ORIGINAL ARTICLE

INUIT ANTHROPOMETRY AND INSULIN RESISTANCE

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Received 9 September 2006; Accepted 1 February 2007

ABSTRACT

Objectives. Due to the increasing prevalence of obesity among Inuit, a study was conducted in an Inuit community to evaluate the anthropometric correlates of indices of insulin resistance using the homeostasis model assessment index (IR_{HOMA}) and the insulin sensitivity index ($ISI_{0,120}$).
Study Design. Data were collected as part of a health screening in a Baffin community in Nunavut, Canada, among adults 18 years of age and above.
Methods. A total of 52 Inuit participated in the health screening of which 46 completed both the fasting and the 2-hour blood tests. Insulin sensitivity indices could be calculated on 45 participants.
Results. Results for women indicated that in age-adjusted linear regression analyses, body mass index, waist circumference (WC) and percent body fat (%BF) predicted IR_{HOMA}, and $ISI_{0,120}$ ($p<0.05$). For men, %BF predicted IR_{HOMA}, and WC and %BF predicted $ISI_{0,120}$ ($p\leq0.05$).
Conclusions. The present study suggests that increasing rates of obesity among Inuit will have health consequences and that anthropometry is a useful tool to indirectly assess insulin resistance/sensitivity. *(Int J Circumpolar Health 2007; 66(2) 129-134)*

Key words: Inuit, insulin resistance, anthropometry, diabetes, obesity

INTRODUCTION

Among Inuit, the role of obesity-related measurements in predicting health risks is not well understood. For example, in Greenland, the central fat patterning of Inuit was not as predictive of metabolic syndrome risk factors compared with a Danish study population (1). Also, when Canadian Inuit were compared with a general North American population, the central fat patterning of Inuit did not have an independent effect on fasting and 2-hour glucose, or on triglycerides, total cholesterol, LDL and HDL cholesterol (2). Central fat patterning of Inuit may have been helpful in surviving the harsh Arctic environment (2). However, as Inuit are undergoing a dietary transition, which also involves decreases in physical activity due to modern-day conveniences and sedentary jobs, the rates of obesity and of obesity-related chronic diseases including type 2 diabetes mellitus (DM) are increasing (3-5). Therefore, an evaluation of the extent to which anthropometric measures relate to indices of insulin sensitivity (6,7) among Inuit, as has been shown among other populations (8-10), was conducted.

MATERIAL AND METHODS

Participant population

A health screening in a Baffin community in Nunavut, Canada, was conducted in May 2005. Inuit aged 18 years and above (721 adults) were eligible to participate. The specifics regarding recruitment to the health screening were worked out in detail with the community steering committee. Volunteers were recruited through community radio announcements, pamphlets and three information sessions where bilingual community research assistants explained the screening and its importance to community members.

Ethical approvals and participatory processes

Approvals for the community health screening were obtained from the McGill Ethics Review Committee, the Nunavut Research Institute and the community following established participatory processes (11). A community steering committee guided all aspects of the fieldwork and ensured appropriate and accurate translations of consent forms and questionnaires into Inuktitut. Informed consent was obtained from each participant.

Sample size

There were a total of 52 Inuit participants for the health screening, which translates into 7.2% of eligible participants. Five reported being diagnosed with type 2 DM and were excluded from the analysis. A total of 46 participants completed both the fasting and the 2-hour blood tests. However, one individual was excluded because fasting insulin was < 14 pmol/L and no insulin sensitivity indices could therefore be calculated, leaving 45 individuals for the analyses.

Anthropometric measurements

Weight and body fat composition were measured using a Tanita leg-to-leg bioelectrical impedance scale. Height was measured without shoes using a leveled height rod equipped with a horizontal headboard. Waist circumference was measured to the nearest millimeter at the point midway between the iliac crest and the costal margin.

Laboratory measurements

Clinical and laboratory measurements included

Table I. Mean (±SD) of insulin, glucose and insulin sensitivity levels in Inuit men and women by obesity: Baffin Community Health Screening.

