Body mass index among immigrant and non-immigrant youth: Evidence from the Canadian Community Health Survey

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ABSTRACT

OBJECTIVES: The objectives of this study are to: i) examine differences in body mass index (BMI) and prevalence of overweight/obesity between immigrant versus non-immigrant youth aged 12-19 years, and ii) identify the extent to which lifestyle and socio-demographic factors account for between-group differences.

METHODS: Data for analyses come from combining repeated, cross-sectional surveys of the Canadian Community Health Survey (CCHS) conducted between 2000 and 2008. The sample for analyses included 63,509 youth aged 12 to 19 years (mean 15.2, SD 2.3 years) with self-reported weight and height. Immigrant youth composed 6.4% of this sample. Multilevel linear and logistic regression analyses were used to address the study objectives.

RESULTS: Approximately 22% of non-immigrant youth were overweight/obese, compared to 18% of immigrant youth ($p < 0.001$). Immigrant youth had a lower zBMI by 0.44 compared to non-immigrant youth ($p < 0.001$) and zBMI increased by 0.02 for every year an immigrant-resident resided in Canada. Measures of lifestyle and socio-demographic factors did not account for differences in body composition between immigrant and non-immigrant youth.

CONCLUSION: Even after adjusting for lifestyle and socio-demographic factors, immigrant youth have a lower level of overweight/obesity and a lower zBMI, compared to non-immigrant youth. Further, for immigrant youth zBMI increases with time spent in Canada, which highlights an opportunity for primary preventative strategies for obesity aimed at newcomers to Canada.

KEY WORDS: Overweight; obesity; immigrant; youth; body mass index

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

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Over the past two decades, the prevalence of childhood overweight and obesity has steadily risen around the world.¹⁻³ In Canada, the prevalence of childhood overweight/obesity has risen from 15% in 1978 to 26% in 2004.⁴ The health consequences of this trend include rising rates of cardiovascular disease, type 2 diabetes and shorter life expectancy.^{5,6}

Immigrants in Canada are the fastest-growing segment of the population, contributing to two thirds of its population growth.⁷ Studies contrasting health outcomes among immigrant versus non-immigrant youth lend support to a general pattern of findings, termed the *healthy immigrant effect* (HIE). The HIE suggests that immigrants arrive in a host country with a favourable state of health, however over time there is evidence of declining health and convergence to that of the native-born population.⁸ Key to this experience is a pattern of findings where, over time, immigrants adopt the host populations' habits and lifestyle, termed *acculturation*, putting them at risk for poor health outcomes.⁸ There are several reasons why immigrant status needs consideration in the epidemic of childhood obesity. First, there is limited information on obesity among Canadian immigrant children and youth. Canadian data on adults suggest that immigrants have lower rates of obesity compared to non-immigrants.⁹⁻¹¹ In contrast, Canadian immigrant youth may experience lifestyle and socio-economic risk factors that place them at risk for obesity and related complications.^{8,12-14} Also, the shift in the national composition of recent immigrants to Canada, combined with the deteriorating

economic circumstances of recent immigrant families over the past 20 years, calls into question the applicability of the HIE to more recent cohorts of immigrant children and adolescents. Foreign-born children are at higher risk for living in lower socio-economic circumstances and with financial adversity,¹³ which in turn may place them at higher risk for poor health outcomes. Further, socio-economic disadvantage during childhood has been associated with an increased risk of overweight/obesity in adulthood.¹⁵ At present, we have minimal empirical evidence that quantifies differences in overweight/obesity between immigrant versus non-immigrant youth, and the extent to which lifestyle and socio-demographic factors contribute to these differences, if they exist.

Using a nationally representative sample of youth in Canada, the objectives of this study are to: i) examine differences in body mass index (BMI) and prevalence of overweight/obesity between immigrant versus non-immigrant youth aged 12-19 years and ii) identify the extent to which lifestyle and socio-demographic factors account for between-group differences.

