
Body composition in Italian and Danish women

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Summary

The objective of this cross-sectional study was to compare the body composition and fat distribution measured by dual energy X-ray absorptiometry (DPX, Lunar) in different age decades of age-matched Danish and Italian women. The subjects comprised 133 healthy Italian women (age 20–60 years) age-matched to a representative sub-sample of healthy Danish women ($n = 375$). Total and abdominal body fat tissue mass were measured by dual-energy X-ray absorptiometry. Italian women were shorter and fatter compared with age-matched Danish women, but in middle-age, had a less abdominal fat distribution. There was no difference in total body bone mineral density.

Keywords: body composition, dual energy X-ray absorptiometry, fat distribution, women.

Introduction

Cardiovascular disease (CVD) is currently the leading cause of death and disability in Western societies (National Research Council, 1989). Within Western Europe, Denmark in Northern Europe has a higher mortality from CVD than countries in Southern Europe, such as Italy (WHO/HFA, 1991). In addition to overweight, which has reached epidemic proportions, abdominal fat distribution is an independent predictor of CVD (Hubert *et al.*, 1983; Lapidus *et al.*, 1984; Manson *et al.*, 1990; Rexrode *et al.*, 1998).

Differences in body fatness and fat distribution could play a role in the difference in CVD between Northern and Southern Europe. However, little is known about differences in body composition and fat distribution between women from Northern and Southern Europe. Dual energy X-ray absorptiometry (DXA) is a practical, precise and accurate method for measurement of body composition and fat distribution (Mazess *et al.*, 1990; Svendsen *et al.*, 1993a,b). We have previously reported body composition and fat distribution measured by DXA in a representative sub-sample of healthy Danish women (Svendsen *et al.*, 1995). The aim of the present study was to compare the body composition and fat distribution in different age decades of these Danish women with age-matched healthy Italian women.

Subjects and methods

We investigated 133 healthy women from the central Italian region (Lazio district), with an age range of 20–60 years and average age of 44.2 ± 15.9 years. Social inquiry indicated that these women belong to the Italian middle class (in employment, with high-school education). About 42% of the Italian and 53% of the Danish women were postmenopausal. The Italian women had participated in various studies of bone metabolism and body composition, as volunteers, at the Human Nutrition Unit, University 'Tor Vergata', Rome. None had any disease or were taking any medications known to affect body composition or bone metabolism.

Subjects were measured in the fasting state in the morning after voiding. Anthropometric and body composition measurements were performed on the same morning for each subject. Body weight was measured to the nearest 0.1 kg in all subjects, clothed in underwear only, and body height was measured without shoes to the nearest 0.1 cm. BMI was calculated as weight/height² (kg/m²).

Body composition and fat distribution results for the Danish women have been reported previously (Svendsen *et al.*, 1995). Briefly, the Danish women ($n = 375$) had participated in various studies at the Center for Clinical and Basic Research, and they were found to be a representative sub-sample of healthy Danish women.

All studies were carried out in accordance with the Declaration of Helsinki II and were approved by the the ethical committees of Rome and of Copenhagen County.

Dual energy X-ray absorptiometry (DXA)

Body composition was measured with a DPX total body DXA scanner (Lunar Radiation Corporation, Madison, Wisconsin, USA) using software versions 3.2 (Denmark) (Svendsen *et al.*, 1993a) and 3.6 (Italy) (De Lorenzo *et al.*, 1997). In order to compare software versions 3.2 and 3.6, ten Danish subjects were also analysed with software version 3.6. There were no significant differences in fat tissue mass, fat percentage, lean tissue mass or total body bone mineral density between software versions 3.2 and 3.6 (0.6 ± 0.5 kg, 1.0 ± 0.7 kg, $0.9 \pm 0.5\%$, 0.01 ± 0.0 g cm⁻², respectively, $P > 0.1$ (mean \pm SEM)). However, the total body bone mineral content was significantly lower (294.4 ± 30 g, $P < 0.001$) using software version 3.6 compared with that using version 3.2.

The abdominal fat was measured between the 1st and the 4th lumbar intervertebral disks by adjusting the lines of the rib box (standard software option) (Svendsen *et al.*, 1993b; Tataranni *et al.*, 1996). As far as DXA is concerned, the human body may be considered to consist of soft tissue and bone. The soft tissue consists of fat mass and lean mass. The fat tissue mass is not adipose tissue, but it is the sum of all fatty elements in the soft tissue. Similarly, the lean mass is not an anatomical entity,

but rather represents the sum of all chemically fat-free soft tissue elements. Thus, DXA measures total body bone mineral content (TBBMC) and density (TBBMD), fat tissue mass (FTM) and lean tissue mass (LTM).

