Predictors of Obesity Among Métis Children: Socio-economic, Behavioural and Cultural Factors

Martin J. Cooke, PhD,[1,2] Piotr Wilk, PhD,[3] Kenneth W. Paul, MSc,[1] Shelley L.H. Gonneville[4]

ABSTRACT

OBJECTIVES: To examine the socio-economic, behavioural and Métis-specific factors that predict obesity among Métis children aged 6 to 14 years. Socio-economic factors included household structure and income, parental education and food insecurity. Cultural factors included knowledge of an Aboriginal language, participation in cultural activities, time spent with Elders and parental residential school attendance.

METHODS: The 2006 Aboriginal Peoples Survey, Children and Youth component collected data about Métis children, including child height and weight, reported by the person most knowledgeable about the child (PMK). Multivariate binary logistic regression was used to predict obesity, defined using IOTF BMI cut-offs. After testing for interactions, models were stratified by age (6-10, 11-14) and gender.

RESULTS: An estimated 18.5% of Métis boys and 14.4% of girls were obese. The effects of socio-economic factors and region varied across age and gender groups, although living in a lone-parent family and rural residence had consistent effects. Many effects of cultural variables were unexpected. Although PMK residential schooling was positively associated with obesity generally, the effects were negative among older girls. As expected, children participating in frequent physical activity generally had lower risk, independent of other factors.

CONCLUSIONS: Although socio-economic factors are related to risk of obesity among Métis children, the effects may not be the same across age groups and for boys and girls. There is some evidence of independent effects of Métis-specific cultural factors, including parental residential schooling, on the risk of child obesity, but further investigation and better data are needed to understand these relationships.

KEY WORDS: Obesity; Body Mass Index; indigenous population; children; Canada

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

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Aboriginal children in Canada and the US are at particularly high risk for overweight and obesity,[1] with a variety of potential health consequences in childhood and later life.[2] Although as many as 30% of Aboriginal people in Canada identify as Métis,[3] there have been no studies of obesity specifically among Métis children.[4]

There is considerable evidence of the effects of socio-economic risk factors for childhood overweight and obesity, especially parental income and education, among the general population.[5] The overall higher risk of obesity experienced by Aboriginal children is likely related at least in part to social and economic conditions, such as higher rates of low income, and increased likelihood of living in underserved communities or neighbourhoods. Average income among Métis aged 15 years and older was about 80% of that of the Canadian population in 2005, and the rate of low income among Métis was 21% in that year, compared with 15% among all Canadians.[6] A higher proportion of Métis also live in rural areas[6] and there is evidence that Aboriginal peoples, including Métis, are at high risk for food insecurity,[7] which may also play a role in the high rates of childhood obesity.[8]

It is generally recognized that the causes of childhood overweight and obesity are complex and operate on several different levels.[9] There is also a growing understanding that Aboriginal peoples' health is affected by unique historical and cultural factors associated with colonialism, including the loss of access to traditional environments,[10] and loss of culture and language.[11,12] In the case of childhood overweight and obesity, Willows and colleagues[9] have developed a socio-ecological framework that incorporates factors operating at the levels of the individual, home and community, built environment and society levels, all within the historical context of colonization and assimilationist policies that include the *Indian Act* and residential schooling. These "Aboriginal determinants of health" and their effects may be different for First Nations, Métis and Inuit populations, owing to their unique cultures and geographies and different histories of colonization and legal recognition.[13]

With this paper we hope to address two gaps in the existing literature regarding childhood obesity and Indigenous peoples. First, although there has been some research regarding overweight and obesity among Aboriginal children in Canada, there has been less work outside of First Nations communities, and none that focuses on Métis children. Second, there have been no examinations of the potential effects of Métis-specific determinants of health, on par-

Author Affiliations

1. School of Public Health and Health Systems, University of Waterloo, Waterloo, ON
2. Department of Sociology & Legal Studies, University of Waterloo, Waterloo, ON
3. Department of Paediatrics and Department of Epidemiology & Biostatistics, Schulich School of Medicine and Dentistry, Western University, London, ON
4. Healing and Wellness Branch, Métis Nation of Ontario, Ottawa, ON

Correspondence: Martin Cooke, School of Public Health and Health Systems, University of Waterloo, 200 University Dr. W., Waterloo, ON N2L 3G1, E-mail: cooke@uwaterloo.ca

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ticular health outcomes. In this case, we hypothesized that access to culture and traditional activities and knowledge of Aboriginal languages may be protective against obesity.[14] Following Willows and colleagues,[9] we hypothesized that parental residential schooling may have an effect on risk of obesity that is independent of other risk factors, possibly through loss of cultural or parenting knowledge.

