Body composition estimated by bioimpedance analysis in Sicilian climacteric women

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Aim, The aim of this study was to evaluate the effects of menopause transition on body weight, and body composition in a Sicilian climacteric population.

Methods. Two hundred and nine (60 pre- and one 149 postmenopausal) untreated, healthy women were selected. Body composition was estimated by BIA101 of AKERN SRL. Body Mass Index (BMI), waist and hip circumferences were also measured.

Results. The mean BMI of the study population was 29.4±0.7. There was no significative difference between pre- and postmenopausal subjects regarding BMI (X2=9.25; P=0.16), its class distribution, fat mass (FM), TBW and waist-to-hip ratio (WHR). The free FM was significantly more represented in pre- than in postmenopausal women (47.43±1.33 vs 45.02±0.81 kg) (P<0.01). Linear regression analysis showed a positive correlation between BMI and fat mass (FM) percentage (X2=0.7045) nevertheless among the subjects aged >55 years, in 57% of the normoweight the body fat (BF) percentage was undesirably high.

Conclusion. Climacteric changes and aging process are related to changes in body weight and fat distribution; even subjects apparently "normo-weight" (BMI below 25) were "over-fat", because revealed indesirably high BF%. Further investigation in larger population is needed to define whether BMI or BF% better predicts the risk of obesity-related diseases in climacteric Sicilian women.

Key words: Body mass index - Body composition - Menopause.

It is known that intrabdominal accumulation of adipose tissue and fasting insulin increase during the menopause transition, which could potentially lead to increased cardiovascular risk.1,3 Factors controlling human adipose tissue accumulation are still unknown. Sex steroids hormones have a key role in the regulation and in the sex difference of adipose tissue distribution.1

Estrogen deprivation after menopause is associated with a gain in visceral fat mass.
with a loss of subcutaneous fat and a loss of
lean body mass.5,6

Many technologies are available to measure
body composition; the use of relatively new
methods such as dual-energy x-ray absorpti-
ometry (DEXA) is limited and often imprac-
tical, because of inaccessibility and the high cost
equipment. Bioelectrical impedance analysis
(BIA) is a convenient non invasive and inex-
pensive method which has also been widely
used in clinics, in sports medicine and in weight
reduction programs.9, 10 Some studies showed
good agreement between BIA and DEXA.11-13

The objective of the present study was to
assess the prevalence of over-weight and
obesity in a Sicilian climacteric population
and the effects of menopause transition on body
weight, total body water, fat free mass, fat
mass and distribution, determined by bio-
electric impedance analysis (BIA).

Materials and methods

Two hundred and nine healthy, sedentary
women, attending the Ambulatory of
Menopause of the Gynecological and Obstetric
Department of the University of Messina were
recruited for this study. They were all Sicilian,
residents in Messina and their age ranged from
42 to 73 years (54.6±0.9). Sixty were pre-
menopausal with a mean age of 48±3.8; 149
postmenopausal with a mean age of 57.2±5.6
and a mean menopause age of 49.7±4.4.

Their body hydration status was normal. All
participants gave informed consent. A com-
plete family history, physical and gynecolog-
ical examination, laboratory evaluation
were performed; life, dietary and exercise
habits were investigated. Anthropometric
measurements and BIA were always made by
the same investigator.

BIA was carried out using a portable ap-
ppliance (BIA101 of AKERN SRL). Patients
were advised not to participate in any physi-
cal exercise in the 8 hours prior to the bioim-
pedance analysis, and not to drink alcoholic
beverages or coffee in the 12 hours prior to
the examination.

Measurements of weight and height, waist
and hip circumference and calculation of BMI
according to the Quetelet formula (weight/
height²) were carried out following bioelec-
tric impedance by the same investigator. For
the evaluation, the patients remained in a
supine position with their arms open at an
angle of 30º in relation to their body and with
their legs apart. Four electrodes were placed
on the right side of the body. Contact areas
were washed with alcohol, and electrodes
were placed on the dorsal surface of patient’s
hands and feet in the distal region of the
metacarpus and metatarsus, respectively, and
also between the medial and lateral malleoli
of the ankle. Resistance measurements, re-
actance, impedance, total body water (TBW
in percentage and liters), fat mass (FM in per-
centage and kilograms) and fat free mass (FFM

