Neighbourhood Socio-economic Status and the Prevalence of Overweight Canadian Children and Youth

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ABSTRACT

Background: The purposes of this study are to determine (i) if neighbourhood socio-economic status (SES) is systematically related to the prevalence of overweight children and youth in Canada, (ii) if the factors accounting for the apparent relationship have face validity, and (iii) if neighbourhood SES has an independent influence on this distribution.

Methods: Cross-sectional data from Cycle 4 (2000/2001) of the National Longitudinal Survey of Children and Youth were used. Children and youth aged 5 to 17 were included. Overweight was established using age and sex cut-off points. Neighbourhood socio-economic data were obtained from the Statistics Canada 2001 Dissemination Area databases and SES quartiles constructed using a composite of socio-economic variables. Hierarchical non-linear modelling was used to test for independent neighbourhood effects.

Results: A gradient of increasing overweight prevalence by decreasing neighbourhood SES quartiles was observed (24% high SES, 30% mid-high SES, 33% mid-low SES, 35% low SES). Controlling for individual age, gender, family income and education hierarchical analysis found that a child's odds of being overweight increases if living in a low versus a high SES neighbourhood (OR=1.29, 95% CI=1.14-1.46).

Interpretation: The prevalence of child and youth overweight in Canada is inversely and statistically significantly related to neighbourhood SES. Independent effects indicate that neighbourhood characteristics directly influence the odds of being overweight. This research suggests that consideration of opportunity structures that exist in different types of neighbourhoods is fundamentally important to health promotion and disease prevention strategies.

MeSH terms: Obesity; socioeconomic factors; population health; residence characteristics

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

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Because bodyweight is an important risk factor for mortality,^{1,2} diabetes,^{3,4} and cardiovascular disease,⁵⁻⁷ and influences psychosocial determinants of health,^{8,9} the increasing prevalence of overweight and obesity¹⁰ among children is a pressing public health problem.^{11,12} Using the Canadian National Longitudinal Survey of Children and Youth (NLSCY), one study found that being from a higher SES family and having a father with more education reduced the risk of child overweight.¹³ Another found that participation in physical activity reduced the risk of overweight, while watching television and playing video games increased the risk of both obesity and overweight.¹⁴

No studies we are aware of have investigated children's bodyweight at the neighbourhood scale in Canada despite empirical and theoretical research linking the neighbourhood environment to bodyweight. Several international studies involving adult populations have found increased prevalence of overweight and obesity in deprived neighbourhoods, after controlling for individual factors.¹⁵⁻¹⁷ Another found that neighbourhoods with lower safety and greater social disorder were associated with less physical activity among 11-16 year olds after controlling for demographic characteristics.¹⁸ Evidence also suggests that individuals living in deprived neighbourhoods have increased exposure to fast food restaurants and fewer grocery stores with affordable healthy foods.^{19,20}

While little Canadian research has linked neighbourhoods and child obesity, neighbourhood deprivation has been linked to other child outcomes. Research using the NLSCY has found child development and behaviour to be independently and negatively influenced by neighbourhood deprivation.²¹⁻²³ The purposes of this paper are to determine: (i) if neighbourhood SES is systematically related to the prevalence of overweight children and youth in Canada; (ii) if the factors accounting for the apparent relationship have face validity; and (iii) if neighbourhood SES has independent effects after controlling for demographic variables.

METHODS

Cross-sectional data from Cycle 4 (2000/2001) of the NLSCY, a nationally

representative longitudinal survey of Canadian children that covers a range of child outcomes including health, learning, behaviour, physical development and the social environment were used.²⁴ Statistics Canada's Labour Force Survey, a stratified, multistage probability sample design was used as the sampling frame to select participating households. A full description of the NLSCY and sampling design is available elsewhere.²⁴ Socio-economic information for each household was collected through an interview with the Person Most Knowledgeable (PMK) about the child. Of children surveyed, the PMK for 89.8% was a mother (biological or step parent), for 8.7% a father (biological or step parent) and for 1.5% neither a mother nor father.