METHODS AND DATA

Data used for the analyses came from the 2006 Aboriginal Peoples Survey (APS),* which was administered to a sample of the off-reserve population who identified as members of an Aboriginal group (First Nations, Inuit, or Métis) in the 2006 Census.[15] The Children and Youth Component of the APS contains data on children aged 6 to 14, provided by the "Person Most Knowledgeable" (PMK) about the child within the household. Nearly all PMKs (97%) were parents, including a small number of step- and adoptive parents, and about three quarters were female, indicating most PMKs were mothers. The analysis included children identified by the PMK as Métis only.

Variables

Obesity was defined based on the International Obesity Task Force's (IOTF) sex- and age-specific Body Mass Index cut-offs,[16] provided on the Statistics Canada datafile, with BMI calculated using PMK-reported height and weight.

Socio-demographic variables included Census family† status[17] as well as child's age and gender. Aspects of socio-economic status captured by the APS included the education of the PMK – a reasonable proxy for parents' education, household income, and whether the family had experienced food insecurity. Household income was divided into groups roughly equivalent to quartiles,‡ with the highest as the reference category. Food insecurity was based on the question, "Has ___ ever experienced being hungry because the family has run out of food or money to buy food?" and was coded dichotomously (Y/N).

Because of the small sample size in some provinces, geography was coded into six regions, with Ontario as the reference category. Urban versus rural residence was defined by Statistics Canada's classification.[15]

There was only one variable that pertained to physical activity, derived from the question, "How often does _____ play sports, including taking lessons?" Responses were coded as "1-3 times per week", "4 or more times per week", with "never or less than once per week" as the reference category. Physical inactivity was assessed by a question pertaining to three activities, "On average, about how many hours per day, if any, does ____watch TV, videos or DVDs?", "…spend time on a computer?", or "…play video games such as Play Stations, Xboxes, Nintendo and Gameboy, excluding computer games?" TV viewing, time spent playing video games and time spent on a computer were coded dichotomously as "two hours or less per day" and "greater than two hours per day". The APS also asked PMKs whether children had ever been breastfed.

The APS dataset includes several questions related to children's cultural activities and knowledge. PMKs were asked, "Does ___ speak an Aboriginal language?" (Y/N). PMKs were also asked how often children "spend time with Elders" and "participate in culturally-related activities." Responses were recoded to three categories, "one to three times per week", "four or more times per week", with "never or less than once per week" as the reference category. PMKs were also asked the question, "Were you ever a student at a federal residential school, or a federal industrial school?" (Y/N).

Table 1. Characteristics of Sample of Métis Children Aged 6 to 14 Years, and Percent Obese (N=4060)

Variable	Value	Percent of Sample	Percent Obese	P-value
Sex	Male	50.5	18.5	0.0005
	Female	49.5	14.4	
Age (years)	6-10	29.2	26.9	<0.0001
	11-14	70.8	11.8	
Single-parent household	No	69.6	14.5	<0.0001
	Yes	30.4	20.3	
PMK education	Some post-secondary	58.3	14.4	<0.0001
	HS diploma	24.2	16.3	
	Less than HS diploma	17.5	22.5	
Household income	<$39,000	23.7	20.4	<0.0001
	$39,001-$63,000	24.9	18.8	
	$63,001-$94,000	24.9	12.9	
	>$94,000	26.6	13.5	
Experience hunger	Never	93.6	16.4	0.7967
	Ever	6.4	15.4	
Region	Québec	6.4	11.5	0.0160
	Atlantic region	4.7	21.2	
	Ontario	19.3	14.1	
	Prairie region	51.9	18.1	
	British Columbia	16.8	13.2	
	Territories	1.0	25.0	
Urban/Rural	Urban	69.1	15.4	0.0179
	Rural	30.8	18.4	
Aboriginal language	No	94.1	16.0	0.0442
	Yes	5.9	20.8	
Time with Elders (times/week)	<1	62.0	15.1	0.0005
	1-3	25.9	16.2	
	≥4	12.1	22.5	
Culturally-related activities (times/week)	<1	86.2	16.1	0.0708
	1-3	12.1	16.3	
	≥4	1.7	28.6	
PMK attended residential school	No	98.3	16.1	0.0186
	Yes	1.7	28.6	
Breastfed	No	29.4	18.5	0.0204
	Yes	70.6	15.4	
Sports participation (times/week)	<1	27.9	18.6	<0.0001
	1-3	49.4	17.5	
	≥4	22.7	11.0	
Watches television (hours/day)	>2	26.7	19.4	0.0021
	≤2	73.3	15.2	
Plays video games (hours/day)	>2	4.0	25.0	0.0008
	≤2	96.1	15.9	
Computer time (hours/day)	>2	6.9	10.7	0.0149
	≤2	93.1	16.6	

