Alberta Journal of Educational Research, Vol. 57, No. 2, Summer 2011, 137-150

A Gradient in Education Due to Health? Evidence from the Study of Health Behavior in School-Aged Children

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Research exploring the relationship between education and health suggests that people with higher levels of schooling report better health. To emphasize health as a determinant of educational achievement, this article establishes a gradient in education by health among Canadian students. Using data from the 2006 Health Behaviour in School-aged Children (HBSC) study, the relationship between self-rated health and achievement is examined for 8,626 students from 131 schools. The variation of the gradient in education by health within and between schools suggests that increases in self-rated health are associated with increased achievement for students. Moreover, the within-school regression accounted for 2.7 % of the variation in achievement due to health, whereas the between-school regression slope accounted for 19.8% of the variation in achievement due to health. Inequalities in achievement associated with health were more pronounced between schools than within schools. Policy implications as they relate to the findings are discussed.

La recherche portant sur le rapport entre l'éducation et la santé donne à penser que les gens les plus instruits se disent en meilleure santé. Afin de mettre en relief la santé comme facteur déterminant dans le niveau d'instruction, cet article développe une échelle liant le niveau de scolarité et la santé chez les élèves canadiens. Puisant dans des données de l'enquête sur les comportements liés à la santé chez les enfants d'âge scolaire (2006), nous examinons le rapport entre la santé et la scolarité telles que décrites par 8 626 élèves provenant de 131 écoles. La variation notée dans le rapport scolarité/santé à l'intérieur des écoles et entre elles donne à penser que plus l'état de santé déclaré est positif, plus le rendement est élevé chez les élèves. De plus, la régression au sein des écoles représente 2,7% de la variation dans le rendement attribuable à la santé, alors que la régression entre les écoles représente 19,8 % de la variation dans le rendement attribuable à la santé. Les inégalités dans le rendement associé à la santé étaient plus prononcées entre les écoles qu'au sein des écoles. Nous discutons des incidences sur la politique qui découlent de ces résultats.

The relationship between education and health is well established in the literature with respect to adult populations over 25 years old (Cutler & Lleras-Muney, 2007; Freudenberg & Ruglis, 2007; Mirowsky & Ross, 2003). These studies that examine the relationships between education and health have generally emerged from fields such as health and economics and tend to explore the relationships between educational attainment and subsequent health behaviors and outcomes. Findings suggest that people with higher levels of schooling also report better health.

For example, analyses of data from the National Health Interview Survey (NHIS) support assertions that education is strongly predictive of adult health (Goesling, 2005). Such studies, described as gradients in health by education (Cutler & Lleras-Muney, 2007), have generally found strong associations between years of schooling and reports of being in good health; positive health behaviors such as not drinking and smoking; fewer lost days of work due to sickness; and reduced morbidity and mortality rates (Freudenberg & Ruglis, 2007; Grossman, 2000, 2005). Despite these consistent findings, it remains unclear whether education causally affects health or vice versa or whether "the relationship between education and health is spurious and driven by factors affecting both education and health" (Monheit, 2007, p. 233). Notwithstanding the resolution of these questions, it remains certain that education is considered one of the necessary social determinants of health that needs to be addressed to reduce disparities in health and socioeconomic conditions across populations (Low, Low, Baumler, & Huynh, 2005).

Such research has led policymakers in European countries to address health and schooling quality among young people. In their first conference (World Health Organization [WHO], 1997), the European Network of Health Promoting Schools (ENHPS) released the Thessaloniki declaration that embodies practical and conceptual links among education, health, participatory values, and policy formulation and implementation. The impetus for these comprehensive school approaches stems from the realization that healthy students are better learners (Whitty, Aggleton, Gamarnikow, & Tyrer, 1998). Similar policies are now being enacted throughout Canada. A consensus statement on Comprehensive School Health released in 2006 by the Canadian Association of School Health, and endorsed by a number of national organizations, emphasizes the need to reduce the risk of health-related problems and support the healthy growth and development of children and youth. Earlier, Ontario's Ministry of Education introduced a new school health program with the intent of "making Ontario schools healthier places to learn" (Kennedy, October 20, 2004). Furthermore, a Pan-Canadian Joint Consortium for School Health has been initiated by health and education deputy ministers across Canada. Its first national symposium, *The Communities and Schools for Health*, was held in November 2004. The Joint Consortium for School Health supports the advancement of comprehensive school health approaches, stating that these initiatives can lead to improvements in children's health and well-being as well as their academic achievement (2007).