Table I displays the published international cut-off points used to classify children as overweight and obese based on their Body Mass Index (BMI), calculated as weight(kg)/height(m)².²⁵ For children under 12, the PMK provided the child's height and weight; youth 12 and over self-reported height and weight. To account for the different reporting mechanisms and physiological differences between children and adolescents, children were categorized as aged 5 to 11 and youth were categorized as aged 12 to 17. Children under 5 were excluded due to the restricted spatial domain of young children as well as fluctuations in BMI at younger ages, which makes assessing overweight problematic. Two dichotomous measures of physical activity were used: participation in organized and unorganized sports, and physical activity ('never or almost never' and 'at least once a week'). These variables were recoded from original NLSCY variables querying children's participation in organized sports and physical activity (e.g., sports teams, dance and gymnastics) and unorganized sports and physical activity using syntax obtained from Willms and Fedick.²⁶ For children 9 and younger, participation was reported by the PMK, while children 10 and over self-reported.

Children's PMK (5-15 years only) responded to the statement, "There are safe parks, playgrounds and play spaces in this neighbourhood". A dichotomous variable 'agree' or 'disagree' was created by collapsing the four-point response 'strongly agree', 'agree', 'disagree', 'strongly disagree'. This item was used to determine

TABLE I

Published International Cut-off Points for Overweight and Obese by Sex That Pass Through a Body Mass Index of 25 and 30 kg/m² at Age 18 Years*

Age (Years)*	Overweight		Obese	
	Body Mass Index 25kg/m ²	Body Mass Index 30kg/m ²	Body Mass Index 25kg/m ²	Body Mass Index 30kg/m ²
	Males	Females	Males	Females
5	17.42	17.15	19.30	19.17
5.5	17.45	17.20	19.47	19.34
6	17.55	17.34	19.78	19.65
6.5	17.71	17.53	20.23	20.08
7	17.92	17.75	20.63	20.51
7.5	18.16	18.03	21.09	21.01
8	18.44	18.35	21.60	21.57
8.5	18.76	18.69	22.17	22.18
9	19.10	19.07	22.77	22.81
9.5	19.46	19.45	23.39	23.46
10	19.84	19.86	24.00	24.11
10.5	20.20	20.29	24.57	24.77
11	20.55	20.74	25.10	25.42
11.5	20.89	21.20	25.58	26.05
12	21.22	21.68	26.02	26.67
12.5	21.56	22.14	26.43	27.24
13	21.91	22.58	26.84	27.76
13.5	22.27	22.98	27.25	28.20
14	22.62	23.34	27.63	28.57
14.5	22.96	23.66	27.98	28.87
15	23.29	23.94	28.30	29.11
15.5	23.60	24.17	28.60	29.29
16	23.90	24.37	28.88	29.43
16.5	24.19	24.54	29.14	29.56
17	24.46	24.70	29.41	29.69
17.5	24.73	24.85	29.70	29.84
18	25	25	30	30

* Adapted from Cole et al.²⁵

the validity of neighbourhood effects. Individual level predictor variables were child's age and gender. Family socio-economic variables selected are estimated family income (centered in thousands) and PMK level of schooling. Dummy variables for four categories of PMK schooling (no high school, high school, beyond high school, post-secondary degree) were created.

Neighbourhood data

Statistics Canada 2001 Census Dissemination Areas (DAs) were selected as proxies for neighbourhoods. DAs are the smallest standard geographic area (400-700 persons) with complete geographic coverage and data availability. As the NLSCY did not contain a link to each child's DA, a Postal Code Conversion File was used to assign DAs.²⁷ Where a single postal code overlapped into multiple DAs, a Single Link Indicator, which identifies the most representative DA, was used.

Data from the 2001 Census was used to assess neighbourhood SES. Three census variables (unemployment rate, median family income, and population over 20 without post-secondary education) were chosen as markers of SES, reflecting workforce participation, income and education-

al attainment. These variables were standardized and summed to create an index of SES and quartiles were constructed (high, mid-high, mid-low, low) and linked to the NLSCY dataset.

After excluding cases with missing data, our final sample yielded 11,455 children (of a possible 19,166 children 5 and over surveyed). Complete height and weight data were lacking for ~23% of cases and ~17% of cases could not be linked to a Dissemination Area (DA) due to suppressed data or missing/incorrect postal codes.

