-based health-promoting interventions (HPIs) support the development of positive physical, emotional and mental health among youth, including the acquisition of healthy lifestyle behaviours.[1,2] Common HPI theme areas include physical activity (which generally declines from childhood into adolescence and young adulthood[3,4]), healthy nutrition (e.g. attaining adequate levels of consumption of vegetables, fruits and whole grains), substance use behaviours (including use of alcohol, tobacco and cannabis, which can emerge early and escalate during adolescence)[5] and awareness related to aggressive behaviour (including verbal, physical and cyber-bullying). School-based HPIs are important components of broader public health strategies that aim to foster health-promoting behaviours in children from an early age.[6] Because children spend many hours each day at school, elementary schools are ideal settings for HPIs because they have high potential for reaching all children, regardless of socioeconomic status.[7]

Numerous HPIs are deemed centrally important for child development and are therefore government-mandated. In Quebec, Canada, these comprise HPIs that aim to

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improve awareness, knowledge and attitudes, and promote healthy behaviours related to physical activity, tobacco use, dental health, sex education and bullying.[8-11] In addition to government-mandated HPIs, many schools choose to implement other HPIs, depending on perceived need within the school community. These school-specific HPIs may be adopted by the school from an external organization or developed *de novo* by the school.

Despite its importance, evaluation of the impact of school-based HPIs can pose major challenges in assessing benefits. Many school-based HPIs are not evaluated[12,13] and among those that are evaluated, results on effectiveness, implementation success and sustainability are often mixed.[14] For example, two reviews[12,15] suggested small to modest effects of tobacco prevention programs, although evidence on long-term effects is limited and most studies are of relatively poor quality.[12] Methodological challenges include ethical and feasibility issues in implementing randomized controlled trials (RCTs) in a school context[12,16-18] and lack of consensus on how to conduct process evaluations of school-based interventions. Evaluations of school-based HPIs often assess one specific intervention within one school, or a specific single theme (e.g. a physical activity) that has been broadly implemented in many schools, which can make generalization to other theme areas or settings challenging.

In addition, obtaining objective data to measure the success of an intervention (i.e. expired carbon monoxide for tobacco control programs, pedometer data for physical activity interventions)[19] can be challenging and expensive. Perceptions of success, especially among decision makers within the school, may be equally if not more important measures of success, since perceived success may be a key driver in the decision to sustain an HPI within the school.[20]

Key features of successful HPIs identified to date include noncurricular approaches, playground interventions, after-school sessions and daily classroom refreshers.[12] In general, community-level interventions including those that are school-based should incorporate knowledge, beliefs and attitudes training while promoting healthy behaviour, since these features are related to intervention success regardless of theme area.[12,21] Further, emerging implementation science literature indicates that factors related to both the school (e.g. organizational context, leadership) and the intervention (e.g. partnerships, planning and implementation processes) are associated with implementation fidelity and effectiveness of HPIs.[22,23] Finally, school principals are key players in the school environment and instrumental in HPI implementation and sustainability.[24] Because they are knowledgeable about their school, the interventions offered and school staff opinions, their perception of HPI effectiveness is a key indicator of the potential usefulness of HPIs.

An increased understanding of what contributes to successful HPIs regardless of theme or setting could help school boards, school staff and the community increase autonomy in developing, selecting, implementing and evaluating interventions that align with school-specific needs. Further, identifying modifiable and nonmodifiable factors that contribute to or hinder the perceived success of HPIs could facilitate adaptations, improve implementation and contribute to the sustainability of school-based HPIs. Overall, offering schools evidence-informed interventions could increase the potential for HPI effectiveness and remove some of the guesswork from choosing an appropriate HPI.

Our objective in this study was to identify factors in three domains associated with perceived success of HPIs among elementary school principals. The three domains were school characteristics, characteristics of the HPI and factors related to planning and implementing HPIs. This project was undertaken as part of Project Prome*SS*, a cross-sectional survey of school principals and/or nominated staff members in a convenience sample of public elementary and high schools in Quebec.

