

ORIGINAL ARTICLE

Emerging obesity among preschool-aged Canadian Inuit children: results from the Nunavut Inuit Child Health Survey

Tracey Galloway¹, T. Kue Young¹, Grace M. Egeland²

¹Dalla Lana School of Public Health, University of Toronto, Toronto, Canada

²Centre for Indigenous Peoples' Nutrition and Environment, McGill University Macdonald Campus, Sainte-Anne-de-Bellevue, Canada

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ABSTRACT

Objectives. The study goal was to evaluate the growth status of preschool-age Canadian Inuit children.

Study design. As part of a larger study of population health across the Canadian High Arctic, the International Polar Year Inuit Health Survey collected growth and nutrition data on 388 children aged 3 to 5 years.

Methods. Data collection included anthropometric measures, health history, food frequency and 24-hour recall. Height and BMI were compared with the 2000 Centers for Disease Control and Prevention (CDC) growth reference (1); 24-hour recall and FFQ results were tabulated to produce daily and monthly frequencies of consumption of market and country foods.

Results. Mean height-for-age z-scores were comparable, but body mass index z-scores were significantly greater than the U.S. standard reference population for all age and sex categories. The overall prevalence of overweight was 50.8%. There were significantly more boys (57.1%) than girls (45.2%) in the overweight category. An examination of biological, socio-economic and dietary factors, including birth weight, breastfeeding, day care attendance, traditional and market food consumption and sweetened beverage consumption revealed no significant associations that could explain the development of obesity risk in this population.

Conclusions. Stature in preschool-age Inuit children is comparable to the U.S. reference, indicating that the previously reported secular trend toward increasing height has continued. Overweight prevalence is higher than that previously reported in Inuit children and may be occurring at an earlier age. The gender difference in child overweight prevalence runs counter to that reported in adults, leading to concern that contemporary growth patterns may result in significant increases in obesity-related illness for young Inuit men.

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INTRODUCTION

A trend toward increasing obesity prevalence among Inuit adults and school-aged children has been observed in a number of studies. Among Canadian Inuit, adult obesity and its associated metabolic factors have increased in recent years to the extent that the prevalence of obesity and cardiovascular disease in many Inuit communities exceeds that of the general Canadian population (2,3). Childhood obesity is also an area of concern. According to a recent study, 21% of Greenland Inuit children were found to be either overweight or obese (4), and the age at which children are developing obesity is rapidly decreasing (5).

There have been a number of efforts to document the obesity status of school-age Inuit children and youth (4-8), whose school attendance makes them generally more accessible to researchers than preschoolers. However, there are little or no recent anthropometric data on the growth of preschool-age Inuit children. As part of the International Polar Year's efforts to gather data on the health of circumpolar populations, the Inuit Health Survey (IHS) undertook health assessments in preschool children living across Nunavut Territory of the Canadian Arctic. The present study reports findings from the Nunavut Inuit Child Health Survey that relate to emerging obesity and its correlates.

MATERIAL AND METHODS

Sixteen of the 25 communities in Nunavut Territory were selected to participate in the child health portion of the IHS. Due to logistics and travel costs, not all communities were

visited. The 16 communities represent approximately 77% of 3-5-year-old Inuit children residing in Nunavut, using Statistics Canada's estimates of population size and extrapolations by age and ethnicity. Ethics approval for the study was provided by the McGill Faculty of Medicine Institutional Review Board, and a Scientific Research License was obtained from the Nunavummi Qaujisaqtulirijikkut (Nunavut Research Institute). After presentation of an informational DVD, written informed consent was obtained from the children's parents or primary caregivers prior to their participation in the study. Study recruitment documents, the DVD and questionnaires were available in English, Inuktitut and Inuinnaqtun. The DVD guide was a word-for-word reading of the consent form, accompanied by photographs and video clips relevant to the study.

