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Associations of sarcopenic obesity with the metabolic syndrome and insulin resistance over five years in older men: The Concord Health and Ageing in Men Project

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ABSTRACT

Purpose: Previous cross-sectional studies investigating associations of sarcopenic obesity with metabolic syndrome (MetS) and insulin resistance have not utilised consensus definitions of sarcopenia. We aimed to determine associations of sarcopenic obesity with MetS and insulin resistance over five years in community-dwelling older men.

Methods: 1231 men aged ≥70 years had appendicular lean mass (ALM) and body fat percentage assessed by dual-energy X-ray absorptiometry and hand grip strength and gait speed tests. Sarcopenia was defined as low ALM/height (m^2) and low hand grip strength or gait speed (European Working Group definition); obesity was defined as body fat percentage ≥30%. MetS was assessed at baseline and 5-years later. Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) was assessed at 5-years only.

Results: Men with sarcopenic obesity (odds ratio, 95% CI: 2.07, 1.21–3.55) and non-sarcopenic obesity (4.19, 3.16–5.57) had higher MetS likelihood than those with non-sarcopenic non-obesity at baseline. Higher gait speed predicted lower odds for prevalent MetS (0.45, 0.21–0.96 per m/s). Higher body fat predicted increased odds for prevalent and incident MetS (1.14, 1.11–1.17 and 1.11, 1.02–1.20 per kg, respectively) and deleterious 5-year changes in MetS fasting glucose, high-density lipoprotein cholesterol and triglycerides (all $P < 0.05$). Compared with non-sarcopenic non-obesity, estimated marginal means for HOMA-IR at 5-years were higher in non-sarcopenic obesity only (1.0, 0.8–1.1 vs 1.3, 1.2–1.5; $P < 0.001$). Similar results were observed when sarcopenic obesity was defined by waist circumference.

Conclusions: Sarcopenic obesity does not appear to confer greater risk for incident MetS or insulin resistance than obesity alone in community-dwelling older men.

1. Introduction

Sarcopenia, the age-related decline in skeletal muscle mass and function, is associated with increased disability in older adults (Marzetti et al., 2017). There is growing interest in the effects of sarcopenia on cardiometabolic health, particularly given the important role that skeletal muscle plays in insulin sensitivity (Bahat and İlhan, n.d.). Sarcopenia has been associated with increased risk for the metabolic syndrome (MetS) (Scott et al., 2016), type 2 diabetes (Cuthbertson et al., 2015) and cardiovascular disease (Chin et al., 2013).

Since obesity is a primary risk factor for poor cardiometabolic health it is possible that risk is increased further in the presence of

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sarcopenia ("sarcopenic obesity"). In cross-sectional studies, Korean older adults with sarcopenic obesity (defined as low appendicular lean mass [ALM] and high visceral fat area) are eight times as likely to develop MetS compared with obese or sarcopenic alone (Lim et al., 2010), and have increased risk of insulin resistance, MetS, and cardiovascular disease (Chung et al., 2013). In contrast, other studies have reported that sarcopenic obesity confers lower risk for cardiovascular disease risk factors (Aubertin-Leheudre et al., 2006) and MetS (Baumgartner et al., 2004) compared with obesity alone, and no increased risk for cardiovascular disease mortality after adjusting for lifestyle factors (Atkins et al., 2014).

A limitation of previous studies is their cross-sectional designs which limit comments on causality in the relationship between sarcopenic obesity and cardiometabolic health. Furthermore, inconsistent findings are likely attributable to considerable heterogeneity in measurements and thresholds used to assess sarcopenia. In recent years, expert groups have provided consensus definitions for sarcopenia which allow investigators to apply consistent methods to explore the relationship between sarcopenia and health outcomes (Cruz-Jentoft et al., 2010). The aim of the present study was to investigate cross-sectional and longitudinal associations between sarcopenic obesity categories and both MetS and insulin resistance in community-dwelling older men, using the current consensus definition of sarcopenia.

2. Materials and methods

2.1. Study design and population

CHAMP is an epidemiological study of Australian men aged 70 years and over. The selection of study subjects has been described in detail elsewhere (Cumming et al., 2009). Briefly, men living in a defined urban geographical region (the Local Government Areas of Burwood, Canada Bay and Strathfield) near Concord Hospital in Sydney, Australia, were recruited. The sampling frame was the New South Wales Electoral Roll, on which registration is compulsory. The only exclusion criterion was living in a residential aged care facility. Eligible men were sent a letter describing the study and, if they had a listed telephone number, were telephoned about one week later. Of 2815 eligible men with whom contact was made, 1511 agreed to participate in the study (54%). An additional 194 eligible men heard about the study from friends or the local media and were recruited after contacting the study investigators, yielding a cohort of 1705 subjects.