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METHODS

Participants

Data for analyses were based on four cycles of the Canadian Community Health Survey (CCHS) - 1.1, 2.1, 3.1, 4.1. The CCHS is a cross-sectional survey conducted biennially by Statistics Canada. A detailed description of the survey methodology has been described elsewhere.¹⁶ The reported response rates for each of the four cycles were 85%, 81%, 79%, and 76% respectively.^{17,18} The CCHS interview was available in 24 different languages and participants could select their choice of language. Approximately 75% of participants chose to complete the interview in English.¹⁸ Data analysis was conducted at the Research Data Centre, operated by Statistics Canada, McMaster University location. Approval for access to the CCHS restricted data file was obtained through the joint committee operated by the Social Sciences and Humanities Research Council (SSHRC) and Statistics Canada.

Sample for analysis

The sample for analysis includes participants aged 12 to 19 years ($n=67,406$), with complete data on the body composition measures, i.e., height and weight ($n=63,509$). The average age of respondents in the sample was 15.5 years with an even distribution between males (51.7%) and females (48.3%). About 6.4% ($n=4,052$) of respondents were born outside of Canada and classified as immigrant youth. The majority of respondents could converse in English and/or French.

Measurement of overweight/obesity

Respondents were asked to self-report their height and weight. From that information, we constructed the variable *body mass index (BMI) z score*: The BMI for each respondent was calculated by dividing the self-reported weight in kilograms (kg) by the square of height in metres (m^2). The BMI z score (zBMI) was calculated using each respondent's BMI, age, sex and the external reference of the World Health Organization (WHO), based on the WHO Reference 2007 for 5-19 year olds.¹⁹

Overweight/obese versus normal weight

For the purposes of estimating the proportion of respondents classified as overweight/obese, BMI was converted to a dichotomous variable using internationally based cut-off points.²⁰ These cut-offs were derived from an international, multicultural sample of cross-sectional growth surveys from six countries (Brazil, Great Britain, Hong Kong, Netherlands, United States and Singapore).²⁰ The cut-off points for overweight and obese correspond to adult (aged greater than 18 years) BMI cut-offs of $25 \text{ kg}/m^2$ (overweight) and $30 \text{ kg}/m^2$ (obese).

Immigrant status and recency

Participants were asked if they were born in Canada. Those who answered "no" to this question were considered immigrants. Follow-up questions were asked about country of birth and year of arrival in Canada. No additional information was collected on parent's country of birth to further classify participants based on immigrant generational status. As such, immigrant status is defined as foreign-born (i.e., 1st generation immigrant) versus Canadian-born (i.e., non-immigrant). Among immigrants, the length of time

living in Canada (reported in years) was also collected and reported as a continuous variable.

Measures of socio-demographic covariates

Ethnicity/race of the participant was determined by asking which racial or ethnic background they belonged to. This variable was dummy coded (0, Caucasian and 1, non-Caucasian). *Language* of the participant was determined by asking if they spoke English and/or French or neither. This variable was dummy coded (0, either/both English and French and 1, neither English nor French). *Household size* was reported by asking the participant the number of people living in their primary residence. *Source of income* was reported by asking the participants the primary source of their household income. The variable was dummy coded 0, non-assisted (i.e., salary, wages, self-employed, pension), and 1, government assisted (i.e., Employment Insurance, government assistance, no income).

Measurement of lifestyle covariates

Physical activity was a derived measure of energy expenditure (EE) (kilocalories expended per kilogram of body weight per day) based on self-reported questionnaire responses. The measure of physical activity takes into account the following information: the number of times the respondent reports participating in any activity; the average duration of the activity (in hours); and the *MET*, which is the "metabolic energy cost" of the activity expressed as kilocalories expended per kilogram of body weight per hours of activity (kcal/kg per hour). To further illustrate the interpretation of METs: 2 METs would describe an activity that required twice the amount of energy as compared to a body at rest. Different activities are pre-assigned METs by the Canadian Fitness and Lifestyle Research Institute.²¹

Fruit and vegetable intake was measured by the participants' response to questions of frequency of consumption of fruits and vegetables per week. Participants reported how many times per week they ate any fruits or vegetables. Of note, this question denotes frequency but not amounts of consumption and is not based on Canada's Food Guide serving sizes.