These provincial initiatives are enacted because schools are considered "social systems for health" in communities with the potential to enhance the health of their populations (Rowling & Rissel, 2000). If establishing comprehensive school health initiatives can lead to improved health and academic achievement of students, there is a rationale to establish the health-education connection. Moreover, research in the field of education has identified family, peer, and economic factors as contributing to academic failure; "often lost in this inquiry, however, is consideration of physical and mental health problems for academic performance" (Needham, Crosnoe, & Muller, 2004, p. 569).

Purpose

In this article we examine the association between health and academic achievement. Adapting models developed by Willms (2003, 2006) to examine the socioeconomic gradient for schooling outcomes, we created a gradient in education by health to represent the relationship between health and student achievement, in this case students' self-reported academic achievement. The

purpose of our work is to examine the relationship between self-rated health and academic achievement and to determine if this relationship varies across schools. The following research questions focused our work.

- Is there a gradient in education by health among Canadian students?
- Does the gradient in education by health vary significantly within and between schools?
- What can the between-school and within-school education by health slopes tell us?

Education and Self-Rated Health

"Health and education appear to be inextricably linked: good health is necessary for effective learning and education is necessary for maintaining good health" (Devaney, Schochet, Thornton, Fascianao, & Gavin, 1993, p. 2). Cutler and Lleras-Muney (2007) suggest that poor health among young people contributes to lower levels of schooling and that increased educational attainment directly improves health even when controlling for family background and socioeconomic status. Research with school-aged children suggests that perceptions of one's health, as assessed by self-rated health and school achievement, go hand-in-hand. For example, Koivusilta, Arja, and Vikat Andres (2003) found self-rated health and health behaviors at age 14 to be predictive of educational attainment in adulthood. Perceptions of one's health measured through self-report provides a summary of subjective as well as objective aspects of health combined with an individual's perceptual framework (Kaplan & Baron-Epel, 2003). Self-rated health is widely used and is considered a valid measure of health status as well as morbidity and mortality (Idler & Benyamini, 1997). Generally, self-rated health among adult populations has been found to reflect physical health problems such as limitations of physical functioning, chronic and acute conditions, and mental health problems. Yet self-rated health among youth appears to encompass more than physical symptoms. For example, Vingilis, Wade, and Adlaf (1998) proposed that self-rated health among high school students in Ontario was a somatic expression of life distress, which could explain the consistent findings about the relationships between self-rated health and social and economic disadvantages among young people. Wade, Pevalin, and Vingilis (2000) suggest that factors in the external environmental both distal and situational may be associated with self-rated health, including family socioeconomic status, family attachment, tobacco use, self-esteem, and even school achievement. In their study of adolescents in public high schools, Zullig, Valois, and Drane (2005) found that both self-reported mental health and self-reported physical health contributed significantly to adolescents' self-rated health, yet in these samples this was "based more strongly on mental health and to a lesser extent on physical health" (p. 7), a finding that is contrary to research with adult samples.

Despite the existence of a small body of research examining correlates of self-rated health among adolescents, we came across only one study that examined the association of self-rated health with academic outcomes. Using data from the National Longitudinal Study of Adolescent Health (Add Health), a large school-based study of adolescents, their schools, and their families in the United States, Needham et al. (2004) conducted a series of logistic regressions of secondary school students to explore whether physical and mental health problems were risk factors for academic failure, controlling for individual and contextual correlates of both health and academic status. To control for preexisting physical and mental health problems in the sample, only students who received no special education services in the 12 months before the

first wave of data-collection were included in the study. The data collected demonstrate that self-rated health and emotional distress are both associated with a greater likelihood of failing a class in the subsequent year, controlling for socio-demographic characteristics. Specifically, the odds of failing one course or more during the second wave of the study were 34% greater for students who rated their own health as fair or poor during the first wave of the study compared with those who rated their health as good to excellent, controlling for prior academic achievement. In summary, adolescents in the study who reported poor self-rated health or emotional distress were also more likely to experience academic failure.

