Comparison of Nutritional Statuses and Bioimpedance Analysis Parameters in Elders Living in a Nursing Home*

Huzurevinde Kalan Yaşlıların Nütrisyonel Durumları ile Biyoimpedans Analiz Ölçüm Parametrelerinin Karşılaştırılması**

Gülistan Bahat Öztürk1, Fatih Tufan1, Bülent Saka2, Sibel Akın1, Esat Karşık3, Nurullah Yücel3, Savaş Öztürk4, Nilgün Erten2, Mehmet Akif Karan1

1 Division of Geriatric, Department of Internal Medicine, Faculty of Istanbul Medicine, Istanbul University, Istanbul, Turkey
2 Istanbul Üniversitesi İstanbul Tıp Fakültesi, İç Hastalıklar Anabilim Dalı, Geriatri Bilim Dalı, İstanbul, Türkiye
3 Istanbul Metropolitan Municipality, Department of Health and Social Services, Directorate of Darulaceze, Istanbul, Turkey
4 SB Haseki Eğitim ve Araştırma Hastanesi, İç Hastalıkları Bölümü, İstanbul, Türkiye

* Bu yazının bir bölümü, Akademik Geriatri 2010 Kongresinde sunulmuştur.
** A part of this research article was presented at the Academic Geriatrics 2010 Congress.

ABSTRACT

Introduction: Little is known about body composition and energy expenditure in the malnourished elderly. Although both fat-free mass (FFM) and resting energy expenditure (REE) are known to decrease in malnourished elders, there is conflicting evidence on the metabolic activity of FFM in these subjects. We aimed to compare the body composition, REE and metabolic activity of FFM in a group of Turkish elders with different nutritional statuses.
Patients and Methods: Two hundred and ten nursing home residents composed the study cohort. FFM, fat mass (FM) and REE were detected by bioimpedance analysis (BIA) via a BC 532 model body analysis monitor convenient for personal use. Nutritional assessment was performed by both body mass index evaluation and mini-nutritional assessment (MNA) test. The residents who were either malnourished or at malnutrition risk according to MNA were defined as “undernourished”.

Results: There were 143 well-nourished residents (93 male, 50 female) and 67 undernourished residents (45 male, 22 female). The mean age was similar in the well-nourished versus undernourished residents for both genders (73.1 ± 6.8 vs. 73.8 ± 7.1, respectively, p = 0.58 for males; 77.7 ± 8.8 vs. 80.0 ± 9.5, respectively, p = 0.31 for females). When compared to healthy elders, undernourished elders had significantly lower absolute FFM value (44.2 ± 8.0 kg vs. 48.5 ± 6.7 kg for males and 33.8 ± 4.0 kg vs. 39.9 ± 6.4 kg for females, p = 0.001 and p < 0.001, respectively), absolute FM value (12.6 ± 9.9 kg vs. 18.3 ± 7.0 kg for males and 13.5 ± 8.1 kg vs. 22.3 ± 8.1 kg for females, p < 0.001 for both genders), FM percentage (19.7 ± 9.2% vs. 25.7 ± 6.3% for males and 25.9 ± 10.0% vs. 33.9 ± 7.9% for females, p < 0.001 for both genders), and FFM index (16.8 ± 2.6 kg/cm² vs. 18.4 ± 2.0 kg/cm² for males and 15.4 ± 1.7 kg/cm² vs. 17.6 ± 2.7 kg/cm² for females, p < 0.001 for males and p = 0.001 for females), but higher FM percentage (77.2 ± 7.0% vs. 70.0 ± 6.8% for males and 71.6 ± 11.4% vs. 63.2 ± 8.3% for females, p < 0.001 and p = 0.001, respectively). The undernourished elders had significantly lower measured and normalized REE according to REE adjusted for FFM differences by ANCOVA in both genders [measured REE (kcal/day): 1327 ± 241 vs. 1490 ± 192 in males (p < 0.001), 1046 ± 117 vs. 1253 ± 192 in females (p < 0.001); adjusted REE (kcal/day): 1320 ± 29 vs. 1479 ± 20 in males (p < 0.001), 1074 ± 42 vs. 1268 ± 27 in females (p < 0.001) for undernourished and well-nourished elders, respectively].

Conclusion: In undernourished elders, the decrease in FM was more prominent than the decrease in FFM, resulting in a higher FM percentage but lower FFM percentage in this group. They have lower REE than the healthy elders due to both lower quantity and metabolic activity of FFM.

Key Words: Body composition, resting energy expenditure, underweight, malnutrition, elderly, metabolic activity.

ÖZET

Giriş: Malnütriyonlu yaşlılarla vücut kompozisyonu ve enerji harcanma konusunda sınırlı bilgi vardır. Malnütrisyonunun ortaya çıkma ve istirahatte harcanan enerji miktarının araştırılması bilinmekle birlikte, bu olgularda yaşşı vücut kütleinin metabolik aktivitesi konusunda çeşitli dikkatler vardır. Bu çalışmada, çeşitli nütrisyon seviyesine sahip bir grup Türk yaşlı vücut kompozisyonu, istirahatte harcanan enerji miktarı ve yaşşı vücut kütleinin metabolik aktivitelerinin karşılaştırılması amaçlanmıştır.


Bulgular: Huzurevi sakınının 143 (93 erkek ve 50 kadın)’ı iyi beslenmiş, 67 (45 erkek, 22 kadın)’si yetersiz beslenmiş olarak değerlendirildi. Iyi beslenmiş ve yetersiz beslenmiş sakınının ortalaması yaşları benzerdı (erkekler için sırasıyla 73.1 ± 6.8 e kızlar 73.8 ± 7.1, p = 0.58; kadınlara için sırasıyla 77.7 ± 8.8 e kızlar 80.0 ± 9.5, p = 0.31). Yetersiz beslenmiş sağlık yapısında yaşşı vücut kütesi mutlak değer (erkekler için 44.2 ± 8.0 kg’a kızlar 48.5 ± 6.7 kg, kadınlar için sırasıyla 33.8 ± 4.0 kg’a kızlar 39.9 ± 6.4 kg, sırasıyla p = 0.001 ve p < 0.001), yaşşı kütleşi mutlak değer (erkekler için 12.6 ± 9.9 kg’a kızlar 18.3 ± 7.0 kg, kadınlara için sırasıyla 13.5 ± 8.1 kg