Inuit households with children aged 3 to 5 years in the selected communities were identified using health centre records and a list of households that participated in the International Polar Year Adult Inuit Health Survey (www.inuithealthsurvey.ca). Of 537 households that were contacted, 75 refused and an additional 74 failed to attend the scheduled clinic visit, resulting in a participation rate of 72.3%. The fieldwork took place in the summer and fall of 2007 and 2008, during which 388 children participated in both the survey and clinical components of the study. The total sample size of 388 children represents 26% of Inuit children 3-5 years of age living in the 16 communities. The sample size per community ranged from 12 to 35 children.

Measures of height and weight were performed by 1 of 2 research team nurses. It is worth noting that both parents and chil-

dren seemed comfortable with the research nurses who were familiar with the North and working with Inuit. Measurement procedures were consistent with standardized anthropometric procedures (9). Shoes and outdoor clothing were removed, and the child's head was placed in the Frankfurt plane. Standing height was measured to the nearest 0.1 cm using a portable stadiometer (Road Rod 214 Portable Stadiometer, Seca, Maryland). Weight was measured to the nearest 0.1 kg using an electronic scale. Results were recorded and returned to the caregiver at the appointment. Measures of height and weight were obtained for 96.9% (376) children, 177 boys and 199 girls in total.

A limitation of the study protocol is the absence of estimates of anthropometric accuracy and reliability. While digital scales of the kind used in this study are extremely consistent, their accuracy can be assured by regular calibration with weights, which was not part of the IHS protocol. Repeat height measures were not recorded and weight was measured only once; therefore, it is not possible to calculate the degree of reliability using technical error of measurement and inter-/intra-observer error for this anthropometric data set.

Following recommended procedures (10-13), a midnight-to-midnight 24-hour dietary recall was conducted for each child participant, with a repeat recall on a non-consecutive day for a 20% subsample. Accuracy was assisted by the use of food models, calibrated containers for portion size estimation and by a series of neutral prompts with which the interviewer checked for omissions or intrusions.

Caregivers also completed a qualitative food frequency questionnaire (FFQ) designed

to capture information about common market and country foods consumed by the child in the previous month. An individual questionnaire for each child focused on *in-utero* exposures, birth weight, early infant feeding and health history.

Statistical analyses

Height-for-age (HA) and body mass index (BMI) were calculated and anthropometric measures were converted to z-scores and percentiles using Epiinfo Version 3.5.1, and analysed using SPSS Version 12.0 software. Student's t-tests were conducted on mean z-scores to permit comparison with the 2000 CDC reference (1). This reference was selected following the Canadian Paediatric Society's statement on growth assessment in Aboriginal children, which recommends the use of the CDC-derived growth reference for all Aboriginal groups as well as all Canadian children (14). BMI percentile (BMIC) scores were categorized as "risk of overweight" ($\text{BMIC} \geq 85$ and < 95) or "overweight" ($\text{BMIC} \geq 95$) according to CDC guidelines (15). Pearson chi-square tests were used to compare frequencies of risk of overweight, and overweight with the reference and cross-tabulations were used to compare risk of overweight and overweight prevalence by gender.

Twenty-four hour recall and FFQ results were tabulated using Epiinfo software to produce daily and monthly frequencies of consumption of various market and country foods. Each child's individual questionnaire was entered into Microsoft Access 2003 software. Logistic regression was performed on the full data set, using overweight and risk of overweight categories as dichotomous outcome variables.

RESULTS

For all age and sex categories, mean HA z-score (HAZ) was within a single standard deviation from the 2000 CDC reference, indicating that the heights of sample children are not significantly different from the reference population (Table I).

In contrast, the mean BMI-for-age z-score (BMIZ) was significantly greater than reference ($p=.000$) for all age and sex categories (Table II). The overall prevalence of overweight (BMIC>95) was 50.8%, and there

were significantly more boys (57.1%) than girls (45.2 %) in the overweight category (Pearson chi-square=4.814, $df=1$, $p=.028$) (Table III).

