

# Income Inequality and Health in Ontario

## A Multilevel Analysis

Guoliang Xi, MD, MSc

Ian McDowell, PhD

Rama Nair, PhD

Robert Spasoff, MD, MSc

### ABSTRACT

**Objective:** To examine the association of income inequality at the public health unit level with individual health status in Ontario.

**Methods:** Cross-sectional multilevel study carried out among subjects aged 25 years or older residing in 42 public health units in Ontario. Individual-level data drawn from 30,939 respondents in 1996-97 Ontario Health Survey. Median area income and income inequality (Gini coefficient) calculated from 1996 census. Self-rated health status (SRH) and Health Utilities Index (HUI-3) scores were used as main outcomes.

**Results:** Controlling for individual-level factors including income, respondents living in public health units in the highest tercile of income inequality had odds ratios of 1.20 (95% CI 1.04-1.38) for fair/poor self-rated health, and 1.11 (95% CI 1.01-1.22) for HUI score below the median, compared with people living in public health units in the lowest tercile. Controlling further for median area income had little effect on the association.

**Conclusion:** Income inequality was significantly associated with individual self-reported health status at public health unit level in Ontario, independent of individual income.

**MeSH terms:** Income distribution; Health Status Index

*La traduction du résumé se trouve à la fin de l'article.*

Department of Epidemiology and Community Medicine, University of Ottawa, Ottawa, ON

**Correspondence:** Guoliang Xi, Department of Epidemiology and Community Medicine, Faculty of Medicine, University of Ottawa, 451 Smyth Rd., Ottawa, ON K1H 8M5, Tel: 613-562-5800, ext.8158, Fax: 613-562-5441, E-mail: gxi@uottawa.ca

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Studies of income distribution and health have been carried out in many industrialized nations,<sup>1-7</sup> with mixed conclusions. In the United States, income inequality has consistently been found to be associated with health indicators such as mortality rates,<sup>8-10</sup> and mechanisms through which income inequality may affect people's health have been proposed.<sup>10</sup> However, recent studies within other nations, including Canada,<sup>7,11,12</sup> Japan,<sup>6</sup> and New Zealand,<sup>3</sup> did not support the association. It is not clear why the association exists in some societies but not in others. Although no significant effect of income inequality on health has been found in Canada, income inequality has been increasing in the past generation.<sup>13</sup>

We hypothesized that the increasing income gaps in Canada may have effects on Canadians' health. We examined the independent effect of income inequality at the public health unit (PHU) level on individual health as measured by self-rated health status (SRH) and the Health Utilities Index (HUI), after adjusting for an individual's income and other characteristics by using a multilevel analysis of Ontario Health Survey (OHS) data.

### METHODS

#### Sources of data

##### *Area-level Data*

Income distribution and median area income for Ontario PHUs came from the 1996 Census.<sup>14</sup> The 1996 Census contained information on annual household income before tax, including benefits and government transfer payments, for 11 income categories. Counts of the number of households falling into each income category along with the total aggregate income were obtained for each of 42 Ontario PHUs, and used to calculate Gini coefficients as measures of income inequality. PHUs were divided into terciles on the basis of the distribution of the Gini coefficients.

##### *Individual-level Data*

Data on individuals aged 25 or older were drawn from the Ontario Health Survey (OHS) 1996-97, an expansion of the National Population Health Survey (NPHS) 1996-97.<sup>15</sup> Our analyses included both core and supplementary samples. The

target population included household residents, excluding residents of Indian reserves, Canadian military bases, and some remote areas. The response rate in Ontario was 78.8%. Interviews were done by telephone, using random digit dialing.

Independent variables at the individual level included age (25-39, 40-64, or 65+ years), sex, smoking habits, household income, educational level, marital status, and regular exercise (yes, no). Smokers included current daily smokers and ex-smokers. Marital status was dichotomized into married and not married (widowed, divorced, separated, or never married). Educational attainment was categorized as less than post-secondary, post-secondary or higher. Income adequacy was classified by Statistics Canada into low-income, middle-income, and high-income groups based on total annual household income adjusted for the number of household members.<sup>15</sup>

## Measures of health outcomes

### Self-rated Health (SRH)

The 1996 Ontario Health Survey included the question, "In general, how would you say your health is?" We dichotomized responses, coding 1 if the respondent answered fair or poor, and 0 if good, very good or excellent.