Conceptual model

Delivery of school-based HPIs in Project Prome*SS* was envisioned based on a conceptual model guided by Rogers' Diffusion of Innovations Theory,[25,26] which explains how and why innovations (e.g. new HPIs) are adopted by schools. Specifically, the decision process is influenced by the characteristics of the innovation, the individuals involved and the organization implementing the innovations.[26] The process described by Rogers comprises four phases: planning, implementation, sustainability and scale-up. The PromeSS conceptual model[27] depicts these four phases in the context of school-based HPI delivery while illustrating environmental influences at the school, neighbourhood and societal levels. During planning, the school matches its needs with an existing intervention or develops an intervention *de novo*. During implementation, the intervention is delivered to students and may be modified. If an intervention is deemed unsuccessful, it can be terminated at any point. Interventions deemed successful may be renewed, become embedded in the school (i.e. sustained) or scaled up.[27] In this study, this model guided the selection of potential correlates of HPI perceived success.

Methods

Data were drawn from Project Prome*SS*. The sampling frame comprised all 1795 elementary and 436 high schools in 69 school boards across Quebec in 2016. Our analytical sample was restricted to elementary schools, since high schools differ markedly in student population, health issues perceived as important by school principals, and relevant HPI content and delivery methods. School board approval was obtained in 32 of 69 eligible school boards (46%), and 594 elementary schools (i.e. 33% of all elementary schools in Quebec) within the 32 school boards were eligible for recruitment. Private schools, schools serving only students with intellectual impairments or learning difficulties, and schools with fewer than 30 students were excluded because they are not assigned a school deprivation indicator. Contact was established with 291 of the 594 eligible elementary schools (49%); 171 of 291 eligible schools (59%) provided verbal assent and completed the interview.

Detailed data collection procedures are described elsewhere.[26] Briefly, schools were mailed or emailed a letter of introduction advising them of an upcoming telephone contact by the team. One week later, principals were contacted to confirm that they had worked in their current school longer than six months, and to solicit participation. If unavailable, the school principal nominated a vice-principal (n = 7/171) or another staff member (n = 5/171) to complete the interview.

Data were collected from 2016 to 2019 in two-part, structured telephone interviews

(median length 52.0 minutes) administered by trained interviewers in English or French. Participants provided data on school characteristics (i.e. school neighbourhood, funding from external sources, student demographics, perceived importance of specific student health issues), participant characteristics (i.e. sex, age, position, years working in the school) and availability of HPIs and extracurricular activities.

HPIs were defined as activities complementary to the educational curriculum offered to all students during class time at no cost, for which student attendance is mandatory. Information on HPIs for selected health theme areas is available elsewhere.[26] HPI availability was measured by asking: "In the past year, has your school offered any health-promoting interventions in which participation is expected at the group, class, grade, or school level to address …?", followed by a list of eight themes (physical activity/active living, sex education, healthy eating, bullying/exclusion, personal safety/injury prevention, mental health and well-being, oral health, tobacco control). Response options were Yes or No.

Participants were then asked to select one HPI offered within the last three years in order to respond to specific questions related to planning, implementing and sustaining that specific HPI. HPIs mandated by the government were ineligible for this section of the questionnaire. Questionnaire items were developed *de novo* or drawn or adapted from questionnaires used in previous work.[28] A retired school principal with more than 30 years' experience working in Quebec schools was centrally instrumental in developing the questionnaires. English and French questionnaires were pilot-tested by asking nine retired principals to narrate their thought processes as they interpreted the questions and formulated responses.

Ethics approval

Ethics approval was obtained from the Centre hospitalier de l'Université de Montréal (CHUM) Ethics Review Committee (2013-4130, CE 12.307).

Study variables

HPI theme area addressed by the HPI selected for in-depth questions was measured by asking: "What aspect(s) of your students' health and well-being does [name of intervention] primarily address?", followed by a list of 12 theme areas (smoking prevention, tobacco control education, aggressive behaviour, mental health [e.g. anxiety], bullying/cyberbullying, physical activity, healthy eating, addiction prevention, personal hygiene, puberty, personal safety/injury prevention, oral health). Descriptions of selected HPIs for each theme area are reported elsewhere.[26]

Perceived success of the HPI selected was measured using four items: (1) [intervention] met all objectives; (2) abandoning [intervention] had/would have a negative effect on the students; (3) [intervention] had a positive impact on students; and (4) animators enjoyed working on [intervention]. Participants responded to each item using a 5-point Likert-type response scale ranging from 1 (strongly disagree) to 5 (strongly agree). To create a mean score, responses were summed and divided by the number of items to which participants responded. Cronbach alpha for the score was 0.7. To provide evidence for convergent construct validity, we correlated perceived success against perceived permanence of the HPI (not at all, moderately, very permanent); the correlation coefficient was 0.27 ($p < 0.01$). Although perceived success does not measure whether the intervention actually resulted in behaviour change, it is a relevant indicator, since school principals who perceive an HPI as successful are more likely to invest resources and effort in its sustainability and in implementing other HPIs.[29]