Data: 2006 Aboriginal Peoples Survey, Children and Youth master file.
Notes: HS (high school); PMK (person most knowledgeable). Significance assessed using chi-square test of independence of independent variable and obesity status. Percentages calculated using sample weights. Totals may not sum to 100% due to rounding.

Analyses

We used binary logistic regression to model the likelihood of a child being obese, with bivariate associations assessed using chi-square tests of independence. Analyses were done using SAS 9.2 for Windows. Bootstrap weights and the *Bootvar* procedure for SAS[18] were used to adjust variance estimates for sampling design effects.

* This analysis used data provided by Statistics Canada through the Research Data Centres programme. The analysis and conclusions do not represent the views of Statistics Canada.

† A *Census family* refers to a married or common-law couple or lone parent and any children who are living in the same dwelling.[17] *Census family* status captures the structure of relationships among family members in the household, including whether members are married, parents or children.

‡ Because of Statistics Canada's disclosure rules, these cut-offs are rounded and are not exactly equivalent to quartiles.

Table 2. Logistic Regression Models Predicting Obesity Among Métis Boys and Girls Aged 6-10 Years

Variable	Boys (N=1030) OR (95% CI)	Girls (N=1005) OR (95% CI)
Socio-economic Characteristics		
Single-parent household	**1.50 (1.35-1.67)**	**1.32 (1.18-1.48)**
Other household type	1.00	1.00
PMK education		
Post-secondary	1.00	1.00
HS diploma	0.98 (0.89-1.06)	1.42 (1.27-1.59)
Less than HS diploma	**1.61 (1.42-1.81)**	**1.92 (1.71-2.15)**
Household income		
4th quartile	1.00	1.00
3rd quartile	1.09 (0.95-1.24)	0.71 (0.62-0.81)
2nd quartile	**1.19 (1.04-1.36)**	**1.33 (1.18-1.52)**
1st quartile	0.95 (0.83-1.01)	0.96 (0.82-1.12)
Experience hunger		
Never	1.00	1.00
Ever	**0.51 (0.41-0.63)**	**1.23 (0.99-1.53)**
Geographic Characteristics		
Atlantic region	**0.68 (0.55-0.83)**	**2.29 (1.91-2.76)**
Québec	**0.48 (0.39-0.59)**	**0.97 (0.79-1.2)**
Ontario	1.00	1.00
Prairie region	0.91 (0.80-1.04)	1.25 (1.08-1.44)
British Columbia	**0.73 (0.62-0.87)**	**1.15 (0.97-1.36)**
Territories	**0.61 (0.48-0.78)**	**1.42 (1.05-1.92)**
Urban location	1.00	1.00
Rural location	**1.52 (1.39-1.66)**	**0.94 (0.86-1.03)**
Culture-related Characteristics		
Aboriginal language		
No	1.00	1.00
Yes	1.21 (1.03-1.42)	0.89 (0.75-1.05)
Time with Elders		
Never or less than once/week	1.00	1.00
1-3 times/week	1.07 (0.97-1.17)	0.99 (0.89-1.10)
4 or more times/week	**1.56 (1.35-1.81)**	**1.70 (1.50-1.94)**
Other cultural activities		
Never or less than once/week	1.00	1.00
1-3 times/week	1.02 (0.89-1.16)	1.04 (0.93-1.17)
4 or more times/week	**0.54 (0.41-0.71)**	**3.03 (2.16-4.25)**
PMK residential school		
Yes	0.70 (0.47-1.02)	**5.23 (3.59-7.60)**
No	1.00	1.00
Early Life Experience		
Breastfed	0.79 (0.72-0.87)	1.11 (1.01-1.22)
Not breastfed	1.00	1.00
Physical Activity/Inactivity		
Sports participation		
Never or less than once/week	1.00	1.00
1-3 times/week	1.08 (0.97-1.19)	0.98 (0.89-1.07)
4 or more times/week	**0.89 (0.79-0.99)**	**0.45 (0.38-0.52)**
Television		
More than 2h/day	1.00	1.00
2h or less/day	**0.75 (0.68-0.82)**	**0.65 (0.58-0.71)**
Video games		
More than 2h/day	1.00	1.00
2h or less/day	**0.74 (0.68-0.81)**	**0.81 (0.57-1.13)**
Computer time		
More than 2h/day	1.00	1.00
2h or less/day	**0.41 (0.30-0.55)**	**1.67 (1.32-2.11)**