### The Health Utilities Index (HUI-3)

The McMaster Health Utilities Index measures an individual's functional capacity, based on eight attributes: vision, hearing, speech, mobility, dexterity, cognition, emotion, and pain and discomfort.<sup>16</sup> It provides a single numerical value (between 0 and 1) for any combination of levels of these eight domains. Because the HUI scores were not normally distributed even after logarithmic transformation, we created a dichotomous outcome measure using the 50th percentile, or 0.947, as the cut-off.

### Statistical analysis

Separate multilevel logistic regression models were applied to examine the relationship of income inequality to poor/fair SRH and to the HUI (< 50th percentile), while controlling for a range of individual-level factors. The data were analyzed using *MLwiN* version 2.1a.<sup>17</sup> Relative weights (population weights divided by the average

**TABLE 1**

**Prevalence (%) of Poor/fair Self-reported Health Status and Health Utilities Index Below the Median According to Various Risk Factors, Ontario Health Survey 1996-97**

	Self-reported Health Status		HUI*	
	No.	Fair/poor (%)	No.	Below the Median HUI (%)
Individual-level Variables				
Age (years)				
25-39	11,367	6.1	11,328	23.2
40-64	12,843	13.6	12,771	35.2
65+	6610	22.8	6524	50.6
Sex				
Male	14,167	12.0	14,076	31.7
Female	16,653	13.5	16,547	36.0
Income				
Low	3364	27.5	3335	53.6
Middle	15,686	11.6	15,626	33.2
High	4091	5.3	4081	22.8
Unknown	7679	12.8	7581	33.1
Regular exercise				
Yes	22,902	9.0	22,829	29.5
No	7172	22.5	7089	45.5
Unknown	746	36.3	705	65.4
Marital status				
Married/common-law/partner	19,255	10.6	19,161	29.7
Single/widowed/separated/divorced	11,565	16.5	11,462	41.3
Smoking status				
Nonsmoker	12,817	10.6	12,723	30.2
Smoker	17,895	14.3	17,801	36.7
Unknown	108	27.8	99	44.4
Educational attainment				
≤Secondary	12,939	17.8	12,834	39.8
Post-secondary	17,462	8.8	17,387	29.5
Unknown	419	23.6	402	46.5
Area-level Variables				
Gini				
Low inequality	10,622	11.3	10,554	32.0
Medium inequality	10,599	13.1	10,538	34.8
High inequality	9599	14.1	9531	35.5
Median household income (\$)				
Low	6775	14.5	6723	35.7
Medium	9433	13.8	9379	35.9
High	14,612	11.3	14,521	32.0

\* percentages do not include subjects whose Health Utilities Index score = 0.947 (median value)

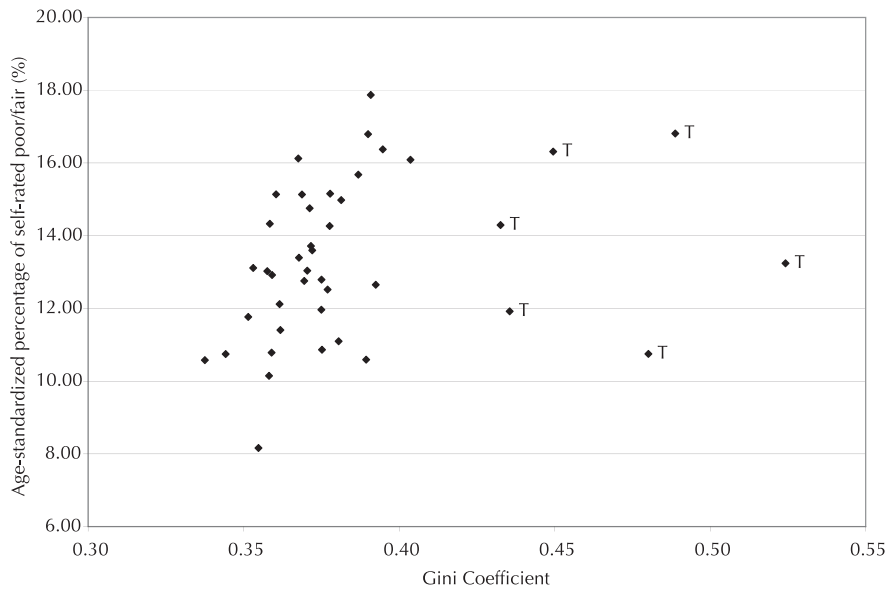
weights) were used in the analysis to compensate for unequal sample probabilities in the survey (V. Goel, Analysis of complex surveys. Institute for Clinical Evaluative Sciences, unpublished manuscript, 1993).