Potential correlates of perceived success of the HPI were selected based on factors known to be associated with successful HPIs[30] and on availability of data in Prome*SS*. These included 11 school-related variables, namely number of students (range 37.0–889.0); number of (full- and part-time) teachers (range 5.0–58.0); language of instruction (English, French); percent of students in nutrition support program (range 0.0–100.0); school neighbourhood (urban, suburban, rural); teacher turnover (several, some, few, none); parent/community engagement in school (range 1.8–5.0); school/teacher commitment to student health (range 1.1–4.9); school physical environment (range 1.1–5.0); and principal leadership (range 2.6–5.0).

In addition, each school was ranked according to the 2016-2017 school deprivation indicator,[31] which is a composite score based on data for each student within the school reflecting whether the mother had completed high school and whether both parents were employed full-time. Scores ranged from 1 (lowest deprivation) to 10 (highest deprivation) and for descriptive purposes, schools were grouped into three categories: schools serving very advantaged students (i.e. school deprivation score = 1–3), those serving moderately advantaged students (4–7) and those serving disadvantaged (8–10) students.

Eight potential correlates related to the structural characteristics of the HPI were investigated: number of years HPI had been available in the school (range 1–43); number of competencies addressed by HPI (range 1–6); grades that received the HPI (yes/no for every grade); HPI was … a special event (yes/no), a pedagogical activity (yes/no) or a program (yes/no); number of learning strategies used in the HPI (range 0–4); and whether the school had a primary partner for the HPI (yes/no).

Nine potential correlates related to planning/implementing the HPI were studied: presence of implementation team leader (yes/no); number of implementation team members (range 2–42); HPI modified prior to implementation (yes/no); HPI modified during implementation (yes/no); school preparedness (range 1.0–5.0); program champion (at adoption or implementation stage; yes/no); number of types of evaluations conducted (range 0–7); school board involved in implementation (yes/no); and whether HPI was developed de novo (by the school) or adopted/adapted from an existing HPI.

Participant characteristics included sex, age, current position in school (principal, vice-principal, teacher), highest level of education completed, number of years of experience in current school (range 1.0–10.0) and number of years at current position (range 1.0–10.0).

Appendix A (available upon request) describes each potential correlate in detail, including questionnaire item(s), response options, coding for analysis and Cronbach alpha for scales.

Data analysis

We used descriptive statistics to characterize study schools and participants. Means

and standard deviation are presented for normally distributed variables, and medians and interquartile ranges for variables that were not normally distributed. To avoid issues of multiple testing, each potential correlate was investigated independently as a single hypothesis, and only two statistical tests (i.e. an unadjusted and a multivariable linear regression model) were performed for each potential correlate.[32,33] All multivariable models were adjusted for number of students, language of instruction, school neighbourhood and school deprivation. We did not test an omnibus model including all potential correlates, since this approach can be affected by an underdeveloped understanding of the possible relationships across all variables (especially in a cross-sectional study design), which can result in bias from over- or unnecessary adjustment. Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). All statistical tests were two-sided, with the significance level set at 0.05.

Results

School characteristics

The study sample included 163 elementary schools (i.e. for which data on perceived success for their chosen HPI were available) that were similar to all eligible elementary schools in Quebec (n = 1795). Specifically, 21% of schools in our sample served very advantaged students versus 24% of all eligible elementary schools; 44% versus 39% served moderately advantaged students and 36% versus 38% served disadvantaged students.[31] French was the official language in 83% of school boards in our sample versus 90% overall. The median number of students per school (n = 267) was similar to that in all eligible schools (n = 259).[26] One-quarter (25%) of study schools were located in urban neighbourhoods, 36% were suburban and 40% were rural. School principals reported French as the mother tongue of 98% of students. Finally, 42% of participants reported high teacher turnover and 22% reported high school principal turnover.

