CMAJ OPEN

Research

Influence of country of birth and ethnicity on body mass index among Canadian youth: a national survey

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Abstract

Background: The body mass index (BMI) of youth often changes when they immigrate to a new country as a result of the adoption of new behaviours, a process called acculturation. We investigated whether BMI differs by country of birth (Canada v. other countries) and ethnicity, both individually and together. We also examined whether time since immigration and health-related behaviour explain any observed BMI differences.

Methods: Data sources were the Canadian Health Behaviour in School-Aged Children study and the Canada Census of Population. Participants were youth in grades 6–10 (weighted sample *n* = 19 272). A questionnaire was used to assess participants' sociodemographic characteristics, height, weight and health-related behaviour. We calculated BMIs from participants' self-reported heights and weights and used World Health Organization growth references to determine BMI percentiles.

Results: Based on self-reported heights and weights, BMI percentiles for foreign-born youth were lower than those of youth born in Canada (–4, 95% confidence interval [CI] –6 to –2). This difference did not decrease with time since immigration. Similarly, BMI percentiles were lower among East and Southeast Asian youth than their peers from the Canadian host culture (–4, 95% CI –6 to –2). Finally, BMI percentiles for foreign-born Arab and West Asian youth and East Indian and South Asian youth were lower than their Canadian-born peers of the same ethnicity (–14, 95% CI –22 to –7; –8, 95% CI –14 to –3).

Interpretation: Immigrant generation and ethnicity were related to BMI among Canadian youth, both independently and together. Some ethnic groups showed differences by country of birth, i.e., East Indian and South Asian, while others showed no such difference, i.e., East and Southeast Asian. There was no association with time since immigration. Our findings reinforce the need to investigate country of birth and ethnicity when considering the determinants of childhood BMI.

When a person immigrates to a new country, his or her health changes, eventually approximating that of people born in the host country, via a process called acculturation.[1] One characteristic that could be influenced by acculturative changes in diet and physical activity is body mass index (BMI).[2–5] This is an important factor because of the high prevalence of obesity and related health problems.[6–9] In Canada, immigrants have a lower BMI than their Canadian-born peers[10,11]; however, findings from international studies have been inconsistent.[12–19]

Two explanations have been proposed for these discrepancies. The "time since immigration" hypothesis suggests that people who have immigrated more recently are less acculturated than established immigrants who have had time to adopt the norms and behaviours of the host country[17,20]; this would lead to discrepancies among studies that did not take this factor into account. The second explanation is that BMI is driven by ethnic differences. Ethnicity is a determinant of BMI, with increased risks for overweight and obesity observed among Hispanic and black people,[13,21] and lower risks among those of East and Southeast Asian descent.[10–14] Thus, it is difficult to establish the etiologic pathway between birth status and BMI from existing studies, because they have not considered time since immigration, have focused on specific ethnic groups and have not explored interactions between immigration and ethnicity.

In this study of a national sample of Canadian school-aged youth, we examined the independent and joint effects of country of birth and ethnicity on BMI. In subsequent analyses, we investigated the effect of time since immigration and whether differences in BMI persist after controlling for behaviours associated with obesity. We hypothesized that foreign-born youth would have a lower BMI than their Canadian-born peers, that this difference would diminish over time and that differences in BMI by ethnicity would exist.

Competing interests: See end of article.

This article has been peer reviewed.

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***CMAJ Open* 2014.DOI:10.9778/cmajo.20130088**

Methods

Data sources

Data on young people were obtained from cycle 6 (2010) of the Canadian Health Behaviour in School-Aged Children (HBSC) study. Conducted under the auspices of the World Health Organization, HBSC is a self-reported general health survey completed by students in classrooms.[22] The 2010 Canadian survey collected information from 26 078 youth in grades 6–10 in 436 schools in 8 provinces and 3 territories (New Brunswick and Prince Edward Island did not participate).[22] In each province, a systematic, multistage cluster sample approach was used, with whole classes selected from a list of eligible and consenting schools. In the 3 territories, a census of all students in grades 6–10 was attempted. Weighting was applied to ensure generalizability of estimates nationally.

