

RESEARCH PAPER

Inuvialuit adults in the Canadian Arctic have a high body mass index and self-reported physical activityB. N. Hopping,* E. Erber,* L. Beck,[†] E. De Roose[‡] & S. Sharma[§]

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Abstract

Background: Inuvialuit in Arctic Canada are undergoing nutrition and lifestyle transitions that encourage decreased physical activity (PA) and increased body mass index (BMI), although data specific to PA and BMI within this unique population are not currently available. The present study aimed to characterise current PA and BMI levels in a sample of Inuvialuit adults.

Methods: Inuvialuit adults randomly selected from a cross-sectional survey of three communities in the Northwest Territories, Canada, completed an adapted International Physical Activity Questionnaire (IPAQ) and an anthropometric questionnaire to obtain height and weight. Data were analysed using the standardised IPAQ protocol, and the results are presented by gender and age group (≤ 50 and > 50 years).

Results: One hundred and ninety-six Inuvialuit adults [148 women, 48 men; mean (standard deviation (SD)) ages 45 (14) and 41 (14) years, respectively; age range 19–84 years] completed the IPAQ (response rates 65–85%). Seventy-one percent of men and 74% of women allowed height measurements, whilst 81% and 84% allowed weight measurements, respectively; the remainder provided self-reported anthropometrics. Mean (SD) BMIs were 28.6 (7.7) kg/m² for males and 30.5 (8.8) kg/m² for females. The greatest percentage of participants in both gender and age groups fell into the obese BMI category. Self-reported PA was high, with means for men and participants ≤ 50 years in the high category of PA and means for women and participants > 50 years in the medium category. Almost two-thirds (65%) of participants were classified as being overweight or obese, although 89% reported medium or high levels of PA.

Conclusions: The results obtained in the present study indicate widespread overweight/obesity accompanying high levels of self-reported PA.

Introduction

Until the last fifty years, Inuvialuit, an Inuit group residing in the Northwest Territories (NWT), Canada, comprised a nomadic population with seasonal patterns of hunting and gathering. This lifestyle provided high levels of physical activity (PA) and promoted close relationships with the land (Takano, 2005). Settlement of Arctic Canadian Aboriginal populations into permanent communities eliminated much of the PA associated with the

traditional nomadic lifestyle. Less time spent on the land engaged in hunting and other subsistence activities, coupled with increased dependence on cars, snowmobiles and other vehicles for basic transportation, has led to a rapid reduction in PA amongst Arctic populations (Bjerregaard *et al.*, 2004; Deering *et al.*, 2009). From 2003 to 2008, the percentage of the NWT population aged ≥ 12 years who were moderately active or active during leisure-time decreased from 54.4% to 39.5% (Statistics Canada, 2009). This lifestyle transition may worsen as climate change will

probably impede the accessibility and availability of traditional foods, which will potentially lead to a further decline in vigorous traditional activities such as hunting, fishing and preparing animal skins for sewing (Arctic Climate Impact Assessment, 2004). Researchers documenting the health effects of this transition have found that prevalence of chronic diseases and their risk factors, such as obesity, hyperglycaemia and cancer, are increasing amongst Aboriginal populations (Young *et al.*, 2007; Circumpolar Inuit Cancer Review Working Group, 2008; Deering *et al.*, 2009).

Important aspects of the current health status of Inuvialuit in the NWT have been described elsewhere (Sharma, 2010). Many of the health issues facing Inuvialuit are experiences shared by other Aboriginal Canadian populations. Amongst First Nations, an increased prevalence of type II diabetes mellitus accompanied acculturation and the nutrition transition (Young *et al.*, 2000). The current prevalence of diabetes amongst First Nations is three to five times the national average (Health Canada, 2008a), which clearly highlights the potential future public health crisis that Inuit groups may face as the transition continues. Inuit and Inuvialuit are currently experiencing increased risk factors for diabetes, such as obesity, although it may still be possible to prevent the diabetes epidemic from reaching the Arctic with the help of public health education and interventions that target the risk factors for diabetes.