Participant characteristics

Sixty-nine percent of participants were female and almost all (97%) were the school principal. Mean (SD) age was 47.3 (7.4) years (range 30–60 years). Participants had worked a mean (SD) of 3.4 (2.6) years (range 1–10) in their current school and 7.1 (3.4) years in their current position (range 1–10).[26]

Description of HPIs

HPIs selected for in-depth questions by the participant often addressed more than one theme area (e.g. physical activity and healthy eating; bullying and mental health). Among the 171 schools studied, 154 different HPIs were reported. More than half (58%) of HPIs addressed physical activity (e.g. daily 15-minute walk for students and staff); 43% addressed healthy eating (e.g. healthy cooking workshop animated by the teacher); 30% addressed personal safety and/or injury prevention (e.g. workshop in conjunction with improved policy to promote safe walking and biking to school); 26% focussed on bullying; 25% targeted aggressive behaviour (e.g. in-class conversations animated by teachers or psychosocial staff); and 21% addressed mental health (e.g. teacher-led workshop to teach young children to verbalize emotions through storytelling). Few HPIs selected by participants for in-depth questions addressed personal hygiene (9%), puberty (6%), addiction prevention (5%), oral health (3%) or tobacco prevention and education (2%).

Perceived success of HPIs

Scores for perceived success of HPIs ranged from 2.3 to 5.0, with a mean (SD) of 4.3 (0.5). The assumption of normality in the distribution of scores was supported.[34]

Correlates of perceived success

Results of the multivariable linear regression analyses adjusting for number of students, language of instruction, school neighbourhood and school deprivation indicated that four of 11 school characteristics were associated with perceived success of the HPI including lower teacher turnover, school physical environment, school/teacher commitment to student health and principal leadership (Table 1). No variable describing structural characteristics of the HPI was associated with perceived success (Table 2). Finally, only one of nine variables related to HPI planning or implementation was related to perceived success. Specifically, being a developer (vs. an adopter) of the HPI related to higher scores of perceived success (Table 3).

Discussion

In this study of Quebec elementary schools, we drew on our conceptual model depicting key elements to consider in the delivery of school-based HPIs, to select potential correlates of perceived success. Although school principals generally perceived HPIs as highly successful, there was variability in perceived success scores, and five factors emerged as correlates. These pertained to school characteristics and to planning and implementing HPIs, but none of the HPI structural characteristics investigated were retained.

School characteristics

Because both the environment and the "actors" involved in a school-based intervention can influence how an intervention is delivered and whether it produces the intended effects,[35] we investigated the context of health promotion programming[36] according to school-level correlates. Among 11 variables describing school characteristics, four (i.e. lower teacher turnover, school physical environment, school/teacher commitment to student health, principal leadership) were associated with perceived HPI success.

First, frequent turnover of school staff could challenge HPI implementation because of lack of continuity, changes in staff priorities and motivation and loss of the "corporate history."[37] It may be prudent for educators and HPI developers to incorporate training larger numbers of staff in HPI implementation, and to foster institutionalizing HPIs into the school curriculum.[24]

Second, as in earlier studies,[24] HPIs were perceived as more successful when components of school culture, including school physical environment, school/teacher commitment to student health and principal leadership, were rated higher. School culture represents the shared beliefs and norms of the school[38] and encompasses the operational processes and motivations that guide HPI delivery. Availability of equipment and space can provide school staff with greater latitude in their HPI choice, increasing their probability of selecting an intervention that fits with the school context.

TABLE 1
Unstandardized beta (β) coefficients and 95% CIs from linear regression models for the association between school characteristics and perceived success of school-based health-promoting interventions (HPIs), Project PromeSS, 2016–2019 (n = 163)