Statistical analysis

The abdominal to total body fat tissue ratio (by DXA) was calculated as an indicator of fat distribution. Comparisons between groups were made by unpaired Student's *t* test. *P* values below 0.05 were considered statistically significant. The abdominal to total body fat tissue ratio was calculated as abdominal FTM divided by total FTM, multiplied by 1000. The Statistical Analysis Package (SAS Institute Inc., Cary, North Carolina, USA) was used for all analyses.

Results

There were no significant differences in age within the five age decades between Italian and Danish women (Table 1), but Italian women had a higher BMI than Danish women (Table 1).

Table 2 gives further DXA results. Italian women had a higher total body (TB fat%) as well as abdominal fatness (abdominal fat%) than Danish women (Table 2). The abdominal to total body fat tissue mass ratio tended to be higher in Danish women than in the Italian women, and it was significantly higher in women in their 50's and 60's (Table 2).

The abdominal to total body fat tissue mass ratio correlated with age in both Italian ($r = 0.29$, $P < 0.01$) and Danish women ($r = 0.40$, $P < 0.001$), but it tended to increase more with age in Danish than in Italian women. Furthermore, in both Italian and Danish women, height ($r = -0.3$ and 0.4 , $P < 0.001$) and lean tissue mass ($r \approx 0.3$, $P < 0.01$) were negatively correlated with age. However, neither BMI, total body fat nor abdominal fat% were significantly correlated with age in Italian women ($P > 0.05$), but they were in the Danish women ($r > 0.33$, $P < 0.001$).

There was no difference in bone mineral density. Total body BMC and BMD were negatively correlated with age ($r \approx 0.5$, $P < 0.001$) both in Italian and in Danish women.

Table 1 Age, BMI, height and weight in healthy Danish and Italian women.

	Total		18–29 years		30–39 years		40–49 years		50–59 years		60–69 years	
	Danish (n = 375)	Italian (n = 133)	Danish (n = 59)	Italian (n = 25)	Danish (n = 53)	Italian (n = 20)	Danish (n = 41)	Italian (n = 28)	Danish (n = 196)	Italian (n = 49)	Danish (n = 26)	Italian (n = 11)
Age (years)	44.8 ± 1.6	44.2 ± 1.5	25.7 ± 2.7	24.5 ± 3.2	33.9 ± 3.0	33.8 ± 3.9	45.2 ± 3.2	45.5 ± 2.4	53.7 ± 2.5	53.8 ± 2.6	65.3 ± 2.8	3.2 ± 2.8*
BMI (kg/m ²)	23.6 ± 1.5	26.2 ± 0.9	21.9 ± 2.7	25.9 ± 5.2**	22.3 ± 2.9	26.7 ± 6.5	23.7 ± 2.4	27.5 ± 4.4***	24.9 ± 3.9	25.1 ± 2.9	25.3 ± 4.0	26.4 ± 3.7
Height (m)	1.71 ± 0.01	1.62 ± 0.01	1.68 ± 0.06	1.65 ± 0.07	1.68 ± 0.06	1.62 ± 0.05**	1.66 ± 0.06	1.57 ± 0.05***	1.63 ± 0.06	1.60 ± 0.0***	1.6 ± 0.06	1.6 ± 0.04
Weight (kg)	64.2 ± 1.8	67.6 ± 3.2	62.0 ± 8.4	72.0 ± 16.9	63.0 ± 9.6	70.6 ± 14.8	65.6 ± 9.5	67.4 ± 11.3	66.1 ± 10.7	64.2 ± 7.2	64.2 ± 9.5	65.0 ± 10.9

Values are means ± SD. BMI, body mass index. Danish versus Italian: *** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$, otherwise $P > 0.05$.

Table 2 Body composition and fat distribution measured by dual energy X-ray absorptiometry (DPX, Lunar) in healthy Danish and Italian women.