Data: 2006 Aboriginal Peoples Survey, Children and Youth master file.
Notes: HS (high school); PMK (person most knowledgeable). Confidence intervals produced using bootstrap estimates of variance. Effects in bold indicate ($p \leq 0.05$).

9.8% of the sample had missing height or weight data and were therefore excluded. The combined percentage of "Don't know" and refusals was low for each of the independent variables (0.6% to 2.3%). These were treated as missing at random and deleted listwise. The resulting unweighted sample size was 4,060 Métis children.

RESULTS

Table 1 describes the sample and presents the bivariate relationships between the independent variables and the dichotomous obesity variable. Overall, an estimated 16.5% of Métis children aged 6 to 14 were obese. Boys were more likely to be obese than were girls (18.5% versus 14.4%). Surprisingly, however, Métis children aged 6 to 10 were much more likely to be obese than those aged 11 to 14 (26.9% versus 11.8%). This is considerably different from the results reported for Canadian children from the 2004 Canadian Community Health Survey, which found 8.0% of children aged 6 to 11 and 9.4% of those 12 to 17 were obese, using the same IOTF cut-offs.[19]

Most of the bivariate relationships were in the directions expected (Table 1). Métis children living in single-parent households and whose PMKs had less than high school education were at higher risk to obesity than were those living in other household types or whose parents had post-secondary education. Those with family incomes in the highest two categories were less likely to be obese than were those in the lowest family income categories. The 6.4% of children whose PMKs reported some experience of hunger due to food insecurity were not more likely to be obese than were other children.

Relationships between the behavioural variables and obesity were also generally as predicted. Children reported as having been breastfed were slightly less likely to be obese than those who were not (15.4% versus 18.5%). Those who participated in sports four or more times per week were less likely to be obese than those who participated less frequently, while those who participated less often in "screen time" activities, including television, video games or computers, were less likely to be obese than other children (Table 1).

We had expected that connection to Aboriginal culture and time spent participating in culture-related activities would be generally protective against obesity. The bivariate relationships shown in Table 1 indicate that the nearly 6% of Métis children who spoke an Aboriginal language were more likely to be obese than those who did not (20.8% versus 16.0%). Likewise, those who spent time with Elders four or more times per week were more likely to be obese, as were those whose PMKs reported that they participated in culturally-related activities four or more times per week. A small proportion of the Métis children in the sample had PMKs who had themselves attended residential or industrial school. However, this group was significantly more likely to be obese than those whose PMKs had not attended residential schools (28.8% versus 16.1%).

Our modelling strategy was to first construct a full model including all of the identified covariates and to test for interactions with the two main non-modifiable risk factors, age group and gender. That at least one category of all of the independent variables interacted with one or both of these non-modifiable factors (not shown) suggested stratification by both age and gender. Four models are presented here (Tables 2 and 3). Least significant variables were removed by backward elimination, to produce parsimonious models (not shown). The elimination of the non-significant variables did not result in meaningful changes to parameter estimates or standard errors, suggesting independence from the included variables.