Baseline data were collected between January 2005 and June 2007. Men completed questionnaires at home including questions on demographics, health status, and physical activity. Subsequently, participants attended a study clinic at Concord Hospital for assessment of body composition, physical performance, medication use and blood biochemistry. These measurements were repeated at follow-up clinics conducted two (January 2007–October 2009) and five years (January 2012–October 2013) after baseline, however for the purposes of this study only 5-year data was included in longitudinal analyses. Trained staff collected data and the same equipment was used for all measurements and assessments, which were carried out in a single clinic. All participants gave written informed consent. The study complied with the Declaration of Helsinki and was approved by the Sydney South West Area Health Service Human Research Ethics Committee, Concord Repatriation General Hospital, Sydney, Australia.

2.2. Anthropometrics, body composition and muscle function

Height was measured using a Harpenden stadiometer and weight using Wedderburn digital scales; BMI was calculated as kg/m^2. Waist circumference was measured around the narrowest point between ribs and hips when viewed from the front after exhaling. Two consecutive recordings were made for each site to the nearest 1 cm using a metal tape on a horizontal plane without compression of skin. The mean of the two values was used in the analysis. Whole-body dual-energy X-ray absorptiometry (DXA) scans were performed using a Hologic Discovery-W scanner (Hologic Inc., Bedford, MA, USA). The same DXA scanner was used for all scans. Quality control scans were conducted daily using the Hologic whole-body phantom and indicated no shifts or drifts. ALM was calculated as the sum of lean mass of arms and legs (kg), and absolute and percentage of total body fat percentage was determined. Hand grip strength (kg) of the dominant hand (best of two trials) was assessed using a Jamar dynamometer (Promedics, Blackburn, UK).

2.3. Sociodemographic and health assessments

Sociodemographic variables included age, education and smoking status. Physical activity was measured using the Physical Activity Scale for the Elderly (PASE) (Washburn et al., 1993). Trained personnel conducted a medication inventory of each participant during the baseline clinic visit. Participants were instructed to bring all the prescription and over-the-counter medications they were taking to the clinic visit for review. They were also asked whether they had taken any prescription or non-prescription medications during the past month. Details of all medications and prescription patterns were recorded. Reported medicines were coded using the Iowa Drug Information Service code numbers (IDIS, n.d.). Data on medical conditions were obtained from self-report of whether a doctor or a health care provider had told participants that they had any of the following: diabetes, thyroid dysfunction, osteoporosis, Paget's disease, stroke, Parkinson's disease, epilepsy, hypertension, heart attack, angina, congestive heart failure, intermittent claudication, chronic obstructive lung disease, liver disease, cancer (excluding non-melanoma skin cancers), osteoarthritis, and gout.

2.4. Blood pressure and blood tests

Systolic (SBP) and diastolic blood pressure (DBP) was measured by trained staff using a sphygmomanometer. The mean of four readings, taken on the right arm, with the participant in a standing and lying position were used in the analysis. Serum from early morning fasting blood samples was stored at −80 °C until assay. Blood tests were performed at the Diagnostic Pathology Unit of Concord RG Hospital, which is a NATA (National Australian Testing Authority) accredited pathology service, using a MODULAR Analytics system (Roche Diagnostics, Castle Hill, Australia). Fasting serum 25-hydroxyvitamin D levels (25(OH)D) were measured by RIA (DiaSorin Inc., Stillwater, MN) (Hirani et al., 2013). The assay for 25(OH)D has a sensitivity of < 3.75 nmol/L with an intra-assay precision of 7.6% and an inter-assay precision of 9.0%. Fasting blood samples for cholesterol and high-density lipoprotein (HDL) cholesterol analysis were performed on a Roche Cobas 8000 analyser using a standard automated enzymatic methodology. Fasting blood samples for glucose measurement were collected in fluoride-oxalate (anticoagulant) tubes. Plasma glucose was measured using the Hexokinase method. Fasting blood results were recorded at baseline and follow-up for LDL and HDL cholesterol, triglycerides, and glucose, but insulin was only measured at 5 year follow up. Homeostasis Model Assessment—Insulin Resistance (HOMA IR) was calculated at 5 years using HOMA calculator v 2.2.3 (© Diabetes Trials Unit, University of Oxford) (HOMA, n.d.).

2.5. Definition of MetS

Metabolic syndrome was defined using the National Cholesterol Education Program (NCEP) Adult Treatment Panel III criteria, which require presence of three or more of: waist circumference > 102 cm; fasting glucose ≥5.6 mmol/L and/or on anti-diabetic medications; triglycerides ≥1.7 mmol/L, high-density lipoprotein cholesterol (HDL-C) < 1.03 mmol/L; and systolic blood pressure (SBP) ≥130 mm Hg and/or diastolic blood pressure (DBP) ≥85 mm Hg and/or on