The link between the health status of students and their academic achievement has not been closely examined or documented in Canada. There is increased emphasis on promoting students' health through schools because health is a valued outcome in itself and because it has been identified as an important determinant of students' academic achievement (Joint Consortium for School Health [JCSH], 2007; St. Leger, 2004). Our research provides an important first step in understanding the relationships between students' health and achievement in a Canadian context.

Data and Methodology

The Health Behaviour in School-aged Children (HBSC) study is a cross-sectional survey developed through an interdisciplinary, cross-national collaboration. HBSC is an ongoing international project sponsored by the WHO and in Canada by the Public Health Agency of Canada. The focus of the HBSC project is to examine the relationship among adolescent health and a wide range of determinants. The HBSC's underlying premise is that the determinants of education and health are closely linked. HBSC not only addresses traditional indicators of health behaviour, but also the structural and practical aspects of schools such as schooling processes, school climate, student attachment and connectedness to school, and the involvement of the community in school life. HBSC offers an opportunity for further understanding of how incorporation of factors related to the school context can contribute to the health and well-being of children and youth. HBSC uses a population health framework, recognizing that the determinants of health operate at two levels: (a) the individual level, and (b) the ecological level (Health Canada, 1994). Having begun in 1989, the HBSC now collects data every four years from students in schools across Canada. These represent three age groups: the onset of adolescence, age 11; the challenge of physical and emotional changes, age 13; and when important life and career decisions are beginning to be made, age 15 (Currie, Samdal, Boyce, & Smith, 2001). In Canada, the frame of reference as well as the sampling criterion is grades rather than age groups. In keeping with the HBSC international protocol where students represent three age groups, the grade-to-age equivalences present in the Canadian sample are: age 11=grade 6; age 13=grades 7 and 8; age 15=grades 9 and 10.

Data for this study came from the 2006 HBSC student survey. The sampling approach used the school class as the unit of selection, with classroom grades chosen to reflect the distribution of students in grades 6–10 in the Canadian population. Schools were selected using a weighted probability technique to ensure that the sample was regionally and demographically representative (religion, community size, school size, language of instruction). In total, the 2006 Canadian HBSC survey collected students' surveys from 187 schools, with a total sample of 9,670 students (47.4% boys and 52.6% girls). The sample consisted of 1,708 students in grade 6, 1,772 in grade 7, 1,897 in grade 8, 2,320 in grade 9, and 1,973 in grade 10.

Self-rated health (SRH) is assessed in the HBSC by asking students to respond to the following question: Would you say your health is: (a) excellent, (b) good, (c) fair, or (d) poor? Academic achievement is assessed using responses to the following question: Which of the following best describes your marks (overall average) during the past year? (a) excellent (mostly A's/above 85% / or level 4), (b) above average (mostly A's and B's/between 70 and 84%/or level 3 and 4), (c) average (mostly B's and C's/between 60 and 69%/or level 3), (d) below average (Mostly C's/between 50 and 59%/or level 2), and (e) poor (mostly marks below C/below 50%/or level 1). These benchmarks were established to best represent the various measures used across Canada. In some provinces a B is 80% whereas in others it is 85 and above. As an example, Ontario uses 80% and above to denote an A, 70% to 80% as B, 60% to 70% as C, and 50% to 60% as D. The scale is different in British Columbia (85% and above is an A, 73-85% is B, 50% to 73% is C, although this is separated into C–, C, and C+). C's are not typically average marks, especially in elementary and middle school. Average marks for students in these grades tend to range from 68-75%.

Underlying the data is a continuous distribution of marks that provided us the rationale to create an average score on these measures; however, the limitation is that the scales used may be more ordinal than continuous in nature.

Before addressing our research questions, we defined the gradient in education due to health as consisting of three components: (a) The *level* of the gradient, (b) The *slope* of the gradient, and (c) the *strength* of the gradient. These elements are based on Willms' (2003, 2006) socioeconomic gradient that examines the relationship of socioeconomic status (SES) and academic achievement outcomes based on PISA data. We substituted the SES measures with health measures from the HBSC. The *level* of the gradient is defined as the expected marks in the past year for a student with average SRH. The level of a gradient for a school is an indication of the overall performance of the school after taking account of students' SRH. The *slope* of the gradient is an indication of the extent of inequality attributable to SRH. Steeper gradients indicate a greater effect of SRH on marks, "that is, greater inequality—whereas gradual gradients indicate a lower effect of [SES]—that is, less inequality" (Willms, 2003, p. 5). The *strength* of the gradient refers to the extent to which marks vary above and below the gradient line. A strong relationship implies that a considerable amount of the variation in marks is associated with SRH, whereas a weak relationship indicates that relatively little of the variation is associated with SRH. The strength of the relationship is assessed by the R-squared value of the regression line.