A three-step sequential modeling strategy was adopted. First, we built a two-level model with only a constant, to estimate between-area (level-2) variance in poor health at the PHU level (Empty model). This estimate provides a base for further comparison. We then adjusted for all the individual predictors to assess whether the between-area variation of poor health persists (Model 1). Finally, we added the Gini coefficient (Model 2) and median area income to the model (Model 3). Wald tests were used to test the significance of estimates, two-sided for fixed parts of the models (odds ratios), and one-sided for random parts (between-area variances in poor health, which cannot be negative). Models were fitted using second-order penalized quasi-likelihood estimation pro-

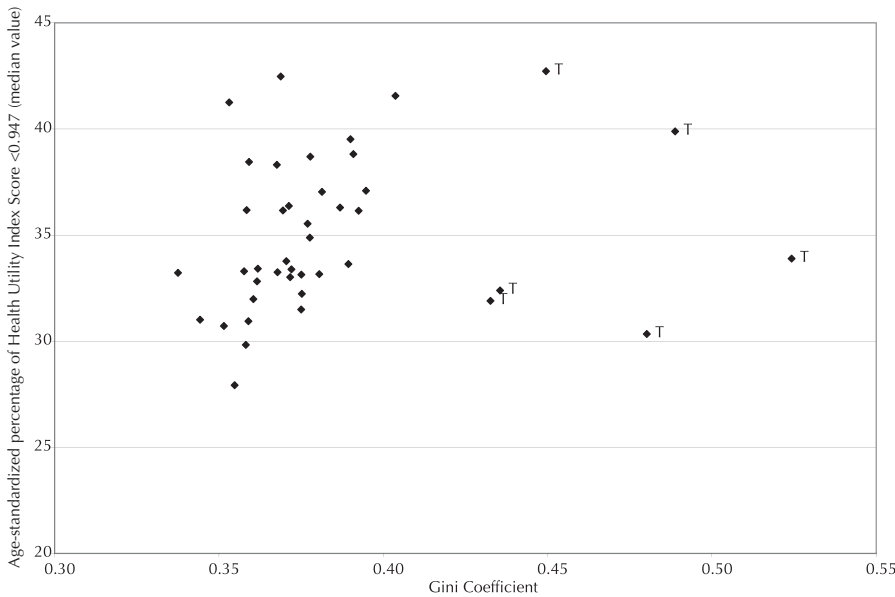
cedures.<sup>18</sup> For discrete dependent variables, the variance at the individual level was set to 1. This assumption of no extra-binomial variation was tested in each logistic regression model, and no evidence was found for it. Evidence of extra-binomial variation could be due to extreme outliers, omission of important explanatory variables, omission of an entire level in the model, or misspecification of the model.<sup>19</sup>

## RESULTS

The OHS sample included 30,939 people aged 25 or older (45.9% males and 54.1% females). The sample sizes from Ontario PHUs ranged from 149 to 2,056. The Gini coefficient ranged from 0.34 to 0.52, with a median of 0.37. The Gini coefficient and median area income were moderately negatively correlated ( $r=-0.37$ ,  $p=0.02$ ). 119 subjects with missing data for key variables such as residential status were excluded, and 197 people with missing val-



**Figure 1.** Age-standardized percentage of self-rated poor/fair by income inequality for the 42 Ontario public health units (T: Toronto PHU).



**Figure 2.** Age-standardized percentage of the HUI score below the median by income inequality for the 42 Ontario public health units (T: Toronto PHU).

ues in the HUI were further excluded from the analysis for HUI. Thus, 30,820 and 30,623 people remained in the analysis for SRH and HUI, respectively.

Table I shows the unweighted sample characteristics and the percentage of subjects reporting fair or poor health and having a HUI below median score, according to various risk factors.