Statistical analysis

Participants' characteristics are reported using descriptive statistics, continuous variables reported as means and standard deviations and categorical variables are reported using percentages. Differences between immigrant and non-immigrant youth were examined using chi-square tests for categorical variables and independent t-tests for continuous variables.

About 33.6% of the sample had one or more missed responses on study variables. Multiple imputation (MI)²² using SPSS 19.0 was used to address missing data in the current study. For MI, SPSS uses an algorithm based on linear regression, Markov chain Monte Carlo (MCMC) method. Five imputed datasets were created and subsequently combined using *Rubin's rules for scalar estimands*.²² Given the design of the CCHS (i.e., individuals clustered within health regions), 2-level, multilevel regression models (MLM) were used for the analysis. A multilevel linear model was used for the continuous dependent variable, zBMI, and a logistic model for the binary response dependent variable, weight category (i.e., normal weight versus overweight/obese). Initially, the model is estimated using first-order marginal quasi-likelihood (MQL). As first-order

Table 1. Descriptive characteristics of respondents by immigrant group (n=63,509)

Characteristic	Non-immigrant (n=59,457)	Immigrant (n=4,052)	p-value
Age, years (mean, sd)	15.51 (0.01)	15.92 (0.03)	<0.001
Sex, female (%)	48.4	46.9	0.022
Race, Caucasian (%)	88.2	26.9	<0.001
Language, English or French (%)	99.5	96.7	<0.001
Weekly consumption of fruits and vegetables (mean, sd)	5.22 (0.02)	5.08 (0.04)	0.001
Energy expenditure (mean, sd)	3.91 (0.02)	3.83 (0.05)	0.118
Number living in household (mean, sd)	4.17 (0.01)	4.38 (0.02)	<0.001
Income source (% assisted)	3.5	5	<0.001
Overweight or obese (%)	21.8	18	<0.001
BMI z score (mean, sd)	0.34 (0.004)	0.09 (0.001)	<0.001

Table 2. Multilevel linear model of zBMI, beta coefficients (β) and standard errors (SE)

	Model 1		Model 2		Model 3	
	β	SE	β	SE	β	SE
Fixed effect intercept	1.02	0.03*	1.04	0.03*	1.22	0.04*
Immigrant (ref = non-immigrant)	-0.44	0.04*	-0.44	0.04*	-0.42	0.04*
Time since immigration	0.02	0.004*	0.02	0.004*	0.02	0.004*
Age	-0.03	0.002*	-0.03	0.002*	-0.03	0.002*
Female (ref = male)	-0.33	0.01*	-0.32	0.01*	-0.32	0.01*
CCHS cycle 2 (ref = cycle 1)	0.04	0.01*	0.04	0.01*	0.03	0.01*
CCHS cycle 3	0.04	0.01*	0.05	0.01*	0.04	0.01*
CCHS cycle 4	0.04	0.01*	0.04	0.01*	0.03	0.01*
Fruit/vegetable consumption			-0.01	0.002*	-0.01	0.002*
Energy expenditure			0.002	0.001*	0.002	0.001*
Language neither English nor French (ref = English and/or French language)					-0.16	0.06*
Income source government assisted (ref = Income source not government assisted)					0.07	0.03*
Non-Caucasian (ref = Caucasian)					-0.02	0.02
Household size					-0.03	0.004*
Random effects variance						
Level 2 (HR)	0.02	0.002	0.02	0.002	0.02	0.002
Level 1 (respondent)	1.25	0.01	1.25	0.01	1.25	0.01
-2*log likelihood		195094.91		195081.28		194990.49

ref = reference category; HR = health region.

* $p < 0.05$.

MQL may underestimate between-group variation, the final model is estimated using second-order penalized quasi-likelihood (PQL) and iterative generalized least-squares estimation. Three models are examined. The first model examines differences between immigrant and non-immigrant youth after adjusting for age, sex and CCHS cycle. Lifestyle factors are added in Model 2 and socio-demographic factors are added in Model 3. Multilevel analyses were conducted with MLwiN software version 2.24.²³

RESULTS

Table 1 presents differences between immigrant and non-immigrant youth on key study variables. About 88.2% of non-immigrant youth identified as Caucasian, compared to only 26.9% of immigrant youth. Immigrant youth consumed fruits and vegetables less frequently compared to non-immigrant youth. Immigrants have lower zBMI scores and have a lower prevalence of overweight/obesity. More immigrant youth live in households that are larger and in households that receive government income assistance, compared to non-immigrant youth. The mean number of years (SD) that immigrant youth lived in Canada was 7.1 (4.1) years.