Obesity is an important modifiable risk factor for type II diabetes and other chronic diseases (Lloyd & Barnett, 2008; Public Health Agency of Canada, 2008a). From 2003 to 2008, the percentage of NWT residents who were overweight or obese rose from 55% to 63% (Statistics Canada, 2009). PA and diet are both highly associated with the development of obesity, and are therefore important targets for obesity and chronic disease prevention (Dyck *et al.*, 1998; Lloyd & Barnett, 2008; Public Health Agency of Canada, 2008a,b). Unfortunately, there is a lack of up-to-date anthropometric and PA data amongst Inuvialuit of the NWT because most current studies assess the territory as a whole without focusing on Inuvialuit specifically. Territorial PA data cannot be applied to Inuvialuit, who are a unique population within the NWT; Inuvialuit culture and the harsh physical environment play a role in determining daily physical activities. The present study aimed to characterise current PA and body mass index (BMI) levels in a sample of Inuvialuit adults.

Materials and methods

Setting and sampling

Recruitment methods and the study setting have been described in detail elsewhere (Sharma, 2010). In brief, three

remote communities in the NWT, Canada, were sampled for the study. Physical activity and BMI were assessed amongst Inuvialuit adults using an adapted International Physical Activity Questionnaire (IPAQ) and an anthropometry worksheet. Trained staff measured the heights and weights of participants; height was measured to the nearest centimetre, and weight was measured to the nearest 1/10 of a pound (50 g) using a digital scale. Institutional Review Board approval was obtained from the Committee on Human Studies at the University of Hawaii and the Office of Human Research Ethics at the University of North Carolina at Chapel Hill, as well as the Beaufort Delta Health and Social Services Authority Ethics Review Committee. The Aurora Research Institute licensed the study.

Statistical analysis

Physical activity analysis

The standard protocol for analysing the IPAQ questionnaire (IPAQ Research Committee, 2005) was closely followed for this analysis. The protocol suggests truncating minutes of walking as well as minutes of moderate and vigorous PA per day exceeding 180 min (3 h) to be equal to 180 min; the values for 52 participants were truncated. Furthermore, outliers with a total PA level of more than 960 min (16 h) should be excluded; however, after truncation of the data, none of the participants fell into this range. Minutes of PA were converted into metabolic equivalents (METs). METs are a measure of PA that relate to the energy expenditure required for each activity, accounting for both duration and intensity. Using established conversions, minutes spent in each level of PA were converted into MET-min per PA level per week. For example, MET-min per week for moderate PA were calculated using the formula: moderate MET-min/week = $4.0 \times$ moderate-intensity activity minutes per day \times days in which participants engaged in moderate-intensity activities. The constant numbers to determine MET-min per week for vigorous PA and walking were 8 and 3.3, respectively. Total PA scores were then attributed to each respondent by calculating the sum of MET-min per week spent walking and in moderate and vigorous PA. Finally, the PA scores were categorised according to the IPAQ guidelines, which placed individuals with total PA of <600 MET-min per week in the 'low' category, those with scores of 600–2999 MET-min per week in the 'moderate' category, and those with ≥ 3000 MET-min per week in the 'high' category.

Body mass index analysis

BMI (kg/m^2) was calculated and adjusted for weight of clothing (1 kg for light clothing, 1.5 kg for medium clothing, 2 kg for heavy clothing). Mean (standard

deviation) BMI and MET-min of PA per week were compared by age groups (≤ 50 versus > 50 years) using Wilcoxon rank sum tests. Additionally, the percentages of participants in each BMI category (underweight/normal = < 25 kg/m²; overweight = 25–29.9 kg/m²; obese = ≥ 30 kg/m²) (World Health Organization, 2000) and each IPAQ PA level (low, moderate, high) were calculated (IPAQ Research Committee, 2005).

Participants who declined to have their height and weight measured self-reported these measures; 27% self-reported height and 17% self-reported weight. These data were included in the estimates of mean BMI to preserve the sample size; self-reported data were perceived to be accurate for the purposes of the present study. The results for men and participants > 50 years are presented for completion; however, because of the low number of participants in both groups, the comparisons between genders and age groups may not be representative. All statistical analyses were performed using SAS statistical software, version 9.1 (SAS Institute, Inc., Cary, NC, USA). All tests and *P*-values were two-sided and were considered statistically significant at $\alpha \leq 0.05$.