Consent was obtained from school boards, schools, parents and children. Approximately 57% of the schools approached agreed to participate, and 77% of the estimated number of students in schools that gave consent participated in the study. Less than 10% declined to participate or spoiled their questionnaires intentionally; the remaining nonparticipants generally failed to return consent forms, failed to receive parental consent or were absent on the day of the survey.[22]

Sample population

From the original sample of 26 082 youth, 7299 were excluded because of missing data (Figure 1). This left a final, unweighted sample of 18 783, which was weighted according to the Canadian HBSC study protocol[22] for a final sample of 19 272. Included participants were slightly older than those who were excluded (14.0 yr v. 13.4 yr, $p < 0.0001$). More second- than first-generation youth provided all relevant covariable information (76% v. 66%, $p < 0.0001$) and response rates by ethnicity ranged from 64% to 76% (data not shown). No other differences were found between those included and excluded from the analyses.

Area-level population demographics were obtained from the 2006 Canada Census of Population.[23] Census responses were linked to schools to describe the neighbourhoods in a 1-km radius around each school, a distance that has been previously shown to represent social constructs accurately.[24]

Country of birth and ethnicity

The study population was categorized by country of birth. This was determined through the HBSC survey question, "In which country were you born?" Youth born outside Canada were categorized as "foreign born," while youth born in Canada were classified as "Canadian born."

Second, youth were categorized into 5 groups by the length of time they had been in Canada based on the HBSC survey question, "How many years have you lived in Canada?" Response options were: "I was born in Canada," "1 to 2 years," "3 to 5 years" "6 to 10 years" and "11 or more years." Because of the small numbers in the fifth group, the last 2 groups were combined to form a "≥ 6 years" group.

Finally, youth were categorized into 7 ethnic groups based on the HBSC survey question, "How do you describe yourself?" and the 16 possible response options; youth were able to select up to 3 response categories. Responses were used to create the following ethnic groups: Canadian host culture, Arab and West Asian, African, East Indian and South Asian, East and Southeast Asian, Latin American and Other. These groups were based on the ethnic groupings defined by the 2006 Canadian Census of Population, with 3 modifications.[23] First, European, North American and Aboriginal youth were combined to create the "Canadian host culture" group (ethics restrictions prohibited a separate study of Aboriginal youth).[25] Second, West Asian and South Asian youth were combined because of the small numbers of the former. Finally, an additional group (Other) was created for youth who identified with more than 1 of the 6 identified ethnic groups.

BMI percentile

Youth self-reported their weight and height in metric or imperial units, as in previously validated instances.[26] From these, BMI was calculated (kg/m^2). To account for growth and maturation, participants' BMI values were converted to age- and sex-specific BMI percentile scores using World Health Organization growth references.[27] These criteria define overweight and obese as +1 and +2 standard deviations, respectively.[27]

Covariables

Individual-level covariables collected via the HBSC survey were age, sex and perceived family wealth (self-perceived socioeconomic status), which are known predictors of BMI among youth.[14,28–32] At the school level, covariables included population centre category,[33] percentage of immigrants in the community and median income quartile.

Seven behaviours were considered as explanatory variables for observed differences in BMI percentile: time spent watching television; using a computer; playing video games; engaging in physical activity; snacking while watching television; snacking while on the computer or playing video games; and frequency of eating at fast-food restaurants. These were chosen as modifiable behaviours associated with BMI that may differ by ethnicity and country of birth.[34,35] The first 3 behaviours were determined by asking the number of hours spent each day on that activity.[36] Physical activity referred to the number of days a week on which the youth engaged in at least 60 minutes of moderate-to-vigorous physical activity.[37] Snacking was assessed by asking, "How often do you eat a snack while you watch TV (including videos and DVDs)?" with response options ranging from "never" to "every day."[38] A similar question asked about snacking while playing video games. Finally, 1 item was used to assess frequency of eating at fast food restaurants, with 7 possible responses ranging from "Never," and "Rarely (less than once a month)," to "5 or more days a week."[39]

Analysis

For all analyses, we used a multilevel approach because of the clustered nature of the data and the inclusion of both individual- and school-level covariables. Level 1 refers to individual-level and level 2 refers to school-level variables.[40] We used cross-tabulations to explore youth BMI percentile by each of

the exposure variables. For all p values calculated for associated statistical tests, we used the Rao–Scott χ^2 test to control for clustering at the school level.