Table 2 presents the results for zBMI. *Model 1* demonstrates a significant, negative association between immigrant status and zBMI. The zBMI is 0.44 lower among immigrant compared to non-immigrant youth. Also zBMI increased by 0.02 for every year an immigrant respondent resided in Canada ($p < 0.05$). Measures of diet (fruit and vegetable consumption) and activity level (energy

expenditure) were added in Model 2. This did not modify the association between zBMI and immigrant status. However, there was a negative association between frequency of fruit/vegetable consumption and zBMI ($b = -0.01$, $se = 0.002$), and a positive association with energy expenditure ($b = 0.002$, $SE = 0.001$). The addition of socio-demographic factors in Model 3 did not affect the strength of association between immigrant status and zBMI. Speaking neither English nor French and more family members residing in a household were significantly associated with lower zBMI scores. Having an income source that was government assisted was associated with a higher zBMI score.

Table 3 presents results from the binary weight variable. The trends had many similarities to the zBMI models. The association between immigrant status and weight category is significant and negative (OR 0.66, 95% CI: 0.45-0.86). Neither the direction nor the magnitude of the association between weight category and immigrant status changed in Models 2 or 3. Of note, energy expenditure demonstrated a significant, negative association with weight category, and having more family members residing in a household was negatively associated with overweight/obesity. Again, having a government-assisted income source was associated with overweight/obesity.

DISCUSSION

Using data from a series of cross-sectional Canadian Community Health Surveys, the current study compares body mass index among immigrant and non-immigrant Canadian youth. A

Table 3. Multilevel logistic model of overweight/obesity, Odds Ratio (OR) and 95% Confidence Interval (CI)

	Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	SE
Fixed effect intercept	0.41	0.26, 0.56	0.47	0.32, 0.63	0.73	0.54, 0.92
Immigrant (ref = non-immigrant)	0.66	0.45, 0.86	0.65	0.45, 0.86	0.64	0.43, 0.85
Time since immigration	1.02	1.00, 1.04	1.02	1.00, 1.04	1.02	1.01, 1.04
Age	1.00	0.99, 1.01	1.00	0.99, 1.01	0.99	0.98, 1.00
Female (ref = male)	0.57	0.53, 0.61	0.56	0.52, 0.60	0.56	0.51, 0.60
CCHS cycle 2 (ref = cycle 1)	1.04	0.98, 1.09	1.04	0.99, 1.09	1.02	0.97, 1.08
CCHS cycle 3	1.06	1.01, 1.11	1.07	1.02, 1.12	1.05	1.00, 1.10
CCHS cycle 4	1.08	1.03, 1.14	1.09	1.04, 1.15	1.07	1.02, 1.13
Fruit/vegetable consumption			1.00	0.99, 1.01	1.00	0.99, 1.01
Energy expenditure			0.98	0.97, 0.99	0.98	0.97, 0.99
Language neither English nor French (ref = English and/or French language)					0.76	0.45, 1.07
Income source government assisted (ref = Income source not government assisted)					1.13	1.03, 1.23
Non-Caucasian (ref = Caucasian)					1.07	0.97, 1.16
Household size					0.92	0.90, 0.94
Random effects variance						
Level 2 (HR)	0.06	0.01	0.06	0.01	0.06	0.01
Level 1 (respondent)	1	0	1	0	1	0

ref = reference category; HR = health region.

* $p < 0.05$.

secondary goal was to identify the extent to which lifestyle and socio-demographic factors account for between-group differences. We found that Canadian immigrant youth have lower zBMI and a lower prevalence of overweight/obesity, relative to Canadian-born youth. Also, for immigrant youth, length of time in Canada (i.e., recency) was associated with higher zBMI scores and increased odds of overweight/obesity. Further, there were differences in lifestyle factors including less frequent consumption of fruits and vegetables among immigrant youth compared to Canadian-born youth.

