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The search for healthy schools: A multilevel latent class analysis of schools and their students

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ABSTRACT

The objective of this study was to establish and investigate a taxonomy of school health among high school students in Ontario, Canada. Data analyzed were based on 3358 9th–12th graders attending 103 high schools who participated in the 2011 Ontario Student Drug Use and Health Survey. Based on 10 health-related indicators, multilevel latent class analysis was used to extract 4 student-level latent classes and 3 school-level latent classes. Unhealthy schools (19% of schools) had the lowest proportion of healthy students (39%) and the highest proportion of substance-using (31%) and unhealthy (18%) students. Healthy schools (66%) contained the highest proportion of healthy students (56%) and smaller proportions of substance-using (22%) and unhealthy students (8%). Distressed schools (15%) were similar to healthy schools in terms of the proportions of healthy and unhealthy students. Distressed schools, however, were characterized by having the largest proportion of distressed students (35%) and the lowest proportion of substance-using students (4%). Meaningful categories of schools with respect to healthy environments can be identified and these categories could be used for focusing interventions and evaluating school health programs.

1. Introduction

Schools provide environments that can influence student health and well-being. As such schools are well-positioned to provide health-enhancing policies and programs (Poland et al., 2000; Sawyer et al., 2012; Lee and Gortmaker, 2012), with evidence for the effectiveness of some school-based interventions (Dobbins et al., 2009; Dobbins et al., 2013; Kahn et al., 2002; Stewart-Brown, 2006). Yet, the school is also a setting where students are exposed to influences potentially detrimental to their health (Forrest et al., 2013).

Concepts such as "healthy schools" (Lee et al., 2010), "health promoting schools" (Stewart-Brown, 2006; Lee, 2009; World Health Organization, 1998), "comprehensive school health" (WHO Expert Committee on Comprehensive School Health Education and Promotion, 1995), and "coordinated school health" (Centers for Disease Control and Prevention, 2013) have gained prominence. These are intuitively appealing and compatible with broader principles of health promotion (World Health Organization, Health and Welfare Canada, Canadian Public Health Association, 1986; World Health Organization, 1997) and ecological models of health (Lee, 2009; McLeroy et al., 1988; Stokols, 1992; Sallis et al., 1999). The concept of healthy schools is endorsed by initiatives such as a coordinated framework developed through the School Health Policies Study (SHPPS) (Centers for Disease Control and Prevention, 2013). However, discussions about healthy schools are arguably more conceptual and prescriptive than evidence-based.

Although the generic concept of healthy schools is inherently positive, the features and composition of a healthy school remain largely uncharted. Which indicators comprise school health and how these are distributed are unclear. Also unclear is whether healthy schools are associated with, or result in, healthy students. Few studies have assessed the characteristics of healthy schools or their relationship to student health behaviours and well-being (Stewart-Brown, 2006), though a recent Cochrane review (Langford et al., 2014; Langford et al., 2011) assessed evidence from cluster randomized controlled trials on the effects of the WHO Health Promoting School Framework. The results indicated evidence of effectiveness for some interventions on particular health outcomes, but not others.

A more fundamental question is whether schools can be simply dichotomized as healthy or unhealthy, or whether a more complex

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taxonomy is necessary to describe them. Identifying a classification of school health would enhance our understanding of the meaning of healthy schools in addition to having potential implications for both public health and education policy and programs. To date, most previous research on health-related behaviours of adolescents has focused on students and schools using multilevel models based on single observed dependent variables, ignoring the interrelationships of multiple dependent measures constituting health, as well as the interrelationships of the multiple independent school characteristics defining healthy schools (Due et al., 2009; Goodman et al., 2003; Kairouz and Adlaf, 2003; Kristjansson et al., 2013; Leatherdale et al., 2005; Lee et al., 2013; Maes and Lievens, 2003; Rehm et al., 2005; Richmond et al., 2006; Richmond and Subramanian, 2008; Saab and Klinger, 2010). Other studies have restricted their investigations to single level, person centered mixture models such as latent class analysis (LCA), but ignoring the hierarchical structure of their student-school data (Chung et al., 2006; Connell et al., 2009; Conway et al., 2013; Jiang et al., 2010; Sullivan et al., 2010). In this paper we explore the question of whether there is a distinct taxonomy of school health by applying recently developed statistical techniques to examine health-related behaviours with data from a representative sample of high school students. In Canada, education is a provincial responsibility and students normally attend elementary (grades K–6), middle (Stewart-Brown, 2006; Forrest et al., 2013) and high school (Lee et al., 2010; Lee, 2009; World Health Organization, 1998; WHO Expert Committee on Comprehensive School Health Education and Promotion, 1995).