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<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Mean±SD</th>
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<tr>
<td>54.6±6.6</td>
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<table>
<thead>
<tr>
<th>Weight (kg)</th>
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<table>
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<th>Height (cm)</th>
<th>Mean±SD</th>
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<th>Fat Mass (kg)</th>
<th>Mean±SD</th>
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<th>Fat-Free Mass (kg)</th>
<th>Mean±SD</th>
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<table>
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<th>Total Body Water (l)</th>
<th>Mean±SD</th>
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<table>
<thead>
<tr>
<th>BMI (kg/m²)</th>
<th>Mean±SD</th>
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<tbody>
<tr>
<td>29.4±5.35</td>
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<table>
<thead>
<tr>
<th>WHR</th>
<th>Mean±SD</th>
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<tr>
<td>0.85±0.01</td>
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<th>Postmenopausal</th>
<th>N</th>
<th>%</th>
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<tr>
<td>BR.5-24.9 (normo-weight)</td>
<td>9</td>
<td>28</td>
<td>37</td>
<td>17.7</td>
</tr>
<tr>
<td>25.0-29.9 (over-weight)</td>
<td>27</td>
<td>51</td>
<td>78</td>
<td>37.3</td>
</tr>
<tr>
<td>&gt;30 (obesity)</td>
<td>24</td>
<td>70</td>
<td>94</td>
<td>45.0</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>149</td>
<td>209</td>
<td>100</td>
</tr>
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Table II — Body Mass Index distribution (N=209).
test the difference in BMI, FM, FFM, TBW, FM%, FFM% (209 subjects), waist to hip girth ratio (WHR) (136 subjects) between pre-menopausal and postmenopausal women. Linear regression analysis was performed to evaluate the relationship between BMI, percentage of fat tissue (FM%) and percentage of lean tissue (FFM%); between waist and hip circumferences; between WHR and FM%.

**Results**

The study population was represented mostly by housewives (49%), 44% by workers and 14% by pensioners. The mean age, anthropometric and BIA characteristics are shown in Table 1.

The mean study population BMI was 29.4±0.7 (range:19-46). Based on BMI classifications suggested by the National Institute of Health (NIH), 17.7% were within the healthy weight range (18.5-24.9), 57.3% were overweight (25-29.9), and 45% were obese (<30) (Table 1). There was no significative difference between pre- and postmenopausal subjects regarding BMI ($\chi^2$=9.25; P=0.16) and its class distribution.

The mean waist and hip circumferences were 92.96 and 108.8 cm respectively, with a mean WHR of 0.85±0.06, that did not show a significative difference between pre- and postmenopausal women ($0.845\pm0.02 \text{ vs } 0.856\pm0.01; \ P>0.5$). Linear regression analysis showed a positive correlation between waist and hip circumferences both in pre-menopause and postmenopause ($r^2=0.6424$ and $r^2=0.7382$ respectively).

### Table III. Distribution of the subjects 25-55 year old (N=104) regarding BMI and global FM% according to Lobman TG et al.

<table>
<thead>
<tr>
<th>BMI</th>
<th>&lt;25% acceptable levels</th>
<th>25-30% lower acceptable levels</th>
<th>50-55% upper acceptable levels</th>
<th>&gt;55% no acceptable levels</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-24.9</td>
<td>6</td>
<td>0</td>
<td>7</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>25-29</td>
<td>1</td>
<td>2</td>
<td>17</td>
<td>21</td>
<td>41</td>
</tr>
<tr>
<td>30-45</td>
<td>4</td>
<td>45</td>
<td>28</td>
<td>45</td>
<td>99</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>2</td>
<td>28</td>
<td>67</td>
<td>104</td>
</tr>
</tbody>
</table>
The mean TBW was 33.9±0.5 L and the mean FM was 26.10±1.3 kg, without significant difference between the two groups (P>0.5).

The mean FFM was significantly different between the two groups (P<0.01); it was more represented in premenopausal than in postmenopausal women (47.43±1.33 vs 45.02±0.81 kg).

Linear regression analysis showed a strong positive correlation between BMI and FM% (r²=0.7045) (Figure 1). BMI had also strong negative correlation with FFM% (r²=0.7054) (Figure 2). No correlation was found between WHR and FM %.

Table III shows the distribution of the subjects aged ≥55 years with at least one or more years of menopause duration (N=104) according BMI and global FM% according to Lohman et al. classification. All the obese and 93% of the overweight revealed percentage levels of total body fat (BF%) >30%; even in 57% of the normoweight subjects (BMI<25) the BF% was undesirably high (no acceptable according to Lohman et al. classification).

Discussion

The analysis of the data of the present study confirms those of other studies in middle-aged women from Italy, that the prevalence of overweight and obese climacteric women in Southern Italy is more pronounced compared to Northern Italy: 37.3% and 45% in the area of this study, 35.7% and 32.3% in Salerno’s area, vs 45.7% and 18.3% in Ferrara’s area respectively. According to Gianpaoli et al. (Research Group of Cardiovascular Epidemiologic Observatory) prevalence of obesity in a female population aged 45-74 years is 35.2% in Southern Italy, 19.4% in the Centre and 16% in the North.

The study population showed a high prevalence of overweight and obese even among premenopausal women (45% and 40% respectively).

