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Original article

Dynapenic abdominal obesity as predictor of mortality and disability worsening in older adults: A 10-year prospective study

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SUMMARY

There are relatively few prospective studies evaluating the combined effect of abdominal obesity and low muscle strength on worsening disability and on mortality. The study aimed at evaluating prospectively the prognostic value of dynapenic abdominal obesity definition on disability worsening in a 5.5-year follow-up and mortality in a 10-year follow-up.

Methods: In 93 men and 169 women aged between 66 and 78 years, leg isometric strength, waist circumference (WC), BMI, glycemia, HOMA, lipid profile, vitamin D3, albumin, fibrinogen, physical activity level, income, smoking status and comorbidities were evaluated at the baseline.

Reported disabilities were measured at baseline, 1-y, 2-y, 3-y and 5.5-y follow-up and mortality rate was evaluated during a 10-y follow-up. The study population was categorized in dynapenic abdominal obese (D/AO), nondynapenic abdominal obese (ND/AO), dynapenic nonabdominal obese (D/NAO), non-dynapenic nonabdominal obese (ND/NAO) according to muscle strength/WC tertiles.

Results: D/NAO subjects presented a disability worsening risk of 1.69 times (95%CI:1.11–2.57), ND/AO subjects showed a 2-fold increase in risk (95%CI:1.34–2.98), while being D/AO more than trebled the risk, even after considering confounding variables (HR:3.39,95%CI:1.91–6.02).

Mortality risk after adjustment for other confounding variables was 1.57 (95%CI:1.16–2.13) for ND/AO and 2.46 (95%CI:1.34–4.52) for D/AO.

Conclusions: Dynapenic abdominal obese subjects are at higher risk of worsening disability and mortality than subjects with dynapenia or central fat distribution only.

1. Introduction

Together with body composition changes associated with aging, an increase in prevalence of obesity observed in the last decades even in older ages leads to a condition called sarcopenic obesity (SO), where the relationship between fat and muscle mass [1,2] presents incongruities. There are relatively few studies that have evaluated the effect of SO in older people as pertains to physical functioning or disability, with conflicting results [3–5]. Alternative definitions of SO have been proposed considering muscle impairment, expressed by muscle strength, rather than muscle mass, and waist circumference (WC) rather than total body fat indexes, and introduce the concept of dynapenic abdominal obesity, but without receiving an unanimously accepted diagnostic definition so far [5]. Dynapenia has a better prognostic value compared to sarcopenia to predict worsening disability [6]. Even abdominal obesity, as assessed by WC, has shown association with disability in older adults [7]. Moreover dynapenic obesity has been shown to create adverse physical functioning effects and on the risk of developing mobility disability [4,5,8]. An association between dynapenia and mortality has been shown [9], which takes into consideration adjustments for total body fat and comorbidities [10]. Numerous studies showed that WC is more strongly associated with higher mortality, including fat mass adjustment, than obesity itself in the elderly [11].

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However, prospective studies evaluating the combination of abdominal obesity and muscle strength on worsening disability and mortality are still lacking. The scope of this study sought to compare the prognostic value of dynapenic/abdominal obesity on worsening disability and mortality in our group of older adults.

2. Materials and methods

2.1. Subjects

Subjects were randomly chosen from patient lists of 11 general practitioners family doctors in the city of Verona. Those subjects who were able to walk at least 1/2 mile without difficulty and i had no cognitive impairment (Mini-mental Status Examination score >24) were accepted. Anthropometric measurements and disability were evaluated at baseline in a cohort of community-dwelling older adults.

None of the subjects participated in regular physical exercise more than once weekly during the study. Subjects with renal failure, disabling knee osteoarthritis, heart failure (NYHA $\geq$ 2), cancer and serious lung disease were excluded. Individuals with more than a 5% weight loss in the year previous to the study were also excluded. At baseline, 177 women and 97 men, aged between 66 and 78 years, were considered eligible and consented to participate in the study. 4 men and 8 women moved to another city and were excluded, due to absence of data on disability and mortality. The study was conducted on a final cohort of 262 subjects, 93 men and 169 women.

