

STUDY DESIGN OF THE MULTICULTURAL COMMUNITY HEALTH ASSESSMENT TRIAL (M-CHAT): A COMPARISON OF BODY FAT DISTRIBUTION IN FOUR DISTINCT POPULATIONS

Objective: To outline the study design of the Multicultural Community Health Assessment Trial (M-CHAT). The purpose of the study is to compare the relationship between visceral adipose tissue (VAT) and total body fat in men and women of Aboriginal, Chinese, and South Asian origin with a similar group of men and women of European origin.

Design: A total of 200 apparently healthy men and women between the ages of 30 and 65 will be recruited from each of the local Aboriginal, Chinese, and South Asian and European communities. Within each sex/ethnic group, an equal representation of participants will have a body mass index between 18.5 to 24.9, 25 to 29.9 and >30. Each participant will undergo an assessment for VAT, total body fat, metabolic risk factors, physical activity, diet, quality of life, and sociodemographics.

Main Outcome Measures: The primary outcome of this study is the relationship between VAT and total body fat in each of the Aboriginal, Chinese, and South Asian cohorts; this relationship will be compared to the European cohort after adjustment for age, sex, socioeconomic status, smoking status, physical activity, diet, and body mass index.

Conclusions: This study will be the first to identify differences in body fat distribution in these populations. We anticipate that in populations of Aboriginal, Chinese, and South Asian origin, a greater proportion of total body fat will be deposited as VAT compared to those of European origin. (*Ethn Dis.* 2006;16:96–100)

Key Words: Aboriginal, Body Fat Distribution, Chinese, Ethnicity, South Asian, Visceral Adipose Tissue

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INTRODUCTION

The prevalence of obesity is increasing in all populations and age ranges such that the World Health Organization describes it as a global epidemic.¹ Several clinical measures, such as body mass index (BMI) and waist circumference (WC), are used to identify patients at increased risk for obesity. However, norms for these measures are based on studies of predominantly Caucasian and European populations, despite evidence to suggest that these norms may not apply to those of non-European origin.

Historically, populations from Asia, such as the Chinese and South Asian populations, as well as Aboriginals in North America, have not had high prevalence rates of obesity, but in recent decades, this prevalence has increased coincident with a “Westernization” of their lifestyle and environment.^{2,3} In China, the prevalences of overweight (BMI 25–29.9 kg/m²) and obesity (BMI >30 kg/m²) have significantly increased over the past two decades^{4,5} and were estimated in the late 1990s at 21.5% and 2.9%, respectively.⁶ In India the prevalence of obesity ranges from 7.0% to 13.3% in men and 15.6% to 23.7% in women, depending on the study.^{7–9} In addition, Chinese and South Asian populations living in Western countries have higher BMI levels than in their originating countries.^{10,11} The prevalence of obesity in North American Aboriginal populations has been reported between 44% to 62% in various studies,^{12,13} which is nearly double that of matched Caucasian populations.^{13,14}

While these populations suffer from the same obesity-related morbidities and mortalities as European populations, recent evidence suggests that the level at which health is compromised based on measures of BMI or WC is lower than that of Caucasian populations. A number of studies have reported that those of Chinese or South Asian origin have an increased percent body fat and risk factors for cardiovascular disease (CVD) compared to similar European populations at the same BMI or WC.^{15–20} In Aboriginal populations, susceptibility to obesity is higher, in particular abdominal obesity, which coincides with an increased prevalence of diabetes.¹⁴ These reports suggest that body fat accumulation and distribution may differ between ethnic groups and has led to a call for population-specific anthropometric targets.⁵

Investigations comparing men and women of European and African-American descent suggest that the distribution of body fat may depend on ethnic background. These well-conducted studies found that African-American men and women had significantly less visceral adipose tissue (VAT) after correction for total body fat compared to men and women of European descent.^{21,22} Studies in Aboriginal, Chinese, and South Asian populations investigating VAT body fat distribution are limited.^{23–26} These reports are inconclusive because of small sample sizes and poor methods. One such study did report a greater amount of VAT (corrected for total body fat) in Korean women ($n=18$) compared to European women ($n=36$) but not in men.²⁷ To date no study has been conducted with the rigor and sample size to conclusively

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determine if body fat distribution (and VAT in particular) is dependent on ethnic background in Aboriginal, Chinese, and South Asian populations.