Our first objective was to examine the associations of self-rated health with academic performance, or in other words, the gradient in education by health for students in our sample. Using the Statistical Package for the Social Sciences (SPSS 16), we conducted Ordinary Least Squares regression (OLS) to obtain the levels, slopes, and strengths of the gradient by separately regressing academic performance as a raw score on the standardized measure of self-rated health for each of the schools. For our analyses, only those schools having at least 30 students who completed the survey were selected in order to obtain relatively stable school estimates. The resulting sample comprised 8,626 students from 131 schools. The school samples ranged in size from 31 to 226 students, with a mean of 66 students per school. Slopes of the health gradient for the set of schools were derived from a set of within-school equations (for details around the parameters represented in this and equations below, see Appendix, Willms, 2003, 2006):

$$Y_{ij} = \beta_{0j} + \beta_{1j}X_{ij} + r_{ij}$$

where β_{0j} is the level of the gradient in education by health and β_{1j} is the slope of the gradient for the set of schools. β_0 is the expected achievement for a person with average SRH for a school. β_1 is the extent of inequality in academic achievement attributable to health. A steep slope indicates a pronounced relationship between health and achievement for a particular school.

Our second objective was to estimate the strength of the education-by-health gradients within and between schools. A school-level file with student aggregate data for health and achievement was created. The slopes (β_{ij}) from each regression equation for each of the schools were added as variables to this aggregate school file. The strength of the gradient was estimated by regressing academic performance on self-rated health for the 131 schools.

Our third objective was to examine whether the gradient in education due to health varied significantly within and between schools. Although the gradient lines derived from the OLS analysis do convey information about the distribution of academic achievement relative to SRH, this does not show how these relationships vary within and between schools. These effects can be estimated through a hierarchical analysis that accounts for the clustering of students in schools, which is not the case in OLS. A two-level HLM model (Version 6.06, Raudenbush, Bryk, Cheong, & Congdon, 2004) was employed in three stages. The first produced a null model containing no explanatory variables to explain the amount of variability present at each of the student and school levels and partitioning of variance into within-school (σ^2) and between-school (τ_{00}) components for each of the outcome measures (Snijders & Bosker, 1999). In the second stage, and following the recommendations of Raudenbush and Bryk (2002), SRH at the student level was added to the null model, the Level-1 model and its aggregate ($X_{.j}$) was included in the final Level-2 model. Applying group-mean centering to SRH in the Level-1 model allows the decomposition of the relationship between SRH and academic achievement into its within- (β_w) and between- (β_b) group components; β_w is the average *within-school* gradient in achievement due to health; β_w is defined here as the expected difference in achievement between two students in the same school who differ by one standard deviation unit on SRH; and β_b is the *between-school* gradient in achievement due to health and is defined here as the expected difference between the mean academic achievement of two schools that differ by one unit in mean SRH (Raudenbush & Bryk, 2002). The mean of the within-school slopes β_w for the 131 schools, is γ_{01}:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\overline{X_{1j}} + u_{0j}$$

The within-school slope consists of the variation in individual scores around their respective school means. The mean of the between-school slopes (β_b) for the 131 schools is γ_{10}:

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

Demonstrating the proportion of variation in schooling outcomes that is within and between schools allows the estimation of the contextual effect due to health on academic performance (Willms, 2003). Contextual factors include the social and economic characteristics of the community in which the school is located and the demographic composition of the student body

such as ethnicity and gender; family characteristics such as socioeconomic status and family structure; and academic achievement (Willms, 2003; Rumberger & Palardy, 2004). Contextual factors create a normative environment that promotes or undermines academic learning. According to Raudenbush and Bryk (2002), the contextual effect (β_c) "is the extent to which the magnitude of the organization-level relationship, β_b, differs from the person-level effect, β_w" (p. 139) and is estimated by the difference of the between-school slope and the within-school slope (β_b - β_w). In this article, β_c is the expected difference in achievement between two students who have the same levels of self-rated health (SRH), but who attend schools differing by one standard deviation unit in mean student SRH.