To assess the impact of neighbourhood level SES on childhood overweight, we used a three-level hierarchical regression model to account for the nested data structure of children (n=11,455) in families (n=9021) in neighbourhoods (n=5531).²⁸ Results are presented for overweight (including obese) because the small number of obese youth precluded conducting separate analyses. A three-level Bernoulli model was specified using HLM 5 (Hierarchical Linear and Non-Linear Modeling) software on unweighted data. A full model with predictors at all levels and a partial model with no predictors at the family level were constructed.

TABLE II

Rates of Overweight, Obesity and 'Never or Almost Never' Participate in Organized and Unorganized Sports by Age-group, NLSCY Cycle 4

	Overweight*		Obese*		Organized Sports (never or almost never)		Unorganized Sports (never or almost never)	
	Total† (N=3,190,300)	% (95% CI)‡	Total† (N=3,190,300)	% (95% CI)‡	Total† (N=2,643,600)	% (95% CI)‡	Total‡ (N=2,640,900)	% (95% CI)‡
All Ages (5-17)	944,700	29.31 (28.05,31.75)	360,100	11.29 (10.25,12.32)	922,800	34.91 (33.22,36.95)	922,500	34.93 (33.30,36.57)
Children (5-11 years)	643,600	33.17 (31.34, 35.00)	268,800	13.85 (12.69,15.01)	651,400	35.30 (33.29,37.31)	674,800	36.62 (34.72,38.51)
Youth (12-17 years)	301,200	24.09 (21.66, 26.56)	91,300	7.30 (5.63,8.97)	271,400	34.00 (30.82,37.18)	247,700	31.05 (27.85,34.25)

NLSCY=National Longitudinal Survey of Children and Youth

* Overweight (includes obese) and obese defined by cut-off points from Cole et al.²⁵ (see Table I)

† The number of children is weighted and rounded to the nearest 100

‡ Percents based on unrounded weighted data, confidence intervals calculated using 1000 bootstrap weights supplied by Statistics Canada to account for the complex sampling design of the NLSCY

RESULTS

Following Statistics Canada's NLSCY data publication guidelines, cross-sectional sampling weights were used in all non-hierarchical analysis so that results are representative of the Canadian population.²⁹ Coefficients of variation computed using 1000 bootstrap weights supplied by Statistics Canada were used to assess the quality of estimates.²⁹ The first two columns of Table II give the prevalence of overweight and obesity for children and youth and show that the prevalence is higher among children (33.17%,13.85%) than youth (24.09%,7.30%). The third and fourth columns of Table II show that, while participation in organized sports is slightly higher among children than youth, both groups have comparable participation in unorganized sports. Figure 1 shows the prevalence of overweight and obese children and youth by neighbourhood SES. Confidence intervals were constructed in SAS software using 1000 bootstrap weights supplied by Statistics Canada to account for the complex sampling design of the NLSCY. For all ages, a social gradient is evident in which the prevalence of overweight (obesity) increases from 24% (7%) in high SES neighbourhoods to 35% (16%) in low SES neighbourhoods. Stratified by age, this gradient is less pronounced among overweight youth but not obese youth. Figure 2 shows the prevalence of children and youth who 'never or almost never' participate in organized and unorganized sports by neighbourhood SES. Participation rates for organized sports follow a similar pattern, but a social gradient is not evident in participation rates for unorganized physical activity by neighbourhood SES category. Figure 3

Figure 1. Prevalence of overweight and obese children (ages 5-11) and youth (ages 12-17) by neighbourhood SES quartiles, NLSCY Cycle 4*
NLSCY = National Longitudinal Survey of Children and Youth; SES = socio-economic status

* Percents based on unrounded weighted data, confidence intervals calculated using 1000 bootstrap weights supplied by Statistics Canada to account for the complex sampling design of the NLSCY

† Overweight (includes obese) and obese defined by cut-off points from Cole et al.²⁵ (see Table I)

‡ The coefficient of variation is between 16.6% and 33.3%, which is considered marginal according to Statistics Canada data quality guidelines

shows a similar gradient in the percent of PMKs who disagree that there are safe parks and play spaces in the neighbourhood. Between high SES and low SES neighbourhoods, there is an approximately three-fold increase in percent PMK who disagree that there are safe parks in the neighbourhood. Thus, factors relating to the underlying opportunity structures are consistent with observed gradients in overweight but appear stronger for children than youth.