Multilevel linear regression was used to explore the relation between country of birth and BMI percentile. Country of birth and ethnicity were included in the modelling process, but time since immigration was not, as it is collinear with country of birth. Six hierarchical regression models were built with the outcome of BMI percentile, following established precedents.[40] First, an empty model was built to investigate the random effect of school on BMI percentile.[40] Second, a "base model" was created that included country of birth and ethnicity as predictors of BMI percentile. The third and fourth models controlled for individual- and school-level covariables, respectively. The fifth model included all covariables found to be significant in models 3 and 4, using a liberal value of $p < 0.20$ to indicate significance. Finally, a sixth model was built that controlled for the variables identified for the adjusted model and investigated the effect of the 7 behaviours on potential differences in BMI percentile by country of birth and ethnicity.

We also investigated the interaction between country of birth and ethnicity by stratifying each ethnic group into 2 groups, Canadian-born and foreign-born, while controlling for covariables identified in the sixth model.

All analyses were conducted using SAS v. 9.3 (SAS Institute, Cary, N.C., USA) using PROC SURVEYFREQ for cross-itabulations and PROC MIXED for regression models. All analyses considered the sample weights and accounted for clustering at the school level.

Ethics approval

This study received ethics approval from the Queen's University General Research Ethics Board (GEDUC-430-09) and Health Sciences Research Ethics Board (6007743).

Results

Our sample was composed predominantly of youth born in Canada (91.6%). Most self-identified as being part of the Canadian host culture (78.2%). Other major ethnic groups included East and Southeast Asian (5.7%), African (3.8%) and East Indian and South Asian (2.9%) (Table 1). Intraclass correlation analysis showed that school grade accounted for 2.7% of the variation in BMI percentile.