	18–29 years		30–39 years		40–49 years		50–59 years		60–69 years	
	Danish (n = 59)	Italian (n = 25)	Danish (n = 53)	Italian (n = 20)	Danish (n = 41)	Italian (n = 28)	Danish (n = 196)	Italian (n = 49)	Danish (n = 26)	Italian (n = 11)
Fat tissue mass (kg)	15.3 ± 6.2	27.4 ± 12.6**	15.8 ± 6.5	26.2 ± 10.9*	18.7 ± 6.9	27.4 ± 8.0***	22.5 ± 7.9	23.8 ± 5.4	23.0 ± 7.5	25.4 ± 7.9
Lean tissue mass (kg)	43.4 ± 4.5	41.5 ± 5.5*	43.5 ± 5.6	41.8 ± 4.6	43.4 ± 3.7	36.9 ± 4.2***	40.0 ± 3.7	37.3 ± 3.3***	38.0 ± 3.8	36.7 ± 3.5
TB fat percentage	25.4 ± 7.0	38.2 ± 9.3***	26.1 ± 7.0	38.1 ± 7.4***	29.4 ± 6.9	41.9 ± 6.2***	35.1 ± 6.8	38.5 ± 5.7**	36.8 ± 8.0	40.1 ± 5.6
Abdominal fat percentage	24.4 ± 9.8	36.4 ± 12.8***	24.2 ± 10.3	31.9 ± 8.7	28.9 ± 9.8	39.7 ± 7.8***	35.7 ± 9.6	36.6 ± 8.2	38.7 ± 9.5	40.6 ± 6.3
Abdominal/TB FTM (10 ⁻³)	66.4 ± 16.4	63.9 ± 14.1	69.9 ± 20.6	63.5 ± 16.2	75.0 ± 17.8	71.8 ± 12.9	83.3 ± 21.0	70.0 ± 14.5***	96.4 ± 18.2	79.9 ± 14.4*
TBBMC (kg)	2.8 ± 0.4	2.6 ± 0.5	2.8 ± 0.4	2.5 ± 0.3*	2.8 ± 0.4	2.8 ± 0.3***	2.4 ± 0.4	2.1 ± 2.6***	2.1 ± 0.3	2.0 ± 0.3
TBBMD (g/cm ²)	1.170 ± 0.068	1.195 ± 0.085	1.180 ± 0.068	1.171 ± 0.070	1.162 ± 0.075	1.133 ± 0.072	1.079 ± 0.086	1.086 ± 0.075	1.012 ± 0.113	1.045 ± 0.086

Values are means ± SD. TB, total body; FTM, fat tissue mass; TBBMC, content; TBBMD, TB bone mineral density. Danish versus Italian: *** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$, otherwise $P > 0.05$.

Discussion

Italian women were found to be shorter and fatter than Danish women. However, the middle-aged Danish women had a higher degree of abdominal fat distribution compared with Italian women. The impact of this finding may depend or derive from a selection bias which suspects the extrapolation of the findings of this study to Danish and Italian women in general. The Danish subjects have previously been shown to constitute a representative sub-sample of healthy Danish women (Svendsen *et al.*, 1995). The Italian women in the present study have a mean BMI, within each age decade, similar to the 51st percentile of the Italian population (Condizioni di Salute, 1994), indicating that this population mirrors the normal Italian female population. It may thus constitute a representative sub-sample of healthy Italian women, even though the number of participants is low (133 women), with a normal Gaussian distribution covering age interval from 20 to 70 years.

More recent studies have questioned the results obtained on different DXA scanners, even from the same manufacturer (Paton *et al.*, 1995; Tataranni *et al.*, 1996; Lantz *et al.*, 1998). Thus, comparisons of fat% measured by two different DPX DXA scanners from Lunar gave results for fat% that varied by 2–5% (Paton *et al.*, 1995; Tataranni, 1996; Lantz *et al.*, 1998). Thus, it cannot be excluded that some of the differences in fat% in the present study between Danish and Italian women were caused by lack of agreement between the DXA scanner in Denmark and that in Italy. Unfortunately, the DPX Lunar scanner at the Center for Clinical and Basic Research in Denmark is no longer available, so comparative measurements on the two DXA scanners could not be performed. However, the differences in fat% between the Danish and Italian women were greater than 5%, especially in the younger age decades, and the BMI was higher in the Italian women than in the Danish women, which suggests that our observations are valid. Nevertheless, the present study emphasizes the need for an inter-calibration of the DXA scanners.

If one assumes that our observations are valid, the differences may be due to genetic and/or environmental causes. The difference in diet between Italian and Danish women could be one explanation. A permanent high-starch, low-saturated-fat, low-cho-

lesterol diet, like the traditional Mediterranean diet, is recommended for prevention of CVD and treatment of overweight (National Research Council, 1989). A Mediterranean diet has been shown to be efficient in secondary prevention of coronary events and deaths (De Lorgeril *et al.*, 1994). Furthermore, an abdominal fat distribution is a strong risk factor, independent of overall fatness, for CVD in women (Manson *et al.*, 1990). Even though the energy intake may be higher, making the Italian women fatter, the composition of the Mediterranean diet could, besides lowering the risk of CVD, also lower the degree of abdominal fatness in Italian women, compared to Danish women. The lower degree of abdominal fatness in Italian women could also in itself contribute to their lower CVD mortality compared to Danish women.

In conclusion, we found that the Italian women were shorter and more obese, but, in middle-age, had a less abdominal fat distribution compared to healthy age-matched Danish women.

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