	n	Perceived success Mean (SD)	β_{crude} (95% CI)	$\beta_{adjusted}$[a] (95% CI)
No. students[b]			0.00 (−0.04, 0.04)[c]	0.00 (−0.06, 0.06)[c]
37–267	81	4.25 (0.51)		
268–889	81	4.26 (0.52)		
No. teachers[b]			0.00 (−0.01, 0.01)	−0.01 (−0.03, 0.02)
5–18	67	4.26 (0.49)		
19–37	81	4.24 (0.51)		
≥ 38	15	4.31 (0.66)		
Language of instruction				
French	136	4.22 (0.51)	ref	ref
English	27	4.43 (0.49)	0.21 (0.00, 0.42)	0.21 (0.00, 0.43)
% of students in nutrition support program[b]			0.00 (0.00, 0.00)	0.00 (−0.01, 0.00)
0	105	4.29 (0.53)		
1–100	50	4.18 (0.49)		
School neighbourhood				
Urban/suburban	98	4.25 (0.51)	ref	ref
Rural	65	4.25 (0.52)	0.00 (−0.08, 0.08)	0.01 (−0.10, 0.11)
School deprivation[b]			0.00 (−0.03, 0.03)	0.00 (−0.04, 0.03)
High	34	4.32 (0.47)		
Moderate	71	4.21 (0.58)		
Low	58	4.27 (0.46)		
Teacher turnover[b]			**0.12 (0.03, 0.21)**	**0.13 (0.04, 0.21)**
Several	17	4.03 (0.54)		
Some	52	4.21 (0.52)		
Few	61	4.22 (0.49)		
None	31	4.46 (0.46)		
Parent/community engagement in school[b]			0.02 (−0.10, 0.15)	0.04 (−0.09, 0.18)
< 3.8	70	4.24 (0.49)		
≥ 3.8	93	4.26 (0.54)		
School physical environment[b]			**0.21 (0.08, 0.34)**	**0.20 (0.07, 0.33)**
< 3.6	88	4.15 (0.50)		
≥ 3.6	75	4.37 (0.51)		
School/teacher commitment to student health[b]			**0.25 (0.11, 0.39)**	**0.28 (0.13, 0.42)**
< 4.0	46	4.08 (0.55)		
≥ 4.0	117	4.32 (0.48)		
Principal leadership[b]			**0.19 (0.03, 0.36)**	**0.20 (0.04, 0.37)**
< 3.9	86	4.14 (0.50)		
≥ 3.9	60	4.36 (0.48)		

Abbreviations: CI, confidence interval; SD, standard deviation.

Note: Bold type indicates confidence intervals that do not include the null. Totals do not always sum to 163 because of missing data. The beta coefficient represents the change in perceived success for every 1-unit change in the correlate.

[a] All models adjusted for number of students, language of instruction, school neighbourhood and school deprivation.

[b] Responses for continuous potential correlates were categorized for descriptive purposes, and the mean (SD) was computed for each group. However, these variables were retained as continuous in the modelling.

[c] The estimate represents a change in the number of students per 100.

Third, school/teacher commitment to student health, which reflects emphasis on and commitment to health promotion by school staff, may positively influence how HPIs are perceived within schools where staff believe in their relevance.[39]

Finally, because school principals are central in guiding staff towards objectives, obtaining resources, distributing responsibilities and solving conflicts,[40] their leadership can be key. Multiple studies stress the need for strong leadership to facilitate HPI delivery.[41-45]

HPI characteristics

Roger's diffusion theory[25] posits that perceptions of the relative advantage, compatibility, complexity, trialability and observability of an intervention are key in selecting and evaluating interventions. We investigated characteristics of HPIs in two categories—structural characteristics, and planning and implementation.

Structural characteristics represent features of the HPI such as target audience and learning strategies used to transmit health knowledge and effect behaviour

TABLE 2
Unstandardized beta (β) coefficients and 95% CIs from linear regression models for the association between eight structural characteristics of school-based health-promoting interventions (HPIs) and perceived success of HPI, Project PromeSS, 2016–2019 (n = 163)

	n	Perceived success Mean (SD)	β_{crude} (95% CI)	$\beta_{adjusted}$ [a] (95% CI)
No. years HPI in school[b]			0.08 (−0.04, 0.20)	0.10 (−0.03, 0.23)
1	32	4.17 (0.56)		
2–5	85	4.25 (0.53)		
≥ 6	36	4.33 (0.43)		
No. of competencies addressed in HPI[b]			0.05 (0.00, 0.10)	0.04 (−0.02, 0.09)
1	58	4.28 (0.50)		
2	42	4.09 (0.56)		
3–6	63	4.34 (0.48)		
All grades received HPI				
No	56	4.36 (0.46)	ref	ref
Yes	107	4.20 (0.53)	−0.16 (−0.33, 0.01)	−0.15 (−0.32, 0.02)
HPI was a special event[c]				
No	114	4.29 (0.54)	ref	ref
Yes	49	4.17 (0.45)	−0.13 (−0.30, 0.05)	−0.11 (−0.29, 0.07)
HPI was a pedagogical activity[c]				
No	114	4.25 (0.55)	ref	ref
Yes	49	4.25 (0.42)	0.00 (−0.18, 0.17)	0.01 (−0.17, 0.19)
HPI was a program[c]				
No	93	4.22 (0.46)	ref	ref
Yes	70	4.29 (0.58)	0.07 (−0.09, 0.23)	0.04 (−0.13, 0.20)
No. learning strategies[b,d]			0.05 (−0.03, 0.14)	0.04 (−0.05, 0.13)
1	71	4.21 (0.57)		
2	55	4.23 (0.48)		
3	26	4.41 (0.41)		
4	11	4.26 (0.52)		
School worked with a partner				
No	50	4.31 (0.56)	ref	ref
Yes	113	4.23 (0.49)	−0.09 (−0.26, 0.09)	−0.09 (−0.26, 0.09)