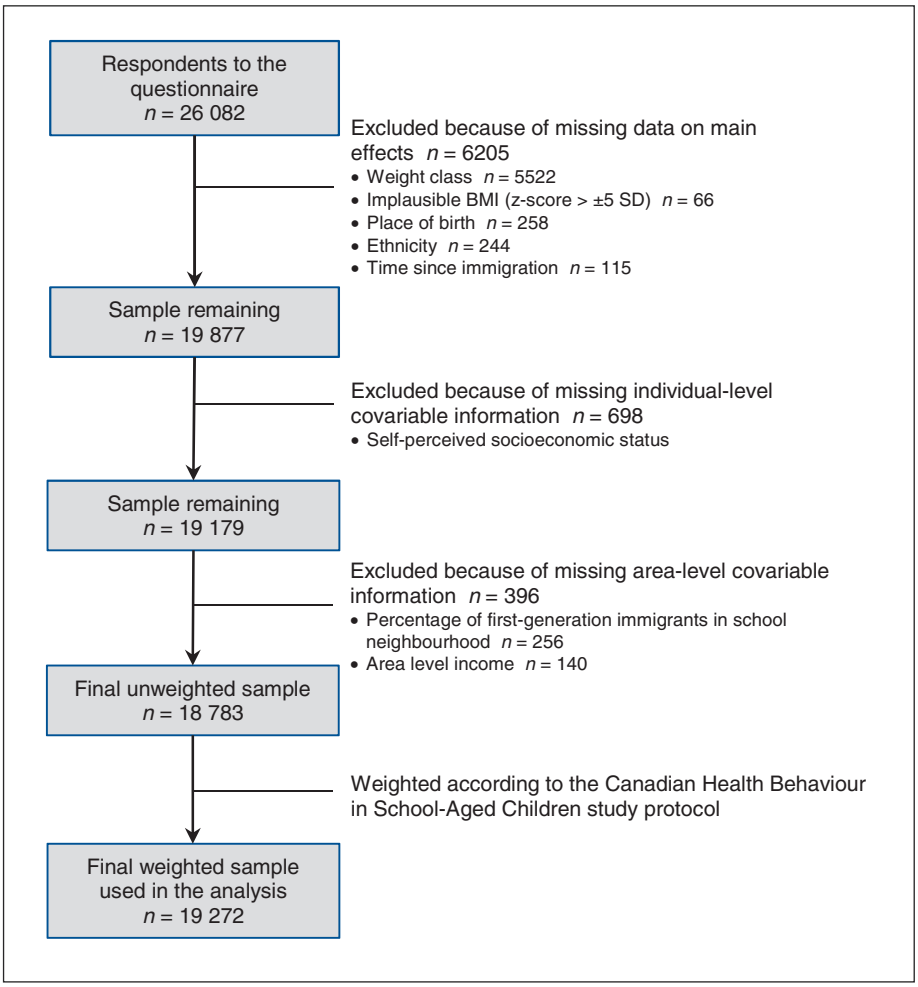

Figure 1: Process for selecting study population from respondents to the Canadian Health Behaviour in School-Aged Children, cycle 6 (2010) study.

Differences in BMI percentile were observed by country of birth. The BMI of foreign-born youth was 4 percentile points lower (95% confidence interval [CI] –6 to –2) than that of Canadian-born youth. Stratification of the foreign-born group showed that changes in BMI percentile were not linearly related to time since immigration, and only youth who had immigrated 6 or more years earlier were significantly different from those born in Canada (Table 1). The observed differences in BMI between countries of birth changed less than 6% after controlling for the 7 behaviours that we hypothesized may explain this relation (time spent watching television; using a computer; playing video games; engaging in physical activity; snacking while watching television; snacking while on the computer or playing video games; and frequency of eating at fast-food restaurants).

BMI differed by ethnicity. After adjusting for relevant covariables, the BMI of both the East Indian and South Asian group and the East and Southeast Asian group was 3–4 percentile points lower than that of the Canadian host culture group (Table 2). Minimal changes in effect estimates (< 3%) were observed for the ethnicity–BMI relation after controlling for the 7 behavioural factors.

The interaction between country of birth and ethnicity was statistically significant ($p = 0.0002$). Compared with Canadian-born youth of the same ethnicity, foreign-born Canadian host culture, Arab and West Asian youth and East Indian and South Asian youth had a lower BMI, with differences ranging from –6 to –14 percentile points (Table 3).

Interpretation

The most important finding of this study was that the BMI of foreign-born youth was lower than that of their Canadian-born peers, and that this association was not linear with time since immigration. This goes against the theory of acculturation. BMI also differed by ethnicity, with East and Southeast Asian youth having a lower BMI than youth of the Canadian host culture, irrespective of country of birth. These findings were robust and persisted after controlling for key behaviours associated with BMI. Finally, the relation between country of birth and BMI appeared to be modified by ethnicity.

Previous research that has examined the association between immigration status and obesity measures among youth has produced mixed findings. Studies of youth in Sweden and the United States both found that youth born abroad were more likely to be overweight and obese compared with their native-born peers.[29,41] In Canada, boys who spent their entire life in Canada had 1.6-fold increased odds of being overweight (95% CI 1.2–2.3).[12] However, another Canadian study found no difference by country of birth.[10] This is likely a result of demographic differences in the samples being investigated.

We were surprised to find that BMI did not change linearly with increased time since immigration. As in previous research of adults in Canada[42] and the United States,[3] we anticipated that differences in BMI would disappear over time. However, this was not the case, and we observed the opposite relation in our sample. This counters the theory of acculturation and may be explained by methodological issues, such as inadequate measurement or uncontrolled confounding. Age at immigration could not be controlled for because of the wide response categories, and this has been shown to be associated with BMI.[3] In addition, family factors, such as parental country of birth, were not accounted for in this survey. Family-level factors, such as family practices, habits and beliefs, are key predictors of the health of youth during this developmental stage and could have an impact on childhood BMI. Finally, our measure of acculturation may not have been precise enough to show a relation. The lack of a linear relation between BMI and time since immigration remains a provocative and interesting finding and, in light of our conclusions, should be examined by ethnic group to ascertain the reason for this relation.