Overall, 12.8% of individuals reported their health as being either fair (9.4%) or poor (3.4%), whereas 87.2% reported

their health as being excellent (23.6%), very good (37.6%), or good (26.0%). Self-rated poor health and low HUI scores were both associated with being unmarried, smoking, having low individual income or low educational attainment, and not doing regular exercise. Females reported poorer health than males. The percentage of people reporting poorer health increased with increasing age. Poor health was also associated with living in poor areas or in areas with medium or high income inequality.

Figures 1 and 2 show the ecological-level correlation between the Gini coefficient and the age-standardized percentage of residents in fair or poor health (Spearman  $r=0.43$ ,  $p=0.01$ ), and age-standardized percentage of residents with the HUI score below the median (Spearman  $r=0.33$ ,  $p=0.03$ ). The 6 outliers are the Toronto PHUs. As Gini coefficients across PHUs were not normally distributed, Spearman correlation coefficients were reported.

Tables II and III present the odds ratios for the effects of income inequality and the between-area variance at PHU level for SRH and HUI from the multilevel logistic regression models. For the random effects, the between-area variance of 0.042 for SRH and 0.022 for HUI in the empty model were significant, suggesting differences in SRH and HUI between PHUs. However, this may be an artefact of not controlling for individual characteristics. Model 1 estimates between-area variation after adjusting for individual variables. Significant variation remained, although the amount of variation between PHUs had fallen markedly. In the fixed component, all the individual compositional factors were significantly associated with poor health, except sex for SRH. Persons in the lowest income class were 3.9 times (for SRH) and 2.4 times (for HUI) more likely to report poorer health than persons in the highest income class. Model 2 shows a modest gradient in the odds ratio for poor health across levels of income inequalities. This relationship was consistently monotonic. Compared with respondents living in areas with the lowest income inequality, those living in areas in the highest tercile of income inequality were 1.20 times for SRH and 1.11 times for HUI more likely to report poorer health. Although corresponding confidence intervals became wider when adjustment was made for median area income, the odds ratios of income inequality for SRH and HUI changed very little (Model 3), and the odds ratio of the highest class of income inequality for SRH remained marginally significant.

**DISCUSSION**

In this paper, we have shown that inequality in income showed a modest but significant association with self-rated poor/fair

TABLE II

## Odds Ratios for Fair or Poor Self-rated Health: Multilevel Multiple Logistic Regression Analysis

	Empty Model	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Fixed effects				
Age (years)				
25-39		1	1	1
40-64		2.19 (1.99 to 2.42)	2.19 (1.99 to 2.41)	2.19 (1.99 to 2.42)
65+		3.44 (3.12 to 3.79)	3.44 (3.10 to 3.83)	3.44 (3.10 to 3.83)
Sex				
Male		1	1	1
Female		1.07 (0.99 to 1.16)	1.07 (0.99 to 1.15)	1.07 (0.99 to 1.16)
Income				
Low		3.90 (3.31 to 4.58)	3.90 (3.31 to 4.58)	3.89 (3.32 to 4.55)
Medium		1.62 (1.41 to 1.87)	1.62 (1.60 to 1.64)	1.62 (1.41 to 1.86)
High		1	1	1
Unknown		1.36 (1.17 to 1.58)	1.36 (1.17 to 1.58)	1.35 (1.16 to 1.57)
Regular exercise				
Yes		1	1	1
No		2.33 (2.15 to 2.52)	2.32 (2.15 to 2.52)	2.33 (2.15 to 2.52)
Unknown		4.76 (4.09 to 5.53)	4.76 (4.09 to 5.53)	4.76 (4.07 to 5.57)
Marital status				
Married/common-law/partner		1	1	1
Single/widowed/separated/divorced		1.36 (1.25 to 1.47)	1.35 (1.25 to 1.46)	1.35 (1.25 to 1.46)
Smoking status				
Nonsmoker		1	1	1
Smoker		1.37 (1.27 to 1.48)	1.38 (1.27 to 1.49)	1.38 (1.27 to 1.49)
Unknown		1.66 (1.06 to 2.61)	1.66 (1.06 to 2.60)	1.67 (1.06 to 2.61)
Educational attainment				
≤Secondary		1.43 (1.32 to 1.54)	1.43 (1.32 to 1.54)	1.43 (1.32 to 1.54)
Post-secondary		1	1	1
Unknown		1.35 (1.05 to 1.75)	1.35 (1.05 to 1.74)	1.35 (1.05 to 1.74)
Gini				
Low			1	1
Medium			1.14 (0.99 to 1.32)	1.11 (0.95 to 1.30)
High			1.20 (1.04 to 1.38)	1.18 (1.01 to 1.37)
Median income				
Low				1.07 (0.92 to 1.26)
Medium				1.18 (1.01 to 1.37)
High				1
Random effects: variance (standard error)				
Level 2	0.042 (0.012)**	0.020 (0.008)*	0.017 (0.007)*	0.017 (0.007)*