	Men				Women			
	BMI†		Waist‡		BMI†		Waist‡	
	Normal (n=8)	Obese (n=3)	Normal (n=7)	High (n=4)	Normal (n=12)	Obese (n=25)	Normal (n=5)	High (n=31)
Glucose,	4.7	4.5	4.6	4.9	4.8	5.1	4.7	5.1
fasting (mmol/l)	(1.1)	(1.3)	(1.1)	(1.2)	(0.8)	(0.9)	(0.5)	(0.9)
Glucose, 2hr	3.1	3.2	2.8	3.9	3.2	3.9	3.1	3.9
(mmol/l)	(1.5)	(1.7)	(1.3)	(1.7)	(1.5)	(1.8)	(1.2)	(1.8)
Insulin, fasting	70.9	75.3	62.3	87.0	72.4	120.0***	53.2	113.5**
(pmol/l)	(40.5)	(30.1)	(36.9)	(33.9)	(31.1)	(40.7)	(15.3)	(41.4)
Insulin,	84.4	177.0	58.7	197.7*	118.0	268.0*	81.0	247.1
2hr (pmol/l)	(70.0)	(29.7)	(17.3)	(41.5)	(74.4)	(237.0)	(38.8)	(219.4)
IRHOMA	2.3	2.3	1.9	2.9	2.3	3.9***	1.6	3.7**
	(1.8)	(1.2)	(1.6)	(1.5)	(1.2)	(1.4)	(0.5)	(1.4)
ISI0,120	211.9	152.4	238.1	128.6	169.1	118.3*	181.7	124.3*
	(87.6)	(44.3)	(66.8)	(51.8)	(67.8)	(49.9)	(53.9)	(56.9)

† Obese BMI ≥30 kg/m^2 and normal is <30 kg/m^2.
‡ Waist circumference for men, normal ≤102cm and high >102cm; for women, normal ≤88cm and high >88cm.
*p ≤ 0.05 **p ≤ 0.01 ***p ≤ 0.001

fasting and 2-hour glucose and insulin tests. A standard 75-gram oral glucose tolerance test (OGTT) was performed in the morning after an overnight fast of 8 hours. MDS Laboratories procedures were followed for preparation, shipping and analyses of the samples without information regarding clinical histories of the patients attending the health screening (MDS Medical Diagnostic Services Laboratories, 4800 Dobrin, Suite 100, St-Laurent, Québec, H4R 2P8, Canada).

Derived indices of insulin action

The homeostasis model assessment for insulin resistance (IR_{HOMA}) based on fasting insulin and glucose values and the insulin sensitivity index at 0 and 120 minutes ($ISI_{0,120}$) were calculated (12-14).

Statistical analyses

Independent student t-tests were used to examine differences in glucose, insulin and the insulin sensitivity indices between the normal weight and the obese group and are presented as means (±SD). Age-adjusted linear regressions were used to evaluate the anthropometric correlates of insulin resistance. All statistical analyses were performed using SPSS version 13.0 for Windows (SPSS, 2004).

RESULTS

The ages ranged from 19 to 77 years of age with a mean of 45 (±17) years. The majority of participants were women (77.1%). The mean WC was 91.6 (±15.6) cm for men, and 103.5 (±14.0) for women. A total of 36.4% of the men had a WC > 102 cm and 86.1% of the women had a WC > 88 cm, representing World Health Organization (WHO) cut-off values of increased risk of health complications (15).

Results indicated that out of 45 participants, 4 had either isolated impaired fasting glucose (IFG) or isolated impaired glucose tolerance (IGT) (mean of 64 years; range 48-77 years) (16), one had elevated fasting insulin (>770 pmol/l) and one had elevated 2-hour insulin (>210 pmol/l). No new type 2 DM cases were found.

Fasting and 2-hour glucose values were similar between obese (BMI ≥30 kg/m^2) and non-obese (BMI <30 kg/m^2) individuals (Table I). Among females, the mean fasting and 2-hour insulin levels were significantly higher in the obese BMI and high WC group than in the normal BMI or WC groups. According to IR_{HOMA} and $ISI_{0,120}$ values, insulin sensitivity was significantly lower among the obese BMI and the high WC groups than among

Table II. Age-adjusted linear regression beta coefficients (SE) for IR_{HOMA} and ISI $_{0,120}$ for each independent anthropometric variable examined separately: Baffin Community Health Screening.