Results

In terms of the four categories of self-rated health (SRH) across the 131 schools, approximately 28.7% of students reported excellent health, 55.1% reported good health, 14.3% reported fair health, and only 2.0% (173 students) reported poor health. Thus most students reported that they believed they were either in good or excellent health. To the extent that the scale can be considered continuous, the students' mean health rating was 3.11 (on a 4-point scale) with a standard deviation of 0.71. The variability in students' health was much lower when their self-rated health was averaged according to school (*SD*=0.15). In terms of achievement during the previous year, 23.7% of students reported average marks that were 85% or greater, 45.8% reported marks between 70% and 84%, 24.1% reported marks between 60% and 79%, and 6.4% reported marks between 50% and 69%. None of the sampled students reported average marks of less than 50%. Hence we had only four categories of marks for our analysis. Considering achievement to be on a continuous scale, the average achievement score across students was 2.87 on the revised 4-point scale with a standard deviation of 0.85. Again, the variability was lower when students' marks were aggregated according to school (0.27). Thus there appears to be slightly less variability across schools in terms of students' self-rated health compared with their academic achievement.

There also appeared to be a significant and moderate relationship between SRH and marks (r=.45, p<.01). The correlation between SRH and marks indicates that higher levels of students' SRH were associated with higher overall marks. As an example, the sample of students reporting poor health had mean marks of 2.37, those reporting fair health had mean marks of 2.64, those reporting good health had mean marks of 2.91, and those reporting excellent health had mean marks of 3.03.

An initial examination of the relationship between SRH and marks for each of the 131 schools showed that this relationship was not consistent across schools, implying that the relationship between SRH and achievement is not fixed, but varies depending on the school examined. Figure 1 illustrates how the relationships between SRH and marks vary within and between schools. A student with an average SRH could be expected to have a mean achievement score of 2.87. The slope for the between-school gradient in education by health is .58. The within-school gradient line (see Figure 1) represents the average within-school gradient for the 131 schools. The slope for this gradient is 0.14, indicating that a unit increase in SRH results in a 14% of a standard deviation increase in achievement or an 0.12-points increase in letter marks for a student (standard deviation for marks=0.85; 14% of 0.85= 0.12).

In Figure 1, each diamond represents a school. Schools that lie above the within-school regression line have relatively higher marks than expected given their students' average SRH