The initial unconditional model (no predictor variables) found statistically significant differences in between-neighbourhood variation ($X_{2(5530)}=5767.81$ $p=0.013$), indicating that some of the variance in overweight can be attributed to the neighbourhood level. The results presented in Table III assess if a child's odds of being overweight is related to neighbourhood, family and individual factors. The first column of Table III shows results unadjusted for family socio-economic background.

Being a youth and being female are associated with reduced odds of being overweight. This relationship corresponds to the pattern observed in previous research using the NLSCY.¹³ Compared to living in a high SES neighbourhood, the odds of being overweight increase with each quartile decrease in SES. The second column of Table III shows results that include family-level covariates. As expected, increasing family income is associated with reduced odds of being overweight. Compared with having a PMK with a post-secondary degree, a child's odds of being overweight is 1.26 times greater if the PMK has no high school. Odds ratios indicate a social gradient of increased odds of being overweight with less PMK schooling, though PMK with beyond high school is not statistically significant at the $p < 0.05$ level. The odds ratios for neighbourhood SES are attenuated with the addition of family socio-economic status, but show a similar social gradient of increased risk of overweight with each decreasing SES quartile. The odds of a child who lives in a low SES neighbourhood being overweight is 1.29 (1.45 unadjusted for family characteristics) times that of a child living in a high SES neighbourhood.

DISCUSSION

This paper provides evidence of a social gradient in the prevalence of overweight by neighbourhood SES in a nationally representative sample. Hierarchical modelling suggests that the neighbourhood socio-economic environment has an independent influence on child overweight after controlling for individual and family characteristics. The finding that living in a low SES neighbourhood increases the odds of being overweight is similar to findings from international studies involving adult populations.¹⁵⁻¹⁷ As this is the first study we know of to examine neighbourhood influences on child overweight, it suggests that neighbourhood influences emerge in childhood. While this study did not assess the pathways and mechanisms through which neighbourhood SES influences child overweight, the analysis suggests that less affluent neighbourhoods have social and physical environments less conducive to maintaining a healthy bodyweight. Descriptive analysis found that as neighbourhood SES

Figure 2. Prevalence of 'never or almost never' participation in organized and unorganized sports for children (ages 5-11) and youth (ages 12-17) by neighbourhood SES quartiles, NLSCY Cycle 4*
NLSCY = National Longitudinal Survey of Children and Youth; SES = socio-economic status

* Percents based on unrounded weighted data, confidence intervals calculated using 1000 bootstrap weights supplied by Statistics Canada to account for the complex sampling design of the NLSCY

Figure 3. Prevalence of PMKs who disagree that there are safe parks and play spaces in the neighbourhood by neighbourhood SES quartiles, NLSCY Cycle 4*†

PMK = Person Most Knowledgeable; NLSCY = National Longitudinal Survey of Children and Youth; SES = socio-economic status

* Percents based on unrounded weighted data, confidence intervals calculated using 1000 bootstrap weights supplied by Statistics Canada to account for the complex sampling design of the NLSCY

† Person Most Knowledgeable (PMK) response to the statement, "There are safe parks, playgrounds and play spaces in this neighbourhood". Disagree represents a response of 'Disagree' or 'Strongly Disagree'

TABLE III

Results for Hierarchical Linear Modelling Analysis Assessing the Influence of Individual, Family and Neighbourhood Characteristics on Child and Youth Overweight*

	Partial Model (Unadjusted for Family)			Full Model (Adjusted for Family)		
	Odds Ratio†	95% CI		Odds Ratio†	95% CI	
		Lower	Upper		Lower	Upper
Individual Level						
Age (youth)	0.61	0.56	0.67	0.61	0.55	0.67
Gender (female)	0.89	0.83	0.97	0.89	0.83	0.96
Family Level						
No high school	—	—	—	1.24	1.08	1.42
High school	—	—	—	1.20	1.08	1.34
Beyond high school	—	—	—	1.10	0.99	1.23
Post-secondary degree (ref)	—	—	—	1.00	—	—
Family income	—	—	—	0.99	0.99	1.00
Neighbourhood Level						
High SES (ref)	1.00	—	—	1.00	—	—
Mid-high SES	1.21	1.08	1.36	1.15	1.02	1.30
Mid-low SES	1.34	1.19	1.50	1.23	1.10	1.39
Low SES	1.45	1.29	1.63	1.29	1.14	1.46