Logistic regression performed on the data set revealed no associations between overweight status and dietary, socio-economic or biologic factors other than gender. Variables such as reported birth weight, breastfeeding, day care attendance, traditional and market food consumption and sweetened beverage consumption were not associated with overweight status in this population.

Table I. Height-for-age z-score (HAZ) by age and sex for children 3-5 years of age ($n=376$) by age and sex from the Nunavut Inuit Health Survey compared to the 2000 CDC growth reference (1).

| | n | HAZ | SD |
|---------|-----|--------|-------|
| Boys | 177 | 0.086 | 0.922 |
| 3 years | 77 | 0.162 | 0.967 |
| 4 years | 56 | -0.092 | 0.820 |
| 5 years | 44 | 0.181 | 0.951 |
| Girls | 199 | -0.102 | 0.938 |
| 3 years | 74 | -0.138 | 0.876 |
| 4 years | 66 | -0.008 | 1.041 |
| 5 years | 59 | -0.161 | 0.899 |
| Total | 376 | -0.013 | 0.934 |

Table II. Body mass index z-score (BMIZ) by age and sex for children 3-5 years of age ($n=376$) by age and sex from the Inuit Health Survey compared to the 2000 CDC growth reference (1) (Significantly greater than reference, $p=.000$).

| | n | BMIZ | SD |
|---------|-----|--------|-------|
| Boys | 177 | 1.787* | 1.118 |
| 3 years | 77 | 2.141* | 1.183 |
| 4 years | 56 | 1.666* | 0.929 |
| 5 years | 44 | 1.322* | 1.037 |
| Girls | 199 | 1.580* | 0.842 |
| 3 years | 74 | 1.757* | 0.834 |
| 4 years | 66 | 1.570* | 0.960 |
| 5 years | 59 | 1.368* | 0.656 |
| Total | 376 | 1.677* | 0.986 |

Table III. Prevalence of risk of overweight ($85 \leq \text{BMI percentile} \leq 95$) and overweight (>95 BMI percentile) among children 3-5 years of age ($n=376$) by age and sex from the Inuit Health Survey compared to the 2000 CDC growth reference (1).

| | n | $85 \leq \text{BMIC} \leq 95$ | >95 BMIC |
|---------|-----|-------------------------------|------------|
| Boys | 177 | 20.9 % | 57.1 % |
| 3 years | 77 | 15.6 % | 71.4 % |
| 4 years | 56 | 23.2 % | 51.8 % |
| 5 years | 44 | 27.3 % | 38.6 % |
| Girls | 199 | 32.7 % | 45.2 % |
| 3 years | 74 | 29.7 % | 55.4 % |
| 4 years | 66 | 25.8 % | 48.5 % |
| 5 years | 59 | 44.1 % | 28.8 % |
| Total | 376 | 27.1 % | 50.8 % |

DISCUSSION

Researchers have documented a secular trend towards increasing HA in American and Canadian Inuit children (6,8,16,17). Shephard and Rode, for example, in a longitudinal study of children living in the eastern Arctic, demonstrated a secular trend in HA which parallels acculturation to a Western lifestyle (6). Despite this trend, researchers continue to report the persistence of low stature in Canadian Inuit children relative to U.S. reference values. According to Zammit et al., the height of Greenland Inuit children and youth falls between the 10th and 50th percentiles of the U.S. reference (8). In a study of Inuit children from 2 communities in coastal Labrador, Tigchelaar et al. find that both boys and girls are significantly shorter than a U.S. reference population (7).

The results of the present study suggest that secular trend in height has continued among Canadian Inuit children to the point that stature is comparable to the 2000 CDC growth reference. This is good news in some ways, as nutritional and socio-economic factors such as food security, while still dire in many regions of the North, do not appear to be constraining linear growth.

Overweight prevalence in this population is markedly higher than previously reported for children in Canada, Greenland and the United States (4-8). For comparison (using the same nomenclature as in this report) a recent study of Greenland Inuit children 5 to 7 years of age (n=2801) found that 16.5% were at risk for becoming overweight and 5.2% were overweight (4).