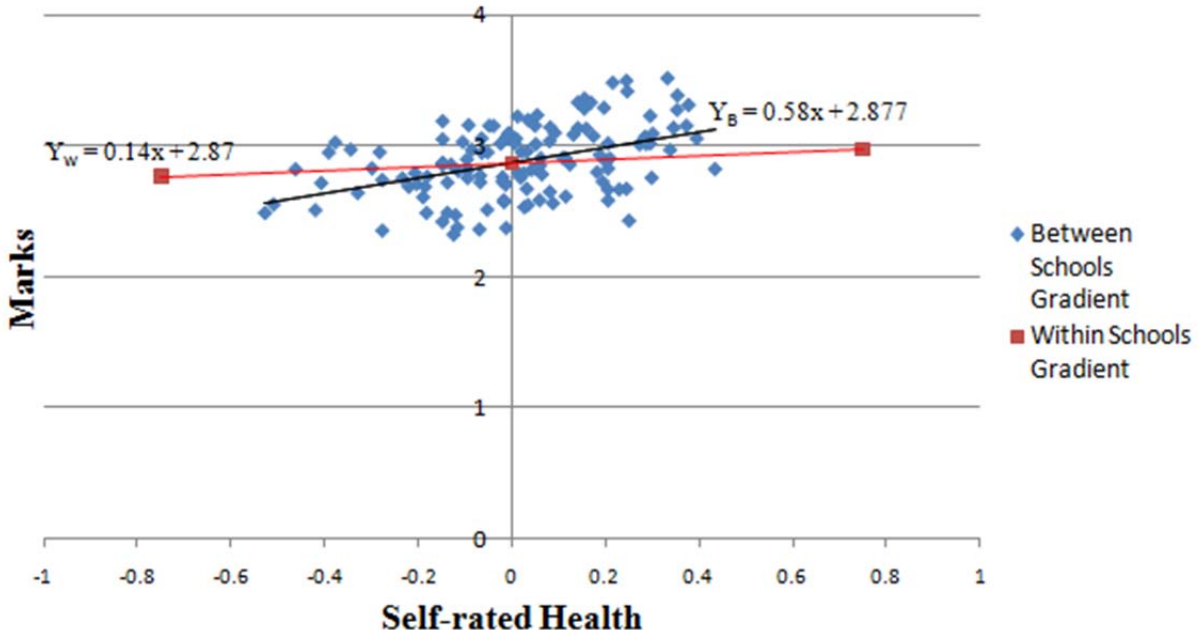

Figure 1. The strength of the between- and within-school gradients in education by health derived from OLS.

levels, whereas those below the line have relatively lower marks than expected given their students' average SRH levels. The within-school gradient in Figure 2, *R2* =.027, indicates that only 2.7% of the variation in marks within schools is associated with students' SRH. However, *R2* for the between-school gradient equals .198, implying that around 20% of the variation in marks between schools is associated with differences in the students' aggregated SRH within the school.

To illustrate the gradient in marks that could exist due to health, we identified and selected two pairs of schools with students with similar mean marks, but with significant differences on the health measure (see Figure 2). Such pairs of schools illustrate the health inequalities that exist between schools. The first pair of schools, schools 137 and 58, fell below the average student (within-school) gradient. Students reporting average health in school 137 had a grade average of 2.43, whereas those in school 58 had a grade average of 2.37. However, the relationship between health and marks for school 137 was more or less constant with little if any relationship between students' SRH and achievement. However, as suggested by the steeper slope for school 58, the relationship between SRH and marks is more pronounced in this school. Students' who reported higher levels of SRH also reported higher marks, with an increase of .30 in marks for each standard deviation increase in SRH. Thus in this school, students with higher levels of SRH were more likely to report higher marks.

School 121 and school 64 both had above average school achievement. Students reporting average health in these schools had average marks of 3.23 and 3.13 respectively. Again, the relationship between health and marks differed for these two schools. Increases in SRH were more closely associated with increased achievement for students in school 121 where the steeper gradient (0.50) indicates that a one standard deviation increase in SRH was associated with a .50-point increase in marks. Students in school 121 reporting higher levels of SRH tended to report higher marks than those reporting lower levels of SRH. On the other hand, although a student with average SRH in school 64 has similar performance to that of his or her counterpart in school 121, the differences in achievement between students reporting low SRH and high SRH