The body fat was mainly distributed at the upper part of the body, both in normal and overweight women in agreement with other studies.

The body composition analysis of this study population shows that the mean FFM was significantly more represented in premenopausal than in postmenopausal women (47.43±1.33 vs 45.02±0.81 kg; P<0.01); this finding is in agreement with other studies, that recognized a loss of lean body mass after menopause, because of estrogen deprivation.

Many studies demonstrate that the relationship between %fat and BMI does vary among ethnic groups and depends on age and sex.

Since postmenopausal women have increased FM and decreased FFM, the relationship between fat% and BMI values is different for this population and is not linear at lower BMI's.

The body composition analysis of subjects aged ≥55 years in this study shows, in agreement with other authors, that BMI does not reflect adequately the body fitness in climacteric normoweight women (Figure 3).

Also in the authors’ experience, more than half of postmenopausal women (at least one or more years of menopause duration) with apparent normal weight, has undesirably high levels of BF%, is therefore normo-weight", but "over-fat" with higher cardiovascular risk.
BMI-based classifications are important in the primary care, but are limited by the lack of clearly defined standards that establish a relationship between fat% and risk factors associated with morbidity and mortality in post-menopausal women. According to Blew et al., body fat percentage ≥ 38 is likely to be consistent with an increased health risk for post-menopausal women.21

Some studies showed good agreement between BIA and DEXA,11-13 although BIA underestimates total and truncal fatness, compared with DEXA, in abdominally obese women, suggesting that the accuracy of BIA is negatively affected by adiposity.25

It is opportune to investigate the body composition and the fat distribution of all women in climacteric period specially normoweight with a less prominent android fat distribution in premenopause, because a major increment in the central android fat after the menopause has been shown to involve with a greater magnitude the lean subjects.30

This study is limited because the BIA equipment is not to invade body fat distribution at different body regions, although waist and hip circumferences measured in 136 subjects showed a body fat distribution mainly at the upper part of the body, both in normal and overweight women.

Conclusions

Properly used BIA approach can quickly, easily and relatively inexpensively provide accurate and reliable estimates of FFM and TBW, which are used to calculate absolute and relative body fat amounts in healthy populations. BIA is a convenient non-invasive method that can be widely used as primary care for predicting fat% to manage obesity during climacteric period and prevent it, specially in normoweight women, because the relationship between fat% and BMI may be different for this period.

Further investigation in larger populations, maybe by segmental multifrequency BIA, is needed to define whether BMI or BF% better predicts the risk of obesity-related diseases in perimenopausal women and, therefore, whether BMI cut-off points would be modified in Sicilian climacteric women, who can obtain from BIA useful support to correct their life style.

Riassunto

Composizione corporea stimata con la bioimpedenza in donne siciliane in climaterio

Obiettivo. L’obiettivo di questo studio è stato quello di valutare gli effetti della meno-pausa sul peso corporeo e sulla composizione corporea determinata mediante impedanza bioelettrica in una popolazione siciliana in climaterio.

Metodi. Sono stati selezionati 209 soggetti di sesso femminile sani e non in trattamento (60 in premeno-pausa e 149 in post-meno-pausa). La composizione corporea è stata misurata utilizzando un apparecchio BIA101 della AKERN SRL. Sono anche stati misurati l’indice di massa corporea (body mass index, BMI) e le circonferenze di vita e fianchi.

Risultati. Il BMI medio della popolazione studiata è stato pari a 29,4±0,7. Non è emersa alcuna differenza significativa tra i soggetti in pre- e post-meno-pausa per quanto riguarda il BMI (t=0,25; P=0,60), la sua distribuzione di classe, la massa grassa (fat mass, FM), la TBW e il rapporto vita-fianchi (waist-to-hip ratio, WHR). La massa magra (FFM) era significativamente più rappresentata nei soggetti in pre-meno-pausa rispetto a quelli in post-meno-pausa (77,4±1,35 vs 75,0±2,01 kg) (P<0,01). La regressione lineare ha evidenziato una correlazione positiva tra il BMI e la percentuale di massa grassa (FM%) (r²=0,7045); tuttavia tra i soggetti con età ≤ 55 anni nel 57% dei soggetti normopeso la percentuale di grasso corporeo (body fat, BF%) era decisamente elevata.

Conclusioni. Le modificazioni indotte dal processo di invecchiamento sono associate a modificazioni del peso corporeo e della distribuzione del grasso; anche i soggetti apparentemente “normopeso” (BMI inferiore a 25) presentavano un “eccesso di grasso”, come evidenziato dall’elevata percentuale del BF. Sono necessari ulteriori studi su popolazioni più ampie per stabilire quale valore, il BMI o la percentuale di BF possa rappresentare il miglior preditore di rischio di patologie obesità correlate nei soggetti siciliani di sesso femminile in climaterio.


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Le Donne


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