Table 2 presents the full model results for Métis boys and girls aged 6 to 10. Both boys and girls in lone-parent households were at higher risk for obesity (OR=1.50 boys, 1.32 girls). Children whose PMK had less than high school were at higher risk than those whose PMK had post-secondary education (OR=1.61 boys, 1.92 girls), and girls whose PMK had high school education were also at higher risk (OR=1.42). Household income had less clear effects, with important gender differences. Boys in second-quartile house-

holds were at higher risk than those in the highest (fourth) income quartile (OR=1.19), while girls in third-quartile and first-quartile households were less likely to be obese than those in the highest income quartile (ORs=0.71 and 0.96, respectively). Boys whose PMKs reported the former had experienced hunger were about half as likely to be obese as others (OR=0.51), but this was insignificant among girls.

Boys in Atlantic provinces, Québec, British Columbia and the Territories were less likely to be obese than boys living in Ontario, whereas girls in the Atlantic provinces, Prairie regions and the Territories were at higher risk than those in Ontario. Living in a rural area was associated with higher risk among boys (OR=1.52), but was insignificant among girls.

Table 1 showed that children who knew an Aboriginal language were more likely to be obese, and this effect was positive among boys aged 6 to 10 once the other factors were controlled (OR=1.21). Also surprisingly, children who spent time with Elders four or more times per week were more likely than those who did not spent time with Elders to be obese, and this was true for boys (OR=1.56) and girls (OR=1.70). Girls whose PMKs reported the former's participating in other cultural activities four or more times per week were also much more likely to be obese (OR=3.03); the effect was negative among boys (OR=0.54). Girls aged 6 to 10 whose PMK had attended a residential or industrial school were also much more likely to be obese (OR=5.23), while this effect was insignificant among boys.

As expected, boys aged 6-10 who had been breastfed were less likely to be obese (OR=0.79), while girls who had been breastfed were at higher risk (OR=1.11). The effects of participating in sports were generally as expected among boys and girls, with participating four or more times per week having protective effects (OR=0.89 boys, 0.45 girls). Similarly, watching two hours or less of television per day had independent protective effects among both boys (OR=0.75) and girls (OR=0.65). Boys who spent two hours or less playing video games were at lower risk (OR=0.74), as were boys who spent two hours or less on a computer (OR=0.41). On the other hand, girls with less computer time were more likely to be obese (OR=1.67).

Table 3 presents similar models for children aged 11-14. As with the younger children, those living in lone-parent households were also at higher risk of obesity (OR=1.36 boys, 2.00 girls). The effects of the other socio-economic variables were not as expected. Among Métis boys in this age group, those whose PMK had less than high school were more likely to be obese than those whose PMKs had post-secondary education (OR=1.47). However, those whose PMKs had high school diplomas were less likely to be obese than those whose PMKs had post-secondary education (OR=0.74), and there were no significant effects of PMK education for girls. Girls in households with income in the second quartile were less likely to be obese than those with fourth-quartile incomes (OR=0.61), while boys in second- and third-quartile households had lower risk than those in the highest income households (ORs=0.76 and 0.42, respectively). As in the younger age group, the effects of having experienced hunger were significant only among boys (OR=0.56).

Among the older children, there were fewer significant regional effects. Boys in the Prairie region (OR=1.36) and girls in the Atlantic region (OR=2.23) and Territories (OR=3.30) were more likely to be obese than children in Ontario. Both boys and girls who lived in rural locations were more likely to be obese than those who lived in urban settings (OR=1.39 boys, 1.55 girls).

Girls aged 11-14 who spoke an Aboriginal language were more likely to be obese (OR=2.18). As with the younger children, Métis children aged 11 to 14 whose PMKs reported that the former spent time with Elders more often were more likely to be obese than those who did so less than once per week. This was true for boys and girls who spent time with Elders one to three times per week (OR=1.17 boys, 2.32 girls), and for girls who spent time with Elders four or more times per week (OR=2.36). Those who participated in other cultural activities four or more times per week were also more likely to be obese, and this effect was stronger among girls (OR=2.57)

Table 3. Logistic Regression Models Predicting Obesity Among Métis Boys and Girls Aged 11-14 Years