Compared with Canadian youth, we found that East and Southeast Asian youth reported heights and weights consistent with lower BMI irrespective of country of birth, a finding supported by others.[10–13] Immigrant and ethnic differences in other determinants of obesity, such as insufficient sleep and smoking,[43] may explain these relations. We examined ethnicity and country of birth together to determine the effect of their possible interaction and found that foreign-born Canadian host culture, Arab and West Asian, and East Indian and South Asian youth had lower BMIs compared with Canadian-born youth of the same ethnicity. This may be because of an unhealthier diet pattern among the latter compared with foreign-born peers, as previously shown among Asian and Hispanic youth living in the United States.[44] It is interesting that we observed no such relation among Asian and Latin American ethnic groups. An interaction between country of birth and ethnicity has been shown in studies of children and adolescents in the US and, as in our study, Asian ethnicity was associated with lower BMI.[13] Second- and third-generation black youth, i.e., youth born in the US, but with parents or grandparents born abroad, were more likely to be overweight or obese. These differences may be attributable to different sociodemographic factors at play in the US and Canada.[13]

Limitations

We did not measure acculturation directly, but used country of birth and time since immigration as proxy measures. This may have resulted in misclassification of youth and biased effect estimates. In addition, the number of people who completed the entire survey differed by country of birth and ethnicity. It is possible that youth of low acculturation did not complete the entire questionnaire, thus biasing the results toward no effect. Another limitation was our use of self-reports of height and weight and, therefore, BMI. Previous research has found that youth will overestimate their height and underestimate their weight, although it found no differences by ethnic group.[26]

Conclusion

Country of birth and ethnicity act as determinants of BMI, individually and synergistically. We investigated the effect of

Table 1: Mean BMI percentile of grade 6–10 students by immigration status and additional covariables based on the 2010 Canadian Health Behaviour in School-aged Children study (weighted sample *n* = 19 272)*

Characteristics of the study population	Weighted sample, no. (%)	BMI percentile		Significance of difference, *p*†
		Mean (95% CI)	Difference from reference group (95% CI)	
Country of birth				
Canadian born	17 659 (91.6)	58 (57 to 58)	Reference	
Foreign born	1 613 (8.4)	54 (52 to 55)	–4 (–6 to –2)	< 0.001
Time since immigration, yr				
Canadian born	17 659 (91.6)	58 (57 to 58)	Reference	
≥ 6	891 (4.6)	52 (50 to 54)	–6 (–8 to –4)	< 0.001
3–5	396 (2.1)	56 (53 to 59)	–2 (–5 to 1)	0.30
1–2	325 (1.7)	55 (52 to 59)	–2 (–6 to 1)	0.23
Ethnicity				
Canadian host culture	15 071 (78.2)	57 (57 to 58)	Reference	
Arab and West Asian	300 (1.6)	58 (54 to 61)	1 (–3 to 4)	0.78
African	737 (3.8)	60 (58 to 62)	3 (0 to 5)	0.028
East Indian and South Asian	559 (2.9)	52 (49 to 55)	–5 (–8 to –3)	< 0.001
East and Southeast Asian	1 089 (5.7)	53 (51 to 56)	–4 (–6 to –2)	< 0.001
Latin American	187 (1.0)	60 (56 to 65)	3 (–2 to 7)	0.24
Other‡	1 330 (6.9)	59 (57 to 60)	1 (0 to 3)	0.15
Individual-level covariables				
Sex				
Male	9 567 (49.6)	61 (60 to 62)	Reference	
Female	9 705 (50.4)	53 (52 to 54)	–8 (–9 to –7)	< 0.001
Perceived family wealth				
Well off	11 064 (57.4)	56 (55 to 57)	Reference	
Average	6 436 (33.4)	58 (57 to 59)	2 (1 to 3)	< 0.001
Worse off	1 772 (9.2)	61 (59 to 63)	5 (3 to 6)	< 0.001
Area-level covariables				
Median annual household income, $				
Quartile 4: > 67 605	4 512 (23.4)	56 (55 to 58)	Reference	
Quartile 3: 53 115–67 605	4 440 (23.0)	56 (54 to 58)	0 (–2 to 2)	0.85
Quartile 2: 43 571–53 114	4 311 (22.4)	56 (55 to 58)	0 (–2 to 2)	0.99
Quartile 1: < 43 571	6 008 (31.2)	59 (58 to 61)	3 (1 to 5)	0.002
Immigrants in the community, %				
Quartile 4: ≥ 17	6 399 (33.2)	55 (54 to 56)	Reference	
Quartile 3: 9 to < 17	5 095 (26.4)	58 (57 to 60)	3 (1 to 5)	< 0.001
Quartile 2: 3 to < 9	4 319 (22.4)	58 (57 to 60)	3 (1 to 5)	< 0.001
Quartile 1: < 3	3 459 (18.0)	58 (56 to 60)	3 (1 to 5)	0.008
Statistics Canada population centre category				
Large urban centre	6 275 (32.6)	56 (54 to 57)	Reference	
Medium centre	3 501 (18.2)	57 (55 to 59)	1 (–1 to 3)	0.24
Small centre	8 898 (46.2)	58 (57 to 59)	2 (0 to 4)	0.015
Rural	597 (3.1)	60 (57 to 64)	5 (1 to 8)	0.019