2. Methods

Our analysis is based on a sub-sample of 3358 students attending 103 high schools completing questionnaire items in our study. This sub-sample was derived from the 2011 Ontario Student Drug Use and Health Survey (OSDUHS), a biennially-repeated survey conducted by the Centre for Addiction and Mental Health (CAMH) and administered by York University's Institute for Social Research (ISR). This province-wide survey employs a stratified (region and school level), two-stage cluster (school, class) sampling design with unequal probability weighting and monitors substance use, mental and physical health, and risk behaviours among students in grades 7–12. The 2011 cycle comprised 9288 students attending 181 publicly funded elementary/middle and high schools in Ontario. Signed parental permission (for those aged under 18) and signed student assent were required for participants and students completed self-administered questionnaires during a regular class period. The school and student response rates were 71% and 63%, respectively. OSDUHS 2011 received approval from the Research Ethics Boards of CAMH, York University, and school boards requiring review (for details including questionnaires: http://www.camh.net/Research/osdus.html.)

2.1. Latent class indicators and covariates

We used 10 health-related indicators to extract student latent class membership, grounded in the Ontario Ministry of Education's (EDU) Foundations for a Healthy School Framework (http://www.edu.gov.on.ca/eng/healthyschools/foundations.html). Accordingly, health-related factors in domains such as healthy eating, physical activity, injury prevention, substance use, mental health, and healthy growth and development are the central curriculum-linked components of a healthy school (see Table 1 for indicators). Each indicator was binary coded with the value 1 depicting a healthy response. Definitions of the indicators are provided in the Supplemental materials (available online).

Student-level covariates included sex (female = 1, male = 0) and grade level (9th–12th), measured by three dummy variables, with the 9th grade set as the reference category. Both have been shown to be predictive of adolescent health behaviours (Centers for Disease Control and Prevention, 2012; Hibell et al., 2012; Leatherdale and Burkhalter, 2012; Paglia-Boak et al., 2012).

Table 1
Characteristics of high school students (n = 3358) from 103 schools in Ontario, Canada, 2011.

	Percent[a]	N[b]
Latent class indicators		
Consumed breakfast during past 5 school days	52.1	1746
Enrolled in physical education class	38.4	1281
Not exposed to bullying at school	74.2	2475
Did not ride in a vehicle with alcohol/drug using driver	65.7	2197
No cigarette smoking in the past 12 months	88.2	2957
No cannabis use in the past 12 months	69.3	2326
cNo binge drinking in the past 4 weeks	69.3	2320
Without elevated psychological distress	63.5	2128
No involvement in suicidal behaviours	88.8	2963
Healthy weight	74.7	2454
Student-level predictors of student-level latent class membership		
Sex		
Female	48.9	1815
Male	51.1	1543
Grade		
9	22.7	879
10	22.8	825
11	23.9	808
12	30.6	846
School-level predictors of school-level latent class membership		
School enrollment		
Small, ≤600 students	19.4	20
Not small, >600 students	80.6	83
Percentage of students in lower-income households, M (SD)	12.3	(7.5)

[a] Percentage is weighted.
[b] N is unweighted.

We obtained two school-level covariates for the 2011/2012 school year from the EDU website http://www.edu.gov.on.ca/eng/sift/glossary.asp: the percentage of students living in low income households and school enrolment. Following Leithwood & Jantzi (Leithwood and Jantzi, 2009), we contrasted smaller schools (≤600 students; coded 1) from larger schools (>600 students; coded 0). Low household income was represented by the percentage of households in the school area with census defined low incomes. Research has also linked school-level socioeconomic status (SES) disadvantage with levels of physical activity (Richmond et al., 2006), obesity (Lee et al., 2013; Richmond and Subramanian, 2008), emotional well-being (Saab and Klinger, 2010), depressive symptoms (Goodman et al., 2003), suicidality (Jablonska et al., 2014), and peer victimization (Due et al., 2009).

2.2. Statistical analyses

Multilevel latent class analysis (MLCA) (Asparouhov and Muthen, 2008; Henry and Muthen, 2010; Vermunt, 2008; Vermunt, 2003) was employed to empirically extract homogeneous latent classes of students based on their responses to 10 health-related indicators forming distinct latent classes of schools based on the distribution of student-level latent classes within schools. The MLCA model extends the traditional latent class (LC) framework to the multilevel context (in our example, the nesting of students in schools) by specifying categorical latent variables for *both* students (Level 1) and schools (Level 2) (Asparouhov and Muthen, 2008; Vermunt, 2003). In this model, student-level LCs are first extracted within clusters (schools), and then the random means from the student-level LC solution are used as indicators for a second LC model at the school-level. Furthermore, because our LC indicators were discrete, we employed nonparametric estimation not assuming normality (Henry and Muthen, 2010). Our rationale for using MLCA is that this approach allows us to explore more substantively meaningful Level 2 outcomes on the school level. The primary benefit of MCLA, then, is that not only are classes of