Previously published work has consistently demonstrated that immigrant adults in Canada have lower rates of overweight/obesity relative to Canadian-born adults.⁹⁻¹¹ Furthermore, evidence from longitudinal data from the National Population Health Survey (NPHS) demonstrated lower BMI among immigrants compared to non-immigrants in Canada and that BMI converged to non-immigrant levels over a 12-year period among Caucasian male immigrants, however the sample did not include anyone under age 18 years.¹⁰ The observation of these findings in Canadian youth is important as it gives valuable insight to an important developmental period that could be pursued for targeted health promotion and prevention efforts.

Despite some differences in lifestyle factors between immigrant and non-immigrant youth, the addition of lifestyle factors, including diet and activity, did not modify the association between immigrant status and zBMI or proportion of overweight/obesity (Tables 2 and 3). However, there were some contrary results between the continuous and binary outcome variables. For energy expenditure, the odds of overweight/obesity decreased by 2.0% (OR 0.98, 95% CI: 0.97-0.99) with each 1-unit increase of energy expenditure. This finding is in line with previously reported literature that reports a negative association between physical activity and rates of overweight/obesity.²⁴⁻²⁶ However we also found a significant association between zBMI and energy expenditure, in an opposite direction: zBMI increased with an increase in energy expenditures. These contradictory results may be due to a lack of robustness in the measure, or non-linearity in the association between the measures due to reporting biases or adjustments to the measurement of zBMI. Albeit statistically significant, the magnitude

of this association with overweight/obesity is small compared to previously reported estimates. It has been shown that children who engage in vigorous physical activity are 33% less likely to be obese compared to those who do not.²⁶ Further, there was no significant difference in physical activity, as measured by energy expenditure (kcd), between immigrant and non-immigrant youth. That being said, it has been demonstrated that Canadian immigrant adults and children in the United States have lower levels of physical activity^{27,28} than their non-immigrant counterparts, and this differing lifestyle routine is one hypothesis with regard to the increasing risk for obesity with time spent living in North America. Also of note is the negative association between frequency of fruits and vegetables consumption and zBMI score. Similar to the case with energy expenditure, the size of this effect in the current study is small, however in comparison to other reported studies, similar in magnitude. For example, in this study, with every 1-unit increase in frequency of fruit and vegetable consumption, we observed a corresponding decrease in zBMI score of 0.01 (SE 0.002, $p < 0.05$). In comparison, a large prospective cohort of American children showed that with every 1 serving of vegetable consumption, boys aged 9-14 had a 0.003 decrease in zBMI (95% CI: -0.004, -0.001).²⁹ Although of similar direction, the unit of sampling, frequency versus serving size, makes direct comparisons difficult. Non-immigrant youth reported greater frequency of consumption of fruits and vegetables than immigrant youth. Although the difference was quite small, the difference in diet may contribute to the observation that the odds of overweight/obesity among immigrant youth increased with time spent in Canada. One factor that may influence the ability to access a healthy diet may be socio-economic status. As previous studies have demonstrated, families with lower socio-economic status consume less fruits and vegetables compared to those of higher socio-economic status,³⁰ and immigrant youth in this study were more likely to have household income in the form of government support, a proxy measure for socio-economic status.

The addition of socio-demographic factors did not attenuate the association between immigrant status and weight measures, suggesting that the observed group differences between immigrant

and non-immigrant youth are not attributable to socio-demographic factors. Government-assisted income source was significantly, positively associated with BMI.

Strengths of the study

At present, we have not been able to identify any other studies that address the issue of overweight and obesity among Canadian immigrant youth, which makes this study unique in describing a growing segment of the Canadian youth population. The strengths of this study include adequate statistical power, with a robust sample size of over 60,000 youth. We also had the opportunity to combine both socio-demographic and lifestyle factors in the models, which allowed for a comprehensive examination of possible contributing factors in the association between overweight/obesity and immigration status.