Model 1: adjustment for all 7 individual-level variables

Model 2: adjustment for all 7 individual-level variables and the Gini coefficient

\*\* p<0.01 (one-sided), \* p<0.05 (one-sided)

health and HUI at PHU level, after controlling for a range of individual-level characteristics including income. Further adjustment for median area income did not significantly change the association. Some previous studies have reported similar findings.<sup>2,20</sup> However a number of studies have found no association of income inequality with health in Canada.<sup>7,11,12</sup> Several explanations for the discrepancies between our findings and those of previous studies in Canada may be plausible.

First, our study used SRH and HUI as health measures, instead of mortality. Although not objective, SRH has previously been used as a health measure to examine the effect of income inequality in the United States,<sup>2</sup> and it has been also shown to predict mortality, independent of medical, behavioural, and psychosocial risk factors in a review of 27 studies.<sup>21</sup> Income inequality in Canada may not be comparable with that in the United States, and may not be strong enough to exert an indepen-

dent effect on mortality; however, it could affect less extreme health indicators like SRH and HUI.

Second, the association of income inequality with health may vary by unit of analysis.<sup>22</sup> We decided to use PHU as the aggregation level rather than some other level such as metropolitan area, because significant regional variations in health were already reported at that level in the literature;<sup>23</sup> PHUs are large enough to allow variations in income distribution; and data were made available at PHU level.

This study had some methodological limitations. Its cross-sectional design limited any inference of causation. Also, the OHS used multistage cluster sampling and the resulting design effect could not be taken into account in the multilevel modeling. Another possible limitation of this study is that the OHS data used are from 1996. The sample size of the 1996 survey was considerably augmented by the pur-

chase of additional sample size by Ontario, making it the most robust database to examine this issue. Larger inequalities in income have increased since 1996.<sup>13</sup>

Our results suggest that income inequality has an association with SRH and HUI in Ontario. Income inequalities have been increasing in the last generation. Yalnizyan pointed out that “the market income ratio of the top 20% of families with children under 18 to the bottom 20% of such families increased from 8.52 in 1980 to 18.65 in 1996”.<sup>13</sup> Such widening inequalities may have implications for Canadian health. It is not known what level of income inequality may start to affect health. The magnitude of the association may depend not only on the degree of inequality in income but also on social characteristics, including social policies. Furthermore, other area-based factors like proportion of residents with high level of education and unemployment rate may play important roles and consequently influence the degree of income