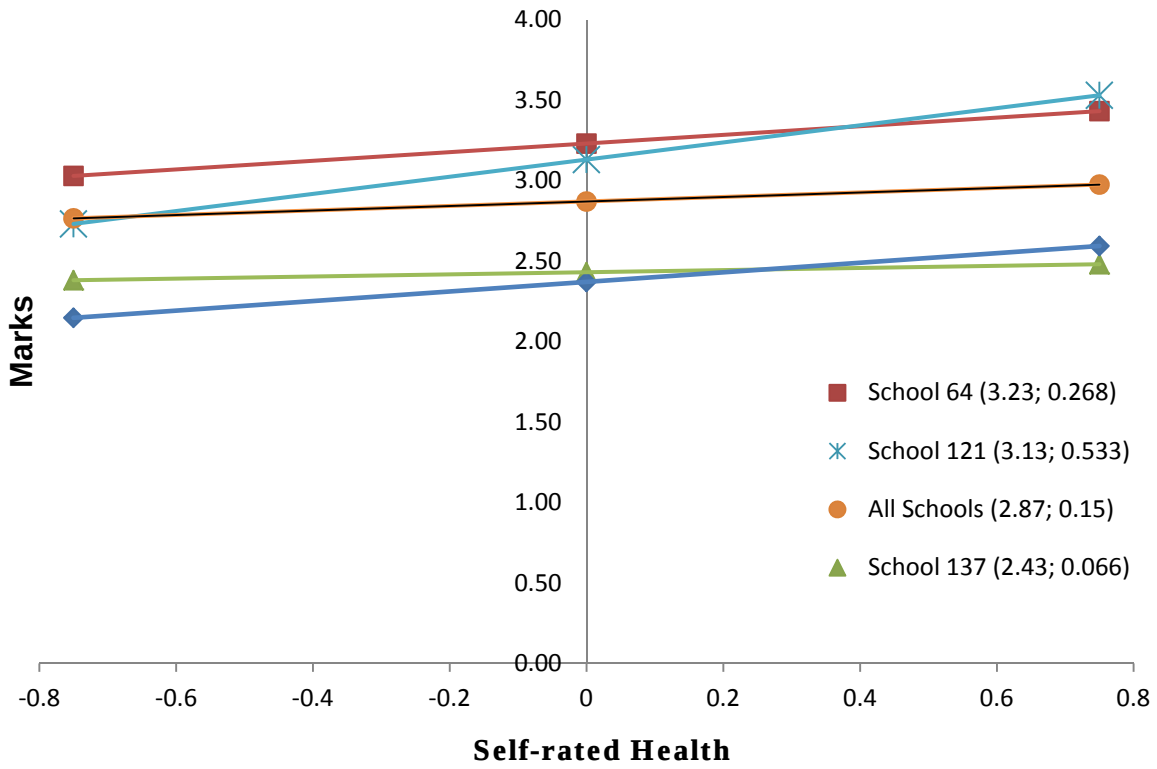

Figure 2. Within-school gradient and gradients for select schools.

Note. The first value in the bracket is the intercept corresponding to the designated school. This intercept refers to the academic achievement for a student in that school who reports mean (average) self-rated health across all schools.

The next value in the bracket refers to the slope of the gradient corresponding to the designated school. This value represents the change in marks associated with a one standard deviation unit increase in self-rated health for a student in that designated school. For example, on a 1 to 4 scale for marks, a student in school 58 would have a .30 increase in marks.

were not as pronounced. This suggests that the relationship between students' reported SRH and their achievement (marks) was much lower in school 64 than in school 121.

When the relationship between health and achievement exhibits variations across schools as is demonstrated in this analysis, a contextual effect is believed to exist. A contextual effect means that differences among social contexts, in this case among schools, are important in explaining individual differences in student outcomes (Duncan & Raudenbush, 1999). The contextual effect β_c in our analysis was 0.46 (β_b=0.64 and β_w=0.18), suggesting that approximately 75% of the variability in the within- and between-school slopes can be attributed to contextual factors attributed to the schools and the community in which the schools operate (Raudenbush & Willms, 1995).

Discussion and Implications

At the center of the comprehensive school health movement is improving health and educational achievement for all students in a school. In terms of an education-by-health gradient

perspective, this goal translates into not only raising the levels of achievement and student health, but also minimizing the extent to which poor student self-rated health is associated with lower academic performance. It is clear from our analysis that some schools are able to achieve both: higher levels of achievement (e.g., schools 64 and 121) and less variability in achievement across students with differing levels of self-reported health (e.g., school 64). The potential policy implications of our findings are that it may be possible to identify programs and interventions in schools that serve to ameliorate the differences in student achievement associated with varying health outcomes. At the same time, it may be possible to determine if some school policies tend to exacerbate the differences in student achievement associated with differences in students' health. For example, a school with a steep slope (e.g., school 121) could examine practices and policies that address those students with poor SRH. On the other hand, a school with low achievement and shallow gradients (e.g., school 137) may be better served by implementing broader school polices that focus on improving the academic achievement of all students while ensuring that students whose SRHs are compromised are also supported.

Our analysis also illustrates that the academic performance of students reporting poor health is on average 0.7 of a standard deviation lower than students who report high SRH (standard deviation for SRH =0.71; mean marks for students who report excellent health=3.03, while mean marks for students who report poor health=2. 37). Considering that health could be a determinant of academic achievement, identifying students who report lower levels of SRH may be useful in recognizing those who are at a greater risk academically. Such a process could allow schools to provide these students with additional supports and resources that may support their learning.