The Multi-Cultural Community Health Assessment Trial (M-CHAT) was designed to compare the relationship between VAT with total body fat in populations of Aboriginal, Chinese, and South Asian origin to a population of European origin and extend this to the presence of CVD risk factors. The study's primary hypothesis is that the relationship between VAT and total body fat will differ significantly between each of the three non-European cohorts (Aboriginal, Chinese, South Asians) and the European cohort after adjusting for age, sex, socioeconomic status, smoking status, physical activity, diet, and BMI. In addition, we will also determine how this relationship affects the risk factor profile for diabetes and CVD in each of the four groups.

METHODS

One hundred men and 100 women will be recruited from each of the local Aboriginal, Chinese, European, and South Asian populations of Vancouver, Canada, resulting in a total study population of 800. Within each sex/ethnic group, we will ensure equal

Table 1. Study inclusion and exclusion criteria

Inclusion Criteria

1. Apparently healthy (no previous diagnosis of disease related to outcomes, ie, CVD or stroke) men and women (equal distribution) between 30 and 65 years of age.
2. Direct descendants of either Aboriginal, Chinese, European, or South Asian populations defined as all known ancestors derived exclusively from one of the respective four ethnic communities based on self-report.*
3. Immigrants, first- and second-generation individuals for those of Chinese, European, and South Asian descent residing in Canada for a minimum of three years to allow for stable interaction with environment.
4. Satisfy one of the three BMI categories until that cell is filled.
5. No weight change >2.5 kg in the past three months.

Exclusion Criteria

1. Pregnant or lactating women.
2. Those currently using medications known to affect CVD risk factors (including hormone replacement therapy).
3. Individuals >136 kg (physical limit of DEXA scan table).
4. Individuals with significant implants, prosthetics, and amputations (affects total body fat determination).
5. Those diagnosed with diabetes, HIV, metabolic disorders, or immuno compromised conditions.
6. Individuals who cannot provide informed consent.

* Inclusion criteria to include those individuals who are 25% non-Aboriginal by descent (one grandparent non-Aboriginal).

CVD=cardiovascular disease; BMI=body mass index.

representation among the following body mass index (BMI) categories (in kg/m²): 18.5–24.9, 25.0–29.9, and ≥30.0.

We will recruit by using advertisements in targeted community media (television, radio, print) and posters and brochures posted at community areas of gathering and community health fairs. Individuals will be screened to establish their ethnic background based on the following criteria: 1) identifying themselves as direct descendants of Aboriginal (reserve and non-reserve residents), Chinese (China, Hong Kong, and Taiwan), European (continental Europe, Ireland, and UK) or South Asian (Bangladesh, India, Nepal, Pakistan, and Sri Lanka) origin; 2) immigrants and those of first and second generation for non-Aboriginal individuals; and 3) all ancestors belonging exclusively to one of the four ethnic groups. Because of the frequent mixing of populations during the settlement of Canada, we will include Aboriginal participants who report at least three of four grandparents of Aboriginal origin. Potential participants will then be screened for the study

inclusion criteria (Table 1) and asked to provide informed consent (approved by the Simon Fraser University Research Ethics Board). In order to minimize a possible language bias, all study forms and related recruiting materials have been translated into Chinese and Punjabi, and the research coordinators have fluency in these languages.

Participants will undergo a one-time assessment for VAT, total body fat, metabolic risk factors, anthropometry, lifestyle factors, and sociodemographics (Table 2). All data will be collected on the same day, except for the metabolic factors, which will be measured from a fasting blood sample conducted within two weeks of the main assessment.