Variable	Boys (N=1030) OR (95% CI)	Girls (N=1005) OR (95% CI)
Socio-economic Characteristics		
Single-parent household	**1.36 (1.18-1.58)**	**2.00 (1.59-2.52)**
Other household type	1.00	1.00
PMK education		
Post-secondary	1.00	1.00
HS diploma	**0.74 (0.65-0.85)**	0.98 (0.77-1.23)
Less than HS diploma	**1.47 (1.23-1.74)**	1.21 (0.99-1.48)
Household income		
4th quartile	1.00	1.00
3rd quartile	**0.42 (0.35-0.51)**	0.98 (0.75-1.25)
2nd quartile	**0.76 (0.64-0.91)**	**0.61 (0.46-0.80)**
1st quartile	0.99 (0.82-1.18)	1.09 (0.81-1.47)
Experience hunger		
Never	1.00	1.00
Ever	**0.56 (0.45-0.69)**	1.16 (0.87-1.54)
Geographic Characteristics		
Atlantic region	1.06 (0.80-1.39)	**2.23 (1.58-3.13)**
Québec	0.79 (0.58-1.07)	1.32 (0.93-1.88)
Ontario	1.00	1.00
Prairie region	**1.36 (1.16-1.56)**	1.28 (1.00-1.64)
British Columbia	0.85 (0.67-1.02)	0.88 (0.64-1.21)
Territories	0.92 (0.63-1.35)	**3.30 (2.22-4.89)**
Urban location	1.00	1.00
Rural location	**1.39 (1.24-1.57)**	**1.55 (1.29-1.84)**
Culture-related Characteristics		
Aboriginal language		
No	1.00	1.00
Yes	0.82 (0.66-1.03)	**2.18 (1.66-2.84)**
Time with Elders		
Never or less than once/week	1.00	1.00
1-3 times/week	**1.17 (1.03-1.34)**	**2.32 (1.92-2.79)**
4 or more times/week	1.16 (0.99-1.36)	**2.36 (1.91-2.92)**
Other cultural activities		
Never or less than once/week	1.00	1.00
1-3 times/week	1.14 (0.96-1.35)	1.04 (0.82-1.31)
4 or more times/week	**1.69 (1.16-2.44)**	**2.57 (1.66-3.98)**
PMK residential school		
Yes	**2.29 (1.48-3.53)**	**0.17 (0.11-.26)**
No	1.00	1.00
Early Life Experience		
Breastfed	0.98 (0.86-1.11)	**0.75 (.063-.090)**
Not breastfed	1.00	1.00
Physical Activity/Inactivity		
Sports participation		
Never or less than once/week	1.00	1.00
1-3 times/week	**0.79 (0.70-0.90)**	**0.48 (0.40-0.57)**
4 or more times/week	**0.33 (0.28-0.38)**	**0.34 (0.25-0.47)**
Television		
More than 2h/day	1.00	1.00
2h or less/day	**0.80 (0.72-0.90)**	**0.66 (0.57-0.78)**
Video games		
More than 2h/day	1.00	–*
2h or less/day	**0.63 (0.54-0.74)**	–*
Computer time		
More than 2h/day	1.00	1.00
2h or less/day	1.08 (0.92-1.27)	**1.38 (1.08-1.75)**

Data: 2006 Aboriginal Peoples Survey, Children and Youth master file.
Notes: HS (high school); PMK (person most knowledgeable). Confidence intervals produced using bootstrap estimates of variance. Effects in bold indicate ($p \leq 0.05$).
* Not estimable because of small counts.

than boys (OR=1.69). Among boys aged 11-14, those whose PMKs had attended residential school were more than twice as likely to be obese as others (OR=2.29), while the effect among girls was in the opposite direction (OR=0.17).

Also like the younger age group, both boys and girls aged 10-14 who participated in sports more frequently were less likely to be obese, with both boys and girls who played sports at least four times per week being about a third as likely to be obese as those who participated less than once per week (OR=0.33 boys, 0.34 girls). Watching two hours or less of television per day was also associated with lower likelihood of being obese among boys (OR=0.80) and girls (OR=0.66). Boys who played video games two hours or less per day were less likely to be obese (OR=0.63), but there were not enough 11-14 year-old girls in this category for a reliable estimate. Girls who used a computer two hours or less per day were more likely to be obese than those who used computers more (OR=1.38).

DISCUSSION AND CONCLUSIONS

This study examined the various socio-economic and behavioural factors that affect the risk of obesity among Métis children. Indeed, many of these risk factors are similar to those observed in studies of the general population, including low parental socio-economic status,[5,20] family structure[5] and living in a rural location[5] as well as more sedentary behaviours and less physical activity.[5,21] However, in models stratified by gender and age, some of these relationships became less clear, with the independent effects of household income and parental education varying between boys and girls, and by age group. Differences in the role of socio-economic status variables as predictors of obesity by gender, age and race/ethnicity group have also been found in the US.[22,23] Although they require further research to be explained, these findings emphasize the importance of understanding the processes that may affect childhood obesity in different populations, including different Aboriginal groups.