	IR_{HOMA} Intercept	Beta (SE)	ISI $_{0,120}$ Intercept	Beta (SE)
Men				
Waist, cm	-2.771	0.096 (0.053)	585.278	-6.348 (2.059) *
BMI, kg/m^2	-1.553	0.275 (0.130)	439.179	-11.884 (7.502)
Body fat, %	3.137	0.248 (0.088) *	231.689	-12.729 (4.300) *
Women				
Waist, cm	-3.874	0.066 (0.015) ***	370.341	-1.910 (0.622) **
BMI, kg/m^2	-2.234	0.157 (0.032) ***	322.431	-4.369 (1.406) **
Body fat, %	-1.303	0.108 (0.029) ***	317.681	-3.612 (1.137) **

*p ≤ 0.05 **p ≤ 0.01 ***p ≤ 0.001

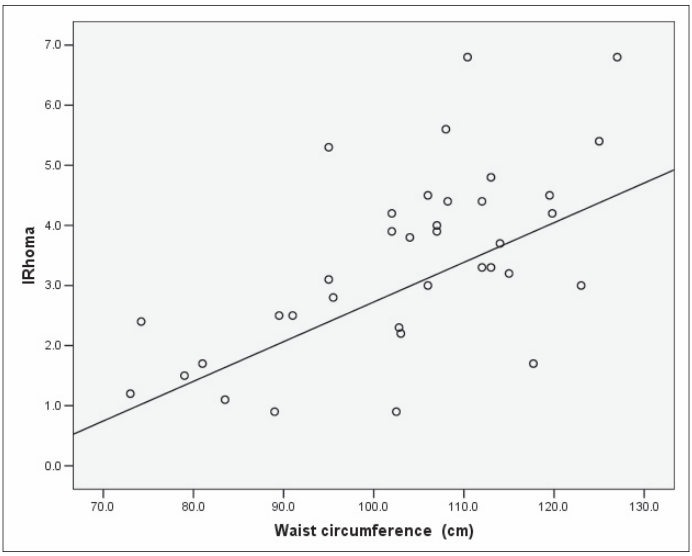

Figure 1. Age-adjusted linear regression coefficients of waist circumference for predicting IR_{HOMA} for Inuit women, Baffin Community Health Screening.

the normal weight and normal WC groups. Among 11 males, similar differences were observed in the $ISI_{0,120}$ between the obese and the non-obese, and in IR_{HOMA} between WC groups, but they were not significant. In age-adjusted linear regression analyses, all three anthropometric variables predicted IR_{HOMA} and $ISI_{0,120}$ in women (Table II, Figure 1). For men, %BF predicted IR_{HOMA} and WC and %BF predicted $ISI_{0,120}$.

DISCUSSION

Based simply on the BMI and the WC, this population of volunteers for the health screening is at risk of developing obesity-related complications such as type 2 DM (17,18). Based on BMI, over a quarter of the male and 68% of the female participants were considered obese according to the Canadian guidelines for body weight classification in adults (17). As for WC, over a third of the men and the majority of the women had values above the WHO recommended cut-off levels (15). However, for Inuit there are possible adaptations to central fat patterning for survival in the Arctic. Inuit may favor intra-abdominal deposition to provide more heat production, whereas subcutaneous fat provides insulation (19). Bioelectrical impedance analysis (BIA), which measures the body's percentage of fat, does not specify the type or location of body fat and is highly influenced by the total body water. Further, BIA has only recently been used among Inuit and needs to be validated using appropriate prediction equations. Until then, BIA instruments are only useful for within-population comparisons. Measuring the type of fat through abdominal ultrasounds on a subgroup of a population may also prove to be useful.

In the current study population, no differences were observed in fasting and 2-hour glucose values in the obese compared with the normal weight group. While results from a volunteer sample may not be representative of the total population, a similar trend was observed among the Keewatin Inuit of the Northwest Territories, where increasing BMI had no effect on fasting or 2-hour glucose values, indicating that the body's glucose disposal was not impaired (2). When Inuit from Greenland were compared with a Danish comparison group, 2-hour glucose and insulin values among Inuit were lower than among Danes for each level of WC (1).

Conclusions

Despite the high prevalence of obesity in the participants, few had abnormalities in IFG, IGT or insulin. However, insulin values and indices of insulin resistance in the population were higher among the obese compared with the normal weight group, and BMI, %BF and WC were all associated with measures of insulin resistance. Data indicate that the increasing prevalence rates of obesity among Inuit will likely have health implications. Therefore, there is a need for ongoing health surveillance and health promotion as well as research to explore the role of potential protective and deleterious dietary and life-style factors for their role in insulin resistance.

Acknowledgments

This work was supported by seed money from the Inuit Tapiriit Kanatami, the Max

Bell Foundation, and the Canadian Institutes for Health Research. The authors' student financial support was provided by Nasivvik. We thank the Baffin Community Steering Committee and all the participants who took part in the study.

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