Note: CI = confidence interval.
**n* values were weighted according to the Canadian Health Behaviour in School-aged Children study protocol.[22] Totals in a category may vary slightly due to rounding.
†We compared the levels of the variables for significant differences while controlling for the clustering effect of school.
‡The "other" ethnic group includes youth who identified with more than 1 of the 6 ethnic groups.

Table 2: Mean BMI percentiles of Canadian youth predicted by three proposed models by country of birth and ethnicity*

	Base model		Adjusted model		Adjusted with explanatory variables	
Main effects	BMI percentile, mean (95% CI)	Difference from reference, *p*	BMI percentile, mean (95% CI)	Difference from reference, *p*	BMI percentile, mean (95% CI)	Difference from reference, *p*
Country of birth						
Canadian born	58 (57–59)	Reference	60 (58–61)	Reference	59 (57–60)	Reference
Foreign born	54 (53–56)	< 0.001	56 (54–58)	< 0.001	55 (53–57)	< 0.001
Ethnicity						
Canadian host culture	56 (55–57)	Reference	57 (56–59)	Reference	57 (56–59)	Reference
Arab and West Asian	57 (54–61)	0.36	59 (56–63)	0.29	59 (55–63)	0.46
African	59 (57–61)	0.01	60 (58–63)	0.007	59 (56–62)	0.12
East Indian and South Asian	51 (49–54)	0.003	54 (51–57)	0.016	53 (50–56)	0.005
East and Southeast Asian	53 (51–55)	0.023	55 (53–58)	0.073	54 (51–56)	0.005
Latin American	60 (55–64)	0.076	62 (57–66)	0.066	61 (56–66)	0.14
Other	57 (55–59)	0.097	59 (57–61)	0.077	57 (55–59)	0.91

Note: CI = confidence interval.
*The base model did not control for any covariables. The adjusted model controlled for gender, age, individual-level perceived family wealth, median neighbourhood income, percentage of immigrants in the community and Statistics Canada's population centre category. The adjusted model with explanatory variables controlled for all variables in the adjusted model, plus television watching, computer use, playing video games, physical activity, snacking while watching television, snacking while on the computer or playing video games and frequency of eating at fast-food restaurants.