Abbreviations: CI, confidence interval; SD, standard deviation.

Note: Bold type indicates confidence intervals that do not include the null. Totals do not always sum to 163 because of missing data. The beta coefficient represents the change in perceived success for every 1-unit change in the correlate.

[a] All models adjusted for number of students, language of instruction, school neighbourhood and school deprivation.

[b] Responses for continuous potential correlates were categorized for descriptive purposes, and the mean (SD) was computed for each group. However, these variables were retained as continuous in the modelling.

[c] Participants were instructed to choose all responses that applied to the questionnaire item: [Name of intervention] was a … (1) special event (e.g. health fair, guest speaker at an assembly, etc.) (specify); (2) pedagogical activity; (3) learning and evaluation situation; (4) program (specify); (5) other (specify).

[d] Participants were instructed to choose all responses that applied to the questionnaire item: What type of learning strategy was used for [name of intervention]? (1) lecture strategies: presentations, demonstrations; (2) individual work: independent practice; (3) interactive teaching strategies: group discussion, role-play, modelling; (4) social constructivist teaching strategies: peer education, tutoring, collaborative and cooperative learning; (5) other (specify).

change. Among eight variables in this category, none were associated with perceived success, although other studies do report that these features are associated with HPI effectiveness. In a systematic review, school-based substance use programs were more effective when focussed on competencies including social skills, self-control and problem-solving.[46] A review of obesity prevention interventions for preschool children identified interactive learning strategies, such as modelling, as key.[47] In our study, rather than focus on HPIs targeting a specific theme, we assessed a broad range of correlates of perceived success of diverse HPIs. Regardless of this heterogeneity, principals regarded most interventions as highly successful, suggestive that correlates other than structural factors might contribute more to perceived success.

We investigated nine characteristics related to planning and implementing HPIs. Based on Rogers' diffusion theory,[25] planning is the first phase of HPI delivery, comprising identification of a need for the HPI in the school and learning about alternate HPIs that can respond to that need.[48] Schools may seek information on existing interventions, be solicited by HPI developers or develop an HPI themselves. Implementation comprises delivering the intervention to students and may involve continuous adjustment to the school context.[27] In this study, the only planning and implementation characteristic associated with perceived success was that the "school developed its own HPI." Staff may feel more ownership of HPIs developed in-house, which may lead to higher levels of commitment and trust in expected benefits.[35,49] It is possible that in-house development produced HPIs better tailored to the school context, since school personnel likely have a well-developed understanding of their students' needs.

Strengths and limitations

Strengths of this study include that it examines numerous correlates of perceived

TABLE 3
Unstandardized beta (β) coefficients and 95% CIs from linear regression models for the association between nine factors related to planning/implementing school-based health-promoting interventions (HPIs) and perceived success of HPI, Project PromeSS, 2016–2019 (n = 163)

