Body composition changes in stable-weight elderly subjects: The effect of sex

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ABSTRACT. Background and aims: Although cross-sectional and longitudinal studies have shown age-related changes in body composition and fat distribution, they may be related to body weight changes. The aim of this study was to evaluate yearly age-related changes in body composition and fat distribution, over a two-year period, in 101 women and 60 men (age range: 68 to 78 years at baseline). Methods: Body composition was evaluated by dual energy X-ray absorptiometry (DXA), and fat distribution by waist and hip circumferences and waist-to-hip circumference ratio. Baseline free testosterone, IGF-1 and serum albumin were evaluated in all subjects, as well as physical activity. Clinical evaluation was performed at baseline and yearly in order to exclude subjects with any condition inducing pathological changes in body composition or fat distribution. Subjects with a weight change >5% of their baseline body weight during the study period, were excluded. Results: Significant increases occurred in Body Mass Index (BMI) (1.18% in women, 1.13% in men), waist (1.75% in women, 1.39% in men), and hip circumference (1.06% in women, 1.31% in men), whereas height decreased significantly in both men (0.42%) and women (0.55%). Significant increases in total body fat (1.31%) and percent body fat (1.27%) were observed in women but not in men. Lean body mass did not change significantly throughout the study in either sex. Significant losses in leg muscle mass and appendicular skeletal muscle mass (ASM), calculated as the sum of arm and leg fat-free soft tissue, were observed in men (respectively 3.56 and 2.77%) and women (respectively 2.41 and 1.59%). A significant decrease in ASM adjusted by stature (ASM/height2), a proposed proxy for sarcopenia, was found in men only (1.97%). The rates of loss in leg muscle mass and appendicular muscle mass were significantly higher in men than in women, even after adjusting for free testosterone, IGF-1, physical activity and serum albumin. Conclusions: These data demonstrate significant changes in body composition and fat distribution in independently living, weight-stable elderly men and women. These changes are dependent on sex and independent of physical activity, hormones or serum albumin.

INTRODUCTION

Cross-sectional and longitudinal studies have shown age-related changes in body composition and fat distribution (1-7). Fat-free mass (FFM) declines, whereas fat mass (FM) and in particular visceral fat increases (1, 8, 9) in the later adult years. Reviewing his own longitudinal data together with those of other researchers, Forbes observed that many subjects lose FFM across the adult age range, but the rate of this loss is closely related to body weight changes (4).

Recently, Gallagher et al. (10) showed a fat-free mass decline over a 5-year period in weight-stable, independently living healthy subjects. Several factors besides weight change may contribute to age-dependent body composition changes, such as a decline in physical activity (11, 12), hormones (11, 13) and serum albumin (12). Further studies are still needed to evaluate age-dependent changes in body composition in a wider population of independent elderly subjects, with a longitudinal design study aimed at evaluating body composition and fat distribution after controlling for physical activity, hormones and serum albumin.

The aims of the present study were to evaluate yearly,
over a 2-year period, age-related changes in body composition and fat distribution in a sample of elderly subjects, and to evaluate the effect of sex on body composition and fat distribution changes after adjustment for physical activity, hormones and serum albumin.

**METHODS**

*Subjects*

Anthropometric measurements, body composition, and clinical status were evaluated at baseline and for two consecutive years in a cohort of community-dwelling elderly men and women. Subjects were randomly selected from the list of 11 general practitioners in the city of Verona, in order to have a good geographical representation of the city. Subjects were eligible if they were able to walk at least 1/2 mile without difficulty and if they had no cognitive impairment (Mini-Mental State Examination score >24). Participation in regular physical exercise more than once a week during the study period constituted an exclusion criterion. Exclusion criteria also included renal insufficiency, disabling knee osteoarthritis, heart failure (New York Heart Association class 2 or higher) and serious lung disease. Weight loss greater than 5% over the last year was another exclusion criterion.

At baseline, 177 women and 97 men, with ages ranging from 68 to 78 years, were eligible and gave their consent to participate in the study.

During follow-up, 3 women died, 12 women were excluded for health reasons (cancer, cerebrovascular disease, physical disability, serious chronic disease), 20 refused to undergo the second or third evaluations, and body composition data were incomplete for 12 persons. Two men died, 5 were excluded for health reasons (cancer, cerebrovascular disease, physical disability), 12 refused to undergo the second or third evaluations, and 7 did not have repeated body composition measures. In addition, 29 women and 11 men with body weight changes greater than 5% of their baseline body weight during the study period were excluded. A total of 101 women and 60 men underwent all 3 DXA evaluations and were thus included in the analysis. No significant differences in body weight, BMI or body composition measurements were observed in either sex between subjects who completed and those who did not complete the study. The study was approved by the Ethical Committee of the University of Verona.

**Anthropometry**

With the subject barefoot and wearing light indoor clothing, body weight was measured on a scale to the nearest 0.1 kg (Salus, Milano, Italy), and height to the nearest 0.5 cm using a stadiometer (Salus, Milano, Italy). BMI was calculated as body weight adjusted by stature (kg/m²). Waist circumference was obtained with a measuring tape at the level of the narrowest part of the torso as viewed anteriorly. Hip circumference was measured at the outermost points on the greater trochanters. The waist-to-hip ratio (WHR) was calculated as the ratio of these circumferences. Thigh circumference was measured in standing subjects using a 1-cm wide metal measuring tape at the midpoint between the inguinal region and mid-patella.

**Dual energy X-ray absorptiometry (DXA)**

Total body fat, lean body mass (LBM) and bone mineral content (BMC) were determined using a DXA array beam (Hologic QDR 2000, Waltham, USA) with software version 7.2. Characteristics and physical concepts of DXA measurements have been described elsewhere (14, 15). All metal objects (jewelry, snaps, belts) were removed. Measurements were taken with the subject supine on the scanning table. Radiation exposure was less than 8 milisieverts and mean measurement time was 6 minutes. Daily quality-assurance tests were performed according to the manufacturer’s instructions. All scans were subsequently analyzed by a single trained investigator. Percent fat was calculated as fat mass (kg) measured by DXA divided by body weight (kg) measured by scale. The coefficient of variation (CV) for double determinations performed on the same day, with subjects repositioned between scans in 11 subjects (male and female, aged 65-75 years) was 1% for total body fat, 1.3% for LBM and 2.3% for percent body fat. Skeletal muscle compartments of arms and legs were examined using the sub-region option of the software. Appendicular skeletal muscle mass (ASM) was calculated as the sum of arm and leg fat-free soft tissue (16). ASM adjusted by stature index (ASM/height²) was computed (17).

**Health status**

The presence of acute and chronic conditions were determined with standardized questionnaires already in use in the Italian Longitudinal Study on Aging (18). At the beginning of the study and yearly thereafter, subjects underwent a careful clinical examination. Information regarding the onset of new diseases was obtained for each subject through their general practitioners. Chronic conditions assessed included: cardiovascular disease, lung disease (emphysema, chronic bronchitis, asthma, other), degenerative joint disease, and hypertension.

Intentional and unintentional weight loss was noted. A cut-off of weight change greater than 5% of baseline body weight during the study period was chosen as an exclusion criterion.

**Physical function evaluation**

The Short-Form 36 Health Survey Questionnaire (19) was administered to all subjects. In this study, we considered only one dimension of the questionnaire, evaluating the subjective level of limitation in physical function as an indirect measure of the level of physical function and exercise. Items of the dimension were summed to obtain