We had expected that language and participation in cultural activities would be protective against obesity. Although there were again differences between age and gender groups, the general pattern was that those participating more often were more likely to be obese. This is not to suggest that these activities themselves cause obesity. Rather, these relationships may be due to other factors not captured in the models, such as family or community characteristics or geography insufficiently controlled by the region and rural/urban indicators. The finding that PMK residential school experience has a significant effect, independent of household income or PMK education, also requires further investigation to understand, as does the finding that PMK residential schooling is a positive predictor of obesity among younger boys and girls, but a negative predictor among older girls.

The APS data used have important limitations. The survey questions regarding cultural activities did not provide information about what activities were involved in "participating in cultural activities" or "spending time with Elders". The physical activity questions included only sports participation, and the food insecurity question addressed only the experience of hunger, rather than more complete conceptualizations of food insecurity (for example, ref. 24). The dependent measures also present limitations. The use of parental reports of children's height and weight may lead to underestimates of obesity,[25] and the high degree of nonresponse to these questions may not be independent of children's actual height and weight. More recent data are needed, and in the absence of anthropometric measures, the overall estimates of obesity presented here should be treated with some caution. Nonetheless, these results provide evidence that the factors that are related to obesity among Métis children may include unique cultural and historical factors, and that the socio-economic and behavioural factors affecting obesity among Métis children may not be the same across gender and age groups.

REFERENCES

1. Schell LM, Gallo MV. Overweight and obesity among North American Indian infants, children, and youth. *Am J Hum Biol* 2012;24(3):302-13.
2. Willows ND. Overweight in First Nations children: Prevalence, implications, and solutions. *J Aboriginal Health* 2005;2:76-86.
3. Statistics Canada. Aboriginal Peoples in Canada in 2006: Inuit, Métis and First Nations, 2006 Census, Catalogue no. 97-558-XIE. Ottawa, ON: Minister of Industry, 2008.
4. Kumar MB, Wesche S, McGuire C. Trends in Métis-related health research (1980-2009): Identification of research gaps. *Can J Public Health* 2012;103(1):23-28.
5. Veugelers PJ, Fitzgerald AL. Prevalence of and risk factors for childhood overweight and obesity. *CMAJ* 2005;173(6):607-13.
6. Janz T, Seto J, Turner A. Aboriginal Peoples Survey, 2006. An Overview of the Health of the Métis Population. Ottawa: Statistics Canada, 2009.
7. Willows ND, Veugelers P, Raine K, Kuhle S. Prevalence and sociodemographic risk factors related to household food security in Aboriginal peoples in Canada. *Public Health Nutr* 2009;12(8):1150-56.
8. Willows ND, Hanley AJ, Delormier T. A socioecological framework to understand weight-related issues in Aboriginal children in Canada. *Appl Physiol Nutr Metab* 2012;37(1):1-13.
9. Lobstein T, Baur L, Uauy R. Obesity in children and young people: A crisis in public health. *Obes Rev* 2004;5:4-85.
10. Richmond CA, Ross NA. The determinants of First Nation and Inuit health: A critical population health approach. *Health Place* 2009;15(2):403-11.
11. King M, Smith A, Gracey M. Indigenous health part 2: The underlying causes of the health gap. *Lancet* 2009;374(9683):76-85.
12. Loppie Reading C, Wein F. Health Inequalities and Social Determinants of Aboriginal Peoples' Health. Vancouver, BC: National Collaborating Centre for Aboriginal Health, 2009.
13. Dyck M. Social Determinants of Métis health. Ottawa: National Aboriginal Health Organization, 2009. Available at: www.naho.ca/documents/metiscentre/english/Research_ SocialDeterminantsofHealth.pdf. (Accessed February 10, 2012).
14. National Collaborating Centre for Aboriginal Health. Culture and Language as Social Determinants of First Nations, Inuit and Métis Health. Vancouver: National Collaborating Centre for Aboriginal Health, 2009. Available at: http://www.nccah-ccnsa.ca/docs/fact%20sheets/social%20determinates/NCCAH_fs_culture_language_EN.pdf. (Accessed April 10, 2013).
15. Statistics Canada. Aborginal Peoples Survey, 2006: Concepts and Methods Guide. Ottawa: Minister of Industry, 2009.
16. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: International survey. *BMJ* 2000;320(7244):1240-45.
17. Statistics Canada. Families Reference Guide, 2006 Census. 2011. Available at: www12.statcan.ca/census-recensement/2006/ref/rp-guides/families-familles-eng.cfm (Accessed February 10, 2012).
18. Statistics Canada. Bootvar Click-Wrap Licence. 2011. Available at: www.statcan.gc.ca/rdc-cdr/bootvar_sas-eng.htm (Accessed February 10, 2012).
19. Shields M. Measured obesity and overweight Canadian children and adolescents, in Nutrition: Findings from the Canadian Community Health Survey. Ottawa: Statistics Canada, 2005.
20. Simen-Kapeu A, Veugelers PJ. Socio-economic gradients in health behaviours and overweight among children in distinct economic settings. *Can J Public Health* 2010;101(Suppl 3):S32-S36.
21. Kuhle S, Allen AC, Veugelers PJ. Prevention potential of risk factors for childhood overweight. *Can J Public Health* 2010;101(5):365-68.
22. Gorden-Larsen P, Adair LS, Popkin BM. The relationship of ethnicity, socioeconomic factors, and overweight in US adolescents. *Obes Res* 2003;11(1):121-29.
23. Wang Y, Zhang Q. Are American children and adolescents of low socioeconomic status at increased risk of obesity? Changes in the association between overweight and family income between 1971 and 2002. *Am J Clin Nutr* 2006;84(4):707-16.
24. World Health Organization. Food Security. 2013. Available at: http://www.who.int/trade/glossary/story028/en/ (Accessed April 10, 2013).
25. Doolen J, Alpert PT, Miller SK. Parental disconnect between perceived and actual weight status of children: A metasynthesis of the current research. *J Am Acad Nurse Pract* 2009;21:160-66.