Limitations of the study

As mentioned previously, the data for this secondary data analysis were cross-sectional in nature. Although four cycles of the CCHS were combined for the analysis, there was only one data point per respondent, ruling out a longitudinal analysis and any opportunity to examine temporal associations among the study variables. Specifically, we were not able to address how differences in lifestyle factors may have affected BMI over time for each group. There was a relatively large amount of missing information, including ~16% missed responses for frequency of fruit and vegetable consumption. To address loss of data, multiple imputation was used to account for variables that were missing. Additionally, the dependent variables were reliant on self-reported height and weight, which may contribute to reporting bias. In a previous study, Shields and colleagues compared self-reported height and weight to measured height and weight in a subsample of the 2005 CCHS survey.³¹ They demonstrated that, in general, respondents over-estimated their height compared to their actual measured height.³¹ Furthermore, respondents generally under-reported their weight, with a larger difference among female respondents than males.³¹ These reporting biases were similar for immigrants and non-immigrants. Although the dependent variable may be affected by self-report, it is likely that the two groups, immigrant and non-immigrant youth, are affected in similar fashion. The majority of other included variables were also self-reported, such as lifestyle factors, including frequency of fruit and vegetable consumption and energy expenditure. A systematic review of assessments of direct versus self-reported physical activity showed low to moderate correlation between measures.³² Further a systematic review examining the reliability and validity of sedentary behaviours, found self-reported methods to be reliable but their validity untested.³³

CONCLUSION

This study adds to the growing body of evidence in North America that adult and youth immigrants compared to native-born peers have different levels of overweight and obesity.^{9-11,34} We demonstrate that immigrant youth in Canada are less often overweight/obese and have lower BMI z scores compared to non-immigrant youth. Also, an important observation to highlight for future primary prevention strategies is the impact of recency on risk of becoming overweight and obese among Canadian immigrant youth. Further, immigrant youth may have modifiable

risk factors, including less frequent consumption of fruits and vegetables, although the magnitude of the difference between groups is modest and conclusions should be drawn with caution. By prospectively studying this subgroup of Canadian youth, we will be able to explore facilitators and barriers to healthy lifestyle behaviours and to design effective intervention strategies.

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RÉSUMÉ

OBJECTIFS : Les objectifs de cette étude sont : i) d'examiner les différences dans l'indice de masse corporelle (IMC) et la prévalence du surpoids/de l'obésité entre les jeunes de 12 à 19 ans immigrants et non immigrants et ii) de déterminer la mesure dans laquelle le mode de vie et les facteurs sociodémographiques expliquent les différences entre ces groupes.

MÉTHODE : Les données d'analyse ont été obtenues en combinant les enquêtes transversales répétées de l'Enquête sur la santé dans les collectivités canadiennes (ESCC) menées entre 2000 et 2008. L'échantillon d'analyse comprenait 63 509 jeunes de 12 à 19 ans (moyenne 15,2, déviation sensible [DS] 2,3 ans) ayant déclaré leur poids et leur taille. Les jeunes immigrants composaient 6,4 % de cet échantillon. Des analyses multiniveaux linéaires et des analyses de régression logistique ont servi à aborder les objectifs de l'étude.

RÉSULTATS : Environ 22 % des jeunes non immigrants étaient en surpoids ou obèses, contre 18 % des jeunes immigrants ($p < 0,001$). Le score-z de l'IMC des jeunes immigrants était inférieur de 0,44 à celui des jeunes non immigrants ($p < 0,001$), et ce score augmentait de 0,02 pour chaque année de résidence au Canada d'un répondant immigrant. Les indicateurs du mode de vie et des facteurs sociodémographiques n'expliquaient pas les différences dans la composition corporelle des jeunes immigrants et non immigrants.

CONCLUSION : Même après un rajustement des données pour tenir compte du mode de vie et des facteurs sociodémographiques, les jeunes immigrants ont un moindre niveau de surpoids/d'obésité et un score-z de l'IMC inférieur à celui des jeunes non immigrants. De plus, pour les jeunes immigrants, le score-z de l'IMC augmente avec le temps passé au Canada, ce qui présente la possibilité de mener des stratégies de prévention primaire de l'obésité axées sur les nouveaux arrivants au Canada.

MOTS CLÉS : surpoids; obésité; immigrants; jeunes; indice de masse corporelle