Results

One hundred and ninety-six Inuvialuit adults participated in the present study; 148 participants (76%) were women, and 48 (24%) were men. Ages ranged from 19–84 years.

Mean (SD) ages were 41 (14) and 45 (14) years for men and women, respectively. The response rates were in the range 65–85% across the communities. Exact response rates could not be calculated because of incomplete records of refusals. Of the men, 71% allowed their heights and 81% their weights to be measured, whilst 74% and 84% of women allowed their heights and weights to be measured, respectively.

Men had a mean (SD) BMI of 28.6 (7.7) kg/m², whilst the mean (SD) BMI of women was higher at 30.5 (8.8) kg/m², corresponding to the overweight and obese BMI categories, respectively (Table 1). The highest proportion of participants fell into the obese BMI category in all participant subcategories; 40% of men, 46% of women, 41% of respondents ≤ 50 years, and 52% of respondents > 50 years were obese according to international standards (World Health Organization, 2000).

Self-reported PA levels were generally high in this population of Inuvialuit adults (Table 2). On average, participants reported 3709 MET-min walking or engaged in moderate or vigorous PA per week, which corresponds with the highest PA level. Both genders and age groups averaged MET-min in the highest category of PA. Amongst men and participants ≤ 50 years, the greatest proportion of respondents reported high PA (58% and 49%, respectively), whilst the greatest proportion of women (48%) and older participants (47%) reported MET-min of PA in the medium category.

Table 1 Body mass index amongst Inuvialuit adults in the Northwest Territories, Canada

Body mass index*	Total (<i>n</i> = 196)	Men (<i>n</i> = 48)	Women (<i>n</i> = 148)	<i>P</i> -value	≤ 50 years (<i>n</i> = 140)	> 50 years (<i>n</i> = 56)	<i>P</i> -value
Mean (SD) body mass index	30.0 (8.6)	28.6 (7.7)	30.5 (8.8)	0.20	29.6 (8.5)	31.2 (8.7)	0.20
Normal (< 25.0 kg m ⁻²) [†]	68 (35.1)	18 (37.5)	50 (34.3)		51 (37.0)	17 (30.4)	
Overweight (25.1–29.9 kg m ⁻²)	40 (20.6)	11 (22.9)	29 (19.9)		30 (21.7)	10 (17.9)	
Obese (≥ 30 kg m ⁻²)	86 (44.3)	19 (39.6)	67 (45.9)	0.74	57 (41.3)	29 (51.8)	0.41

*Missing information for two participants.

[†]Only two participants were underweight (≤ 18.5 kg m⁻²).

Table 2 Physical activity amongst Inuvialuit adults in the Northwest Territories, Canada

Physical activity*	Total (<i>n</i> = 196)	Men (<i>n</i> = 48)	Women (<i>n</i> = 148)	<i>P</i> -value	≤ 50 years (<i>n</i> = 140)	> 50 years (<i>n</i> = 56)	<i>P</i> -value
Mean (SD) [†]	3709 (3519)	4556 (4197)	3432 (3235)	0.07	3895 (3488)	3233 (3582)	0.05**
Low [‡]	22 (11.3)	6 (12.5)	16 (10.9)		13 (9.3)	9 (16.4)	
Medium [§]	84 (43.1)	14 (29.2)	70 (47.6)		58 (41.4)	26 (47.3)	
High [¶]	89 (45.6)	28 (58.3)	61 (41.5)	0.07	69 (49.3)	20 (36.4)	0.17

*Missing information for one participant.

[†]Metabolic equivalent (MET)-min per week.

[‡]Less than 600 MET-min per week spent walking or in moderate or vigorous physical activity.

[§]Between 600 and 2999 MET-min per week spent walking or in moderate or vigorous physical activity.

[¶]Greater than 2999 MET-min per week spent walking or in moderate or vigorous physical activity.