	n	Perceived success Mean (SD)	β_{crude} (95% CI)	$\beta_{adjusted}$[a] (95% CI)
No. implementation team members[b,c]			−0.01 (−0.03, 0.01)	−0.01 (−0.03, 0.01)
2–4	50	4.31 (0.39)		
5–42	41	4.18 (0.54)		
Implementation team leader[c]				
No	27	4.17 (0.45)	ref	ref
Yes	65	4.28 (0.48)	0.12 (−0.10, 0.33)	0.10 (−0.12, 0.31)
HPI modified prior to implementation				
No	96	4.23 (0.49)	ref	ref
Yes	48	4.30 (0.52)	0.07 (−0.11, 0.24)	0.05 (−0.13, 0.23)
HPI modified during implementation				
No	65	4.23 (0.51)	ref	ref
Yes	98	4.27 (0.52)	0.04 (−0.13, 0.20)	0.04 (−0.12, 0.21)
School preparedness[b]			**0.09 (0.01, 0.17)**	0.08 (0.00, 0.16)
0–2.75	90	4.17 (0.55)		
≥ 2.76	73	4.36 (0.45)		
Program champion				
No	55	4.14 (0.54)	ref	ref
Yes	106	4.30 (0.49)	0.16 (−0.01, 0.33)	0.14 (−0.03, 0.32)
No. of types of evaluation[b,d]			0.05 (0.00, 0.10)	0.05 (0.00, 0.11)
0	3	4.06 (0.82)		
1	14	4.27 (0.69)		
2	21	4.17 (0.48)		
3	37	4.12 (0.55)		
4	44	4.30 (0.47)		
5	21	4.23 (0.45)		
6–7	23	4.48 (0.43)		
School board involved in implementation				
No	116	4.20 (0.52)	ref	ref
Yes	30	4.36 (0.40)	0.16 (−0.04, 0.37)	0.18 (−0.03, 0.38)
School				
Developed HPI	97	4.35 (0.45)	ref	ref
Adopted HPI	66	4.12 (0.57)	**−0.23 (−0.39, −0.07)**	**−0.24 (−0.40, −0.08)**

Abbreviations: CI, confidence interval; SD, standard deviation.

Note: Bold type indicates confidence intervals that do not include the null. Totals do not always sum to 163 because of missing data. The beta coefficient represents the change in perceived success for every 1-unit change in the correlate.

[a] All models adjusted for number of students, language of instruction, school neighbourhood and school deprivation.

[b] Responses for continuous potential correlates were categorized for descriptive purposes, and the mean (SD) was computed for each group. However, these variables were retained as continuous in the modelling.

[c] Only HPIs with team members responded to this question.

[d] Participants were instructed to choose all responses that applied for the questionnaire item: Did your school do any of the following to evaluate [name of intervention]? (1) Hold regular meetings; (2) Obtain feedback from the [name of intervention] animators; (3) Document the extent to which implementation was carried out in accordance with the plan; (4) Document the number of students participating in the [name of intervention]; (5) Document the barriers and facilitators to implementation; (6) Formally evaluate the outcomes of the [name of intervention]; (7) Other (specify).

success across a wide variety of HPIs. In addition, although Prome*SS* included a convenience sample of schools, which could limit generalizability,[50] the characteristics of Prome*SS* schools resembled those of all eligible elementary schools in Quebec.

Limitations include that, although responses from a single person within a school may not provide an accurate portrayal of the organizational perspective, data collection from multiple respondents within the same school was not feasible. However, the Prome*SS* questionnaire was sent to participants in advance of the interview so that participants could consult their staff in preparation for the interview. Our measure of perceived success was created *de novo*. Until its validity and reliability are established, the interpretation of absolute differences between scores remains uncertain. Further, responses were right-skewed (i.e. more participants perceived success favourably), which limited variability and may have rendered detection of correlates more difficult. Recall error could have resulted in misclassification bias in the observed associations. Finally, the precision of estimates in Prome*SS* was limited because of the relatively small sample size.

Conclusion

School personnel in elementary schools generally perceived that school-based HPIs

are highly successful. Correlates of perceived success include low teacher turnover, positive school physical environment, school/teacher commitment to student health, principal leadership and developing the HPI *de novo*. If replicated in other independent studies, these factors should be considered by HPI developers and school personnel when planning and implementing HPIs in schools.

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Conflicts of interest

The authors have no competing interests.

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Authors' contributions and statement

All authors contributed to conceptualization of the study objectives and analytic plan, interpreted the results and reviewed and revised the manuscript. EOL conducted the analyses, reviewed the literature and drafted the manuscript. JK developed the school culture variables, wrote the discussion and reviewed the manuscript. AP conducted analyses and reviewed the manuscript. TR contributed to analysis of the results and reviewed the manuscript. JOL developed and oversaw all aspects of Project Prome*SS* including its conceptualization, funding, design and data collection. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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