* Results based on unweighted data

† Odds ratios in bold are significant at the $p < 0.05$ level

decreases, fewer children participate in organized physical activity. This lower participation rate may be due to a lack of local facilities and/or a lack of resources (money, time and transportation) and/or a lack of awareness of (or interest in) the availability of organized sports. Though no difference was found in participation in unorganized sports, safety concerns may also restrict physical activity as PMKs in low SES neighbourhoods were more likely to report a lack of safe playgrounds and parks. The direction of effect is consistent with the interpretation that opportunity structures in lower income neighbourhoods may be less conducive to maintaining a healthy bodyweight than in high SES neighbourhoods. These findings also indicate that the neighbourhood may be a site for the implementation of policies to target overweight and obesity, such as ensuring that neighbourhoods are safe and have infrastructure for physical activity. This research suggests that understanding the determinants of the obesity epidemic among children requires an understanding of the places children live.

There are several limitations of this study. First, the use of BMI to assess overweight has well-known limitations.³⁰ Second, height and weight were not directly measured but assessed through PMK reports for children under 12 and self-reports of children 12 and over. Female youth may be more likely to underestimate their weight and male youth may be more likely to overestimate their height.³¹ Third, the model estimated neighbourhood context controlling for individual variables.

While variables such as age and gender may be independent of context, other variables may not be entirely separate (e.g., parental education and family income). Thus, the context and composition distinction, while required for modelling purposes, is not a simple dichotomy.³² Finally, DAs were used as proxies for children's and youth's neighbourhood. A DA may be appropriate for a young child but may be too small for a teenager. Moreover, little is known about the social relations embedded in the spatial units of these 'neighbourhoods'. Nonetheless, the results of this analysis are consistent with a growing body of research demonstrating that neighbourhood characteristics exert an independent influence on the prevalence of overweight and obesity.

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RÉSUMÉ

Contexte : Notre étude visait à déterminer i) si le statut socioéconomique (SSE) du quartier est systématiquement lié à la prévalence de l'embonpoint chez les enfants et les adolescents au Canada, ii) si les facteurs expliquant ce lien possible ont une validité apparente, et iii) si le SSE du quartier exerce une influence indépendante sur cette répartition.

Méthode : Nous avons utilisé des données transversales du 4^e cycle (2000-2001) de l'Enquête longitudinale nationale sur les enfants et les jeunes, en incluant les enfants et les adolescents de 5 à 17 ans. L'embonpoint a été déterminé selon des points limites par âge et par sexe. Les données socioéconomiques des quartiers sont tirées des bases de données des aires de diffusion de Statistique Canada pour 2001, et les quartiles par SSE ont été calculés à l'aide d'une moyenne composée de variables socioéconomiques. Nous avons utilisé la modélisation hiérarchique non linéaire pour évaluer l'influence indépendante exercée par les quartiers.

Résultats : Nous avons observé une prévalence croissante de l'embonpoint inversement proportionnelle au quartile du statut socioéconomique du quartier (24 % d'embonpoint dans les quartiers ayant un SSE supérieur, 30 % pour un SSE moyen à supérieur, 33 % pour un SSE moyen à inférieur et 35 % pour un SSE inférieur). Après avoir apporté des ajustements pour tenir compte des effets de l'âge, du sexe, du revenu familial et de la scolarité, nous avons déterminé grâce à une analyse hiérarchique que la probabilité d'embonpoint augmente si l'enfant vit dans un quartier au SSE faible plutôt que dans un quartier au SSE élevé (RC=1,29, IC de 95 %=1,14-1,46).

Interprétation : La prévalence de l'embonpoint chez les enfants et les jeunes au Canada est inversement proportionnelle au SSE du quartier, et cette relation est statistiquement significative. D'après l'étude des effets indépendants, les caractéristiques du quartier influencent directement la probabilité de faire de l'embonpoint. Notre étude donne à penser qu'il est fondamental, dans les stratégies de promotion de la santé et de prévention des maladies, de tenir compte des structures de possibilités qui existent dans différents quartiers.

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