**TABLE III**

**Odds Ratios for Health Utilities Index (<50th percentile) in the Multilevel Logistic Regression Models**

	Empty Model	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Fixed effects				
Age (years)				
25-39		1	1	1
40-64		1.77 (1.67 to 1.88)	1.77(1.67 to 1.88)	1.77(1.67 to 1.88)
65+		2.92 (2.71 to 3.14)	2.92 (2.71 to 3.14)	2.92 (2.71 to 3.14)
Sex				
Male		1	1	1
Female		1.15 (1.08 to 1.22)	1.15 (1.08 to 1.22)	1.15 (1.08 to 1.22)
Income				
Low		2.44 (2.16 to 2.74)	2.43 (2.18 to 2.71)	2.43 (2.18 to 2.71)
Middle		1.35 (1.24 to 1.46)	1.35 (1.24 to 1.46)	1.34 (1.24 to 1.45)
High		1	1	1
Unknown		1.10 (1.01 to 1.21)	1.10 (1.01 to 1.21)	1.10 (1.01 to 1.20)
Regular exercise				
Yes		1	1	1
No		1.63 (1.53 to 1.73)	1.63 (1.53 to 1.73)	1.63 (1.53 to 1.73)
Unknown		3.87 (3.37 to 4.43)	3.86 (3.36 to 4.42)	3.86 (3.36 to 4.42)
Marital status				
Married/common-law/partner		1	1	1
Single/widowed/separated/divorced		1.41 (1.33 to 1.50)	1.41 (1.33 to 1.49)	1.41 (1.33 to 1.50)
Smoking status				
Nonsmoker		1	1	1
Smoker		1.34 (1.27 to 1.43)	1.35 (1.28 to 1.42)	1.34 (1.28 to 1.42)
Unknown		1.29 (0.85 to 1.95)	1.29 (0.86 to 1.92)	1.29 (0.86 to 1.93)
Educational attainment				
<Secondary		1.12 (1.06 to 1.18)	1.12 (1.06 to 1.18)	1.12 (1.06 to 1.18)
Post-secondary		1	1	1
Unknown		1.31 (1.08 to 1.59)	1.31 (1.07 to 1.60)	1.31 (1.08 to 1.59)
Gini				
Low			1	1
Medium			1.10 (1.00 to 1.21)	1.09 (0.97 to 1.22)
High			1.11 (1.01 to 1.22)	1.09 (0.97 to 1.21)
Median income				
Low				1.03 (0.92 to 1.15)
Medium				1.05 (0.95 to 1.17)
High				1
Random effects: variance (standard error)				
Level 2	0.022 (0.007)**	0.011 (0.004)*	0.010 (0.004)*	0.010 (0.005)*

Model 1: adjustment for all 7 individual-level variables

Model 2: adjustment for all 7 individual-level variables and the Gini coefficient

\*\* p<0.01 (one-sided) , \* p<0.05 (one-sided)

inequality. At least three plausible causal pathways by which income inequality may affect health have been proposed: under-investment in human capital, erosion of social capital, and stressful social comparisons.<sup>24</sup> As public goods and services like education and health care are mostly publicly funded in Canada, it may reduce the influence of income inequality on health. However, income inequality may still have an effect on health by lowering the level of social capital and creating a stressful compassion result from large gaps between the poor and the rich. More investigations need to be carried out to provide a clear and comprehensive picture of the relationship of income inequality to health in Canada.

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**RÉSUMÉ**

**Objectif :** Examiner l’association entre l’inégalité des revenus à l’échelle des unités de santé publique et l’état de santé individuel en Ontario.

**Méthode :** Étude transversale multiniveau effectuée auprès de sujets de 25 ans et plus desservis par les 42 bureaux de santé publique de l’Ontario. Les données individuelles provenaient des réponses de 30 939 répondants à l’Enquête sur la santé en Ontario (1996-1997). Le revenu médian par zone et l’inégalité des revenus (coefficient de Gini) ont été calculés d’après les données du recensement de 1996. Les principaux résultats que nous avons utilisés ont été les scores obtenus aux chapitres de l’état de santé auto-évalué (ESAE) et du Health Utilities Index (HUI-3).


**Résultats :** Après les ajustements pour tenir compte des effets de facteurs individuels, dont le revenu, les répondants desservis par les bureaux de santé publique dans le tercile supérieur de l’inégalité des revenus présentaient un risque relatif de 1,20 (IC de 95 % = 1,04-1,38) pour un ESAE moyen ou mauvais, et un risque relatif de 1,11 (IC de 95 % = 1,01-1,22) pour un HUI inférieur à la médiane, par rapport aux personnes desservies par les bureaux de santé publique dans le tercile inférieur. L’apport d’autres ajustements pour tenir compte des effets du revenu médian de la zone a peu modifié cette association.

**Conclusion :** L’inégalité des revenus présente une corrélation significative avec l’état de santé auto-évalué à l’échelle des bureaux de santé publique en Ontario, quel que soit le revenu personnel.

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 The Canadian Association of Principals

# Mental Health

The school should be a place where students feel welcome and secure. It should be a place that helps students through stressful times and the transitions in their lives. The school should also be a place where students with mental illness or specific conditions can receive support, referrals, or help in re-integrating into regular school life.

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- a school checklist from the Canadian Association for School Health
- reports on mental health from the Centre on Addictions and Mental Health
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