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RÉSUMÉ

OBJECTIFS : Examiner les facteurs socioéconomiques, comportementaux et culturels prédisant l'obésité chez les enfants métis de 6 à 14 ans. Les facteurs socioéconomiques étaient la structure et le revenu des ménages, l'instruction parentale et l'insécurité alimentaire. Les facteurs culturels étaient la connaissance d'une langue autochtone, la participation à des activités culturelles, le temps passé avec les Aînés et la fréquentation parentale des pensionnats.

MÉTHODE : Le volet sur les enfants et les jeunes de l'Enquête auprès des peuples autochtones (2006) présente des données sur les enfants métis, y compris leur taille et leur poids, déclarées par la personne connaissant le mieux l'enfant (PCME). Par régression logistique binaire multivariée, nous avons prédit l'obésité (définie selon les points-limites d'IMC de l'IOTF) chez ces enfants. Après évaluation des interactions, les modèles ont été stratifiés par âge (6-10 ans, 11-14 ans) et par sexe.

RÉSULTATS : Environ 18,5 % des garçons métis et 14,4 % des filles étaient obèses. Les effets des facteurs socioéconomiques et régionaux variaient selon les groupes d'âge et de sexe, mais vivre dans une famille monoparentale et résider en milieu rural produisaient des effets uniformes. De nombreux effets des variables culturelles étaient inattendus. Bien que la fréquentation d'un pensionnat par la PCME soit associée positivement à l'obésité en général, son effet était négatif chez les filles de 11 à 14 ans. Comme prévu, les enfants s'adonnant fréquemment à l'activité physique avaient un risque d'obésité inférieur dans l'ensemble, indépendamment des autres facteurs.

CONCLUSIONS : Bien que les facteurs socioéconomiques soient liés au risque d'obésité chez les enfants métis, leurs effets peuvent ne pas être les mêmes dans tous les groupes d'âge ou entre les garçons et les filles. Il semble que les facteurs culturels propres aux Métis, dont la fréquentation parentale des pensionnats, exercent des effets indépendants sur le risque d'obésité chez les enfants, mais il faudrait pousser la recherche et obtenir de meilleures données pour comprendre ces liens.

MOTS CLÉS : obésité; indice de masse corporelle; population d'origine amérindienne; enfant; Canada