It is becoming more apparent that educational attainment is closely linked to health promotion efforts in school (Paulus, 2005) and the means by which schools promote student well-being through their organization and structure (Markham & Aveyard, 2003). Potential sources of variability in the relationship between health and academic achievement are those factors inherent in the structure and operations of a school. These have been described by Willms (2003) as contextual factors that consist of the environment in which teaching and learning takes place, school and classroom resources, interaction among peers, the relationships between teachers and students, the disciplinary climate of the classroom, and the norms for academic success. Other contextual variables are the school location (urban, suburban, or rural); size and type (public or private); as well as school resources such as the ratio of students to teachers.

The contextual effect in our analysis of 0.46 suggests that the difference in slopes can be explained by contextual factors attributable to schools or the collective properties of schools. These findings help explain our results that only 2.7% of the variation in marks within schools is associated with SRH, whereas about 20% of the variation in marks between schools is associated with SRH (Figure 2). Klinger, Rogers, Anderson, Poth, and Calman. (2006) state that achievement is not only related to the efforts and actions of individual students, "but also to the efforts and activities of schools and their staff" (p. 751); such contextual variables are important and need to be considered when examining student achievement. Studies have found that the social composition of schools predict school engagement, achievement, and dropout rates even after controlling for the effects of individual background characteristics of students (Willms, 2003).

Our analysis demonstrates a positive relationship between students' SRH and their academic marks. Needham et al. (2004) point out, "If child and adolescent health problems

destabilize student trajectories through the formal schooling system, then the negative long-term association between educational attainment and adult health may be due, in part, to these early health problems" (p. 582). Efforts that address the health needs of students and create opportunities for improved health need to be explored as possible venues for enhancing students' academic achievement. Further analyses of the HBSC 2006 data will examine the associations of school-level factors that are the contextual factors derived from the school-level surveys to student health outcomes.

Instruments and measures used in research programs such as the HBSC are limited by a variety of factors. These instruments commonly rely on self-reported scores, and the questions may require students to provide both retrospective and current information. As an example, it would be possible to acquire more reliable student achievement data if HBSC surveys were linked to provincial achievement data. Further, the HBSC health items typically refer to students' current health, whereas the achievement items refer to prior achievement. Because a portion of students move between schools each year, our attempts to measure between-school effects are compromised. Certainly our decision to use a minimum school sample of 30 students minimized this problem, but such issues highlight the potential problems with the cross-sectional data collected in studies such as the HBSC. Longitudinal data-collection methods that allow for the establishment of baseline measures are required to allow us to make causal inferences and establish the temporal order of the association between health and educational achievement. Although our analysis establishes only a limited associational model of health and marks, it does highlight the need for further exploration.

Policy recommendations outlined by Cutler and Lleras-Muney (2007) to diminish the gradients in health by education are designed to improve schooling and promote college and university attendance (National Poverty Center, 2007). In this respect, some argue that "health policy and education policy represent a two pronged approach to improving population health" (Monheit, 2007, p. 236). Others acknowledge the substantial interface between education and health at an early stage of human development and suggest that health promotion in its broad sense contributes to a school's educational aims. From this perspective, school factors and policies associated with higher student educational outcomes and those that promote the health and well-being of students are probably not discrete, but overlapping (Paulus, 2005). It is essential, then, that education and health sectors move to develop a common agenda and a shared public policy that can in tandem address the health of young people in schools and their academic achievement.

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Appendix

$$Y_{ij} = \beta_{0j} + \beta_{1j}X_{ij} + r_{ij}$$

Where Y_{ij} represents the achievement (marks) of student i in school j,
β_{0j} is the average achievement in school j,
X_{ij} is the SRH of student i in school j
β_{1j} is the predicted effect of student *i*'s SRH on his/her achievement in school *j* (slope of the gradient), and
r_{ij} represents the student-level error term.

β_{1j} provides a measure of the extent of inequality in academic achievement attributable to health. Steeper slopes indicate stronger relationships between students' self-reported health and their achievement in a school. In contrast, a school having a shallow line (gradient) is one in which changes in students' SRH are not strongly associated with changes in students' achievement.

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\,\overline{X}_{1j} + u_{0j}$$

Where γ_{00} represents the average mean achievement of all school means,
γ_{01} represents the mean of the within-school slopes β_w for all schools, and
u_{0j} represents the school-level error term.

The within-school slope consists of the variation in individual scores around their respective school means. The mean of the between-school slopes (β_b) for the 131 schools, is γ_{10}:

$$\beta_{1j} = \gamma_{10} + u_{1j}$$