Mortality rate was obtained from death certificates of Verona's registry office. Initial, intermediate and final death causes, identified through the Italian National Statistics Institute (ISTAT) death certificates, were categorized in neoplastic, cardiac (ischemic, valvular, heart failure), infectious, respiratory cerebrovascular and other causes (malnutrition, fractures and neurodegeneratives).

All subjects gave their written informed consent to be part of the study, which was approved by the University of Verona's Ethics Committee.

2.2. Anthropometry

Subjects were weighed barefoot and wearing light indoor clothing to the nearest .1 kg (Salus scale, Milan, Italy), and height was measured to the nearest .5 cm using a stadiometer (Salus stadiometer, Milan, Italy). Body weight adjusted by stature (kg/h^2) were used to give BMI. A measuring tape was used to measure WC at the narrowest part of the torso as viewed from the front.

2.3. Strength

Maximal voluntary isometric strength of the dominant knee extensors was tested by a Spark Handheld Dynamometer model 160 (Spark, Iowa City, IA, USA) as previously reported [12]. A familiarization testing session was conducted one week before knee extensor strength measurement. Test retest reliability was evaluated in a sample of 30 older subjects, the interclass correlation coefficient was .914 and the coefficient of variation (CV) was 9.69% for the dominant leg as previously reported [12].

2.4. Health status

Acute and chronic conditions were assessed by standardized questionnaires f the Italian Longitudinal Study on Aging [12]. The study started with a thorough clinical investigation of the subjects and then it was repeated at the 1,2,3 and 5.5-y follow-up. Information about the appearance of new diseases was collected for each subject from their family doctors, hospital documentation, physical examination and laboratory tests. Chronic conditions assessed included: hypertension, diabetes, hypercholesterolemia, cardiovascular disease (myocardial infarction and heart failure), chronic obstructive pulmonary disease (COPD) and stroke.

2.5. Classification of groups

Isometric leg muscle strength sex-specific tertiles were created. Subjects in the lowest tertile of leg muscle strength (<15.33 kg <8.33 kg respectively in men and women) were considered dynapenic, while those in the second and third tertiles were considered non dynapenic. Sex-specific cutoffs based on WC tertiles were used to categorize individuals as abdominal obese (above the highest tertile of WC, 100 cm and 87 cm respectively in men and women) or non-abdominal obese (those in the first and in the second tertiles).

The study population was categorized into four groups based on sex-specific WC and strength tertiles: dynapenic abdominal obese (D/AO), non-dynapenic abdominal obese (ND/AO), dynapenic non-abdominal obese (D/NAO), non-dynapenic non-abdominal obese (ND/NAO).

2.6. Reported disability

The definition of reported disability as per Langlois et al., was used [13], regarding capacity to do four of the six items from the Activity of Daily Living scale (ADLs) associated with three Rosow–Breslau physical function items and selected Instrumental Activity of Daily Living scale (IADLs) as previously reported [12].

Four groups were established:

1. Participants with disability – for subjects reporting that $\geq$1 of the ADL items were difficult, very difficult or impossible.
2. Participants with moderate disability – for subjects reporting that $\geq$1 physical function items was very difficult or impossible and/or could not walk 800 m.
3. Participants with mild disability – for subjects reporting $\geq$1 higher level of physical function items or IADL difficult but all other physical function tasks, except walking 800 m and ADL, were easy.
4. Participants without disability – if subjects reported “easy” for all the ADLs, “no difficulty” in the physical functions items, and “no difficulty” or “don't do” for all IADLs.

Changes in any reported disability score between baseline and subsequent assessment (2,3,4 and 5.5-y follow-up) were assessed in 262 subjects divided into two classifications:

Unchanged: having an unchanged score over the follow-up period.

Worsened: when score decreased by one or more points in the scale over the follow-up period.

2.7. Biochemical measures

At baseline blood samples were taken from each participant after overnight fasting. A compact chemistry analyzer method (Eastman Kodak, Inc., Rochester, NY) was used to measure plasma glucose. This method had an interassay CV of 2% [14].

Plasma immune-reactive insulin underwent duplicate measurements by double antibody radioimmunoassay with a commercial kit (Diagnostic Products Corp., Los Angeles, CA). Sensitivity was 6 pmol/L and the intra-assay CV was 4.9%. Insulin resistance was estimated with the HOMA (homeostasis model assessment of insulin resistance) method [14].