**Statistically significant at $\alpha \leq 0.05$.

Discussion

BMI and self-reported PA levels were both high in this population of Inuvialuit adults. Almost two-thirds (65%) of participants were classified as being overweight or obese, although 89% reported medium or high levels of PA. The results from the present study contradict other studies indicating low levels of PA in the NWT. In 2005, 47% of the NWT population aged ≥ 12 years reported being physically inactive during leisure time (Statistics Canada, 2005). The difference between the study findings may be a result of the methods used to measure PA, or may be a result of the use of different study populations.

The results obtained in the present study show an increase in mean BMI for both men and women compared with studies conducted between 1990 and 2001 (Young *et al.*, 2007). For most respondents, BMI was higher than recommended (World Health Organization, 2000; Health Canada, 2008b). The positive correlation between BMI and chronic disease development (World Health Organization, 2000; Young *et al.*, 2000) indicates that overweight and obesity play a role in the increased development of chronic disease in most populations. However, BMI cut-points for 'overweight' (25–29.9 kg/m²) and 'obesity' (≥ 30 kg/m²) were developed for non-Aboriginal populations, and may therefore not be suitable for use with Inuvialuit (Charbonneau-Roberts *et al.*, 2005; Young *et al.*, 2007). Several factors, including stature and muscularity, are known to significantly influence BMI categorisation (Heymsfield *et al.*, 2009). The body composition of Inuit populations may differ from other ethnicities, therefore potentially influencing the extent to which BMI can be used to predict disease risk amongst Inuvialuit (Jørgensen *et al.*, 2003).

There were several limitations to the present study. First, PA levels were self-reported, which may have introduced recall bias. The self-reported height (29% of men, 26% of women) and weight (19% of men, 16% of women) may have also introduced bias and affected the prevalence of obesity. However, the response rate for measured heights and weights was higher in the present study than in the 2004 Canadian Community Health Survey: Nutrition, a large national study for which only 54% of men and 61% of women consented to have their heights and weights directly measured (Tjepkema, 2006). More women than men participated in the present study because the main food shoppers and preparers, primarily women, were targeted. Finally, the IPAQ questionnaire asked respondents only about PA in the previous week, which may not have been an accurate representation of participants' usual activity levels. The seasonal variation in PA levels was not accounted for in the present study, which only captured summer months; Inuvialuit may be

more physically active during the spring and summer as a result of engagement in outdoor activities, such as camping and hunting.

Although the IPAQ validation study demonstrated a high correlation between self-reported and actual PA in 12 countries (Craig *et al.*, 2003), Inuvialuit are a unique population that may not quantify time spent in various activities in the same way as the other populations included in the validation study. As evidence for this, reported mean measurements of activity levels were higher than guidelines provided for chronic disease prevention (Centers for Disease Control, 2008; Public Health Agency of Canada, 2008c), although the prevalence of chronic disease is currently increasing amongst Inuvialuit (Health Canada, 2008a; ITK, 2008). Whilst other factors, such as diet and genetics, may also play a role in disease development, it is likely that PA levels were over-reported in the present study. The IPAQ, therefore, may not have strong reliability or validity amongst Inuvialuit and other Aboriginal Arctic populations.

A validation study of the IPAQ amongst this population, or the development of a culturally appropriate assessment tool, is needed. Future work in accurately assessing PA levels in this population, as well as investigating factors affecting both PA and BMI, are warranted.

To the authors' knowledge, this is the only study to report current BMI and PA data from an Inuvialuit population, a group at increasingly high risk for chronic disease development. The results obtained showed a widespread prevalence of overweight and obesity despite high self-reported PA levels. The international instrument used in the present study may not be suitable for use with Inuvialuit, and future research should therefore aim to investigate and validate appropriate methods for measuring adiposity, PA and their influence on disease risk amongst Inuvialuit.

Conflict of interests, sources of funding and authorship

The authors declare they have no conflicts of interest. The project was supported by American Diabetes Association Clinical Research award 1-08-CR-57, Government of the Northwest Territories Department of Health and Social Services, Health Canada, Public Health Agency of Canada and Northwest Territories and Nunavut Public Health Association. SS developed the conception and design of the study. EDR oversaw all data collection and field activities. BNH and EE contributed to data analysis. All authors were responsible for data interpretation. BNH drafted the manuscript, and all authors critically reviewed its content and have approved the final version submitted for publication.

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