The CDC risk of overweight and the overweight categories provide comparable but

slightly different results from the International Obesity Task Force criteria for overweight and obesity, respectively. While there has been some discussion around the use of CDC-derived cut-offs (18,19), numerous authors report comparable prevalence of overweight obtained using CDC and IOTF references (20,21). Roberts and Dallal (15) observe inconsistencies in the CDC and IOTF cut-offs for the 3-to-7-year-old age category in particular.

Calls for an Inuit-specific growth reference (3) largely rest on the pattern of low height-for-weight due to high sitting-to-standing height ratios observed in past studies of Inuit populations (6-8,16). However in a longitudinal study of Greenland Inuit children, Becker-Christensen reports that stature remains consistent with Danish reference values until the age of 14 years in boys and 11 years in girls, when decreased standing height gives rise to a higher sitting height ratio compared to Danish children (22). The young age of children in the present study makes it unlikely that children's sitting height ratios are affected by population-specific changes in stature. Also, sitting height references are non-existent for this age group. Moreover, it is conceivable, though we have no sitting height data on preschool-age children to test this hypothesis, that the secular trend towards increasing standing height in Canadian Inuit children may be accompanied by a negative secular trend in sitting height ratio. These questions could be addressed by the collection of sitting height data in Canadian Inuit children across a broad age range.

Regardless of the cut-points used, the increase of overweight prevalence in children among circumpolar populations is concerning, especially since there is evidence of increasing

metabolic disease associated with adult obesity in these populations (23). There is also evidence that the age-of-onset for obesity in Inuit populations is decreasing. A retrospective study of Greenland Inuit found the age at which 30% of children were obese had decreased from 9.7 to 7.3 years for boys and 14.7 to 4.6 years for girls in the period 1973-1992 (5). The results of the present study suggest that age-of-onset may be declining yet further, as evidenced by high overweight prevalence in this preschool-age population.

The gender difference observed here runs counter to that commonly reported in Inuit adults, where obesity prevalence is greater in women than in men. High prevalence of obesity and central fat patterning have been documented among Inuit women (3) and the results of 4 pooled studies of Inuit across wide geographic areas in Alaska, Canada and Greenland indicate that women have significantly higher obesity prevalence (25.5%) than men (15.8%) (22). The higher overweight prevalence in boys in this sample raises concern that contemporary growth patterns in children may also lead to significant increases in obesity-related health issues for young Inuit men.

The results of the regression analysis were disappointing in that no associations arose between dietary factors and obesity status that could reveal the processes underlying emerging obesity in this population. However, in further dietary analyses of the study population, a high prevalence of consumption of energy-dense food and beverages were reported (24). It is likely that with the high prevalence of overweight children observed and the high prevalence of at-risk dietary behaviours we lacked sufficient power to identify statistically signifi-

cant differences. Further, the study identified a high degree of food insecurity (25) and a high prevalence of poverty indicators, both of which have been related to obesity in several studies (26,27). Initial qualitative follow-up discussions suggest that there may be some variation in overweight prevalence between communities. Territorial leaders suggest towns located in the most remote regions, or at the end of food distribution networks may have a lower prevalence of overweight children than more centralized communities. However, a community-specific analysis of overweight children in the current article was not possible due to sample size constraints. Further, discussions have included intriguing suggestions from community members about possible factors influencing child growth in Nunavut Inuit communities, including the influence of socioeconomic and cultural factors. Future studies will employ qualitative methods in order to analyse the processes underlying emerging obesity in this population as a means for improving health promotion.

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Grace Egeland
 Centre for Indigenous Peoples' Nutrition and Environment
 McGill University, Macdonald Campus
 2111 Lakeshore Road
 Sainte-Anne-de-Bellevue, QC H9X 3V9
 CANADA
 Email: grace.egeland@mcgill.ca