Table 3: Interaction between ethnicity and country of birth among Canadian youth, controlling for level of physical activity and eating behaviours*

				Difference between Canadian- and foreign-born youth	
Ethnicity	Country of birth	*n*	BMI percentile, mean (95% CI)	Mean (95% CI)	*p* value
Canadian host culture	Canadian born	14 650	59 (58 to 60)	Reference	
	Foreign born	421	53 (49 to 56)	–6 (–9 to –3)	< 0.001
Arab and West Asian	Canadian born	182	65 (60 to 70)	Reference	
	Foreign born	118	50 (45 to 56)	–14 (–22 to –7)	< 0.001
African	Canadian born	569	60 (57 to 63)	Reference	
	Foreign born	168	60 (54 to 65)	–1 (–6 to 5)	0.84
East Indian and South Asian	Canadian born	344	56 (53 to 60)	Reference	
	Foreign born	214	48 (44 to 53)	–8 (–14 to –3)	0.003
East and Southeast Asian	Canadian born	615	53 (50 to 56)	Reference	
	Foreign born	475	55 (52 to 59)	3 (–1 to 7)	0.16
Latin American	Canadian born	102	61 (54 to 68)	Reference	
	Foreign born	85	61 (54 to 68)	0 (–9 to 10)	0.96
Other	Canadian born	1 206	59 (57 to 61)	Reference	
	Foreign born	124	58 (52 to 64)	–1 (–7 to 5)	0.72

Note: CI = confidence interval.
*The model controlled for gender, age, individual level perceived family wealth, median neighbourhood income, percentage of immigrants in the community and Statistics Canada population centre category, as well as television watching, computer use, playing video games, physical activity, snacking while watching television, snacking while on the computer or playing video games and frequency of eating at fast-food restaurants.

important health behaviours on these differences and found that they did not explain observed differences. For those in public health, our findings stress the importance of considering both ethnicity and country of birth when designing and implementing weight-loss interventions. Given the high proportion of Canadians who are immigrants, uncovering reasons for weight gain will lead to a better understanding of the determinants of childhood BMI.

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Contributors: All authors conceived the study design. Atif Kukaswadia conducted the statistical analyses, had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. All authors interpreted the findings, were involved in writing the paper and gave final approval of the submitted and published versions. All authors agreed to act as guarantors of this work.

Competing interests: Atif Kukaswadia has received personal fees from the Canadian Obesity Network unrelated to this study. Ian Janssen has received speaker honoraria from Public Health Ontario; consulting fees from Health Canada, the Public Health Agency of Canada and Active Healthy Kids Canada; conference travel support from Public Health Ontario, Active Healthy Kids Canada, the Heart and Stroke Foundation of Ontario, the International Development Research Centre, the Canadian Society of Exercise Physiology, the American College of Sports Medicine, the Canadian Obesity Network, the University of Guadalajara and Food & Consumer Products of Canada; funding for graduate students from the Ontario Ministry of Research and Innovation; and an operating grant from the International Development Research Centre.

Funding: The Canadian Health Behaviour in School-Aged Children study (principal investigators John Freeman and William Pickett) was funded by the Public Health Agency of Canada and Health Canada. This analysis was supported by the Canadian Institutes of Health Research and the Heart and Stroke Foundation of Canada (MOP 97961; PCR 101415). Atif Kukaswadia was supported by a Canadian Institutes of Health Research Frederick Banting and Charles Best Canada Graduate Scholarships Doctoral Award. Ian Janssen was supported by a tier 2 Canada Research Chair in Physical Activity and Obesity. The funders did not have any role in the design or conduct of the study; collection, management, analysis or interpretation of the data; preparation, review or approval of the manuscript; or decision to submit the manuscript for publication.

Acknowledgements: Health Behaviour in School-Aged Children is a World Health Organization/Euro collaborative study. The international coordinator of the 2009–2010 study is Candace Currie, St. Andrews University, Scotland; the databank manager is Oddrun Samdal, University of Bergen, Norway. We thank Andrei Rosu for the collection of geographic information integral to this analysis and for feedback and support regarding the geographic variables; we thank Andrew Day for statistical support and feedback.

Supplemental information: For reviewer comments and the original submission of this manuscript, please see www.cmajopen.ca/content/2/3/E145/suppl/DC1