Visceral Adipose Tissue

Visceral adipose tissue will be assessed by computed tomography (CT) scan using a CTi Advantage Scanner (General Electric, Milwaukee, Wisc). A cross-sectional 10-mm slice will be obtained at the L4/L5 intervertebral disc. Adipose tissue will be identified according to the attenuation range of –190 to –30 Hounsfield units. Com-

Table 2. List of variables captured during the participant assessment

Interview	Anthropometry	Metabolic Risk Factors	Lifestyle
<ul style="list-style-type: none"> • Sex • Date of birth • Years in Canada • Address • Education • Occupation • Medical history • Family history • Menopausal status 	<ul style="list-style-type: none"> • Body mass index • Waist circumference • Hip circumference • Triceps skinfold 	<ul style="list-style-type: none"> • Lipids (TC, HDL-C, LDL-C, TG, apo B, Lp(a)) • Blood pressure • Insulin • Glucose • Fibrinogen • Total homocysteine • C reactive protein • Thyroid stimulating hormone 	<ul style="list-style-type: none"> • Smoking status • Quality of life • Physical activity • Diet
	<p>CT Scan</p> <ul style="list-style-type: none"> • Visceral adipose tissue • Total abdominal adipose tissue • Subcutaneous abdominal adipose tissue 		<p>DEXA Scan</p> <ul style="list-style-type: none"> • Percent body fat • Total body fat

TC=total cholesterol, HDL-C=high density lipoprotein cholesterol, LDL-C=low density lipoprotein cholesterol, TG=triglycerides, apo B=apolipoprotein B, CT=computer tomography, DEXA=dual energy x-ray absorptiometry

putation of surface areas from the CT scans will be conducted with SliceO-matic 4.2 medical imaging software (SliceOmatic v.4.2, Tomovision, Montreal). Total abdominal fat will be calculated as all pixels within this attenuation range in the abdominal image. Visceral adipose tissue will be defined as adipose tissue within the inside edge of the abdominal wall and calculated as all pixels in this attenuation range, and subcutaneous abdominal adipose tissue will be calculated as the difference between total abdominal adipose tissue and VAT.

Total Body Fat

Total body fat will be assessed by dual energy x-ray absorptiometry with a Norland XR-36 scanner with Host Software Version 3.9.4 and Scanner Software 2.1.0 (Norland Medical Systems, White Plains, NY). Participants will be instructed to remove all jewelry and metallic objects that can affect the scan results. Percent total body fat will be calculated as total body fat in kilograms divided by total body mass in kilograms.

Metabolic Risk Factors

Every participant will provide a morning fasting blood sample. Blood samples will be separated and immediately assessed for total cholesterol, high-

density lipoprotein cholesterol (HDL-C), triglycerides, apolipoprotein B, lipoprotein (a), C-reactive protein, homocysteine, glucose, insulin, fibrinogen, and thyroid stimulating hormone. All measures will be assessed at the St. Paul’s Hospital clinical laboratory by using standard procedures. The inter- and intra-assay precision of this laboratory meets the stringent criteria required by the Canadian Reference Foundation Laboratory. Low-density lipoprotein cholesterol (LDL-C) will be calculated by using the Friedewald equation.²⁸

Blood Pressure

Blood pressure will be assessed following 10 minutes of seated rest in the left arm. Five measures will be taken in a five-minute period, with the average recorded, by using the BpTRU model BPM-200 oscillometric office blood pressure monitor (VSM MedTech Ltd., Coquitlam, British Columbia).

Anthropometry

Body mass index will be calculated from weight in kilograms divided by height in meters squared. Weight will be assessed with participants in light street clothing, footwear removed, and pockets emptied. Waist circumference will be recorded in centimeters as the average of two measures taken halfway between the lower rib margin and the

iliac crest against the skin following a normal expiration. Hip circumference will be recorded in centimeters as the average of two measures taken at the point of maximal gluteal protuberance from the lateral view over undergarments. Waist-to-hip ratio will be calculated as waist circumference over hip circumference. Skinfolds will be assessed at the following areas: biceps, triceps, subscapular, iliac crest, and calf region.

Lifestyle Factors

Smoking status will be assessed by self-report and recorded as nonsmoker, former smoker, or current smoker. For former and current smokers we will record the average number of cigarettes per day and number of years smoked. Diet will be reported as percent daily kilocalories fat, protein, and carbohydrates according to a three-day food record analyzed by a registered dietitian using Nutritionist Pro Diet Analysis software (First Data Bank), which has a diverse selection of ethnic-specific foods. Leisure time physical activity will be reported as hours per week and assessed by the Modifiable Activity Questionnaire, which has been used in multiethnic populations.²⁹⁻³¹ Quality of life will be assessed with the European Quality of Life (EuroQOL) instrument.^{32,33}

SOCIODEMOGRAPHICS

During the assessment, participants will be interviewed to assess education, occupation, income, medical history, and family history. Socioeconomic status will be determined by categories for education and household income.

Sample Size

The primary outcome is the difference in the relationship between VAT and total body fat between each of the non-European cohorts (Aboriginal, Chinese, and South Asians) and the European cohort after adjustment for age, sex, socioeconomic status, smoking status, physical activity, diet, and BMI. Our power is based on a convenience sample of 200 participants within each group. From previous research in our group,³⁴ the standard deviation for VAT is 66.93 cm². With a power of 80% ($\beta=.20$) and using the Bonferroni correction to adjust for the three primary comparisons between each of the non-European and the European groups ($\alpha=.0167$), we will be able to detect a minimum difference in VAT of 21.65 cm². This difference is much smaller than that reported in investigations between African-American and European-descent populations that used similar methods.^{21,22}

STATISTICAL ANALYSES

Means and standard deviations for continuous variables and proportions for descriptive statistics will be compared between European and non-European ethnic groups. All continuous variables will be tested for normality. Continuous variables will be compared with the Student *t* test and the $X\chi^2$ test for categorical variables. Non-normally distributed risk factors will be analyzed with nonparametric tests. If significant differences are found, pairwise comparisons of the adjusted means will be conducted with the Bonferroni test. A

natural log transformation of VAT will be performed to achieve normality and homoscedasticity of the residuals as per the work of Park et al.²⁷ Analysis of covariance (ANCOVA) will be used to test the primary hypothesis. This model will include VAT as the dependent variable and total body fat and ethnicity as the primary independent variables, adjusted for age, sex, socioeconomic status, smoking status, physical activity, diet, and BMI. Based on the literature, we will first test for an interaction between ethnicity and body fat. The effect of VAT on the observed association between risk factors for diabetes and CVD and ethnicity will be done by using ANCOVA. In these analyses the initial model will consist of the risk factor of interest and VAT adjusted for age, sex, socioeconomic status, smoking status, physical activity, diet, and BMI and then adjust for ethnicity to evaluate the effect of ethnicity on the magnitude of the association.

DISCUSSION

The M-CHAT study will be unique with respect to the type of investigation and the study populations included. We anticipate that in populations of Aboriginal, Chinese, and South Asian origin, a greater proportion of total body fat will be deposited in intra-abdominal area as VAT. If our hypothesis is correct, it will provide novel findings and require the development and adoption of population-specific anthropometric targets. In addition, we anticipate that differences in the ratio of VAT to total body fat will in part account for the observed differences in CVD risk factors along ethnic lines, such as the high incidence of diabetes in those of Aboriginal and South Asian origin.^{13,35} Future investigations will focus on assessment of the proteins and hormones involved in adipose tissue homeostasis to explore the physiologic mechanisms and long-term follow-up to

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determine if changes in body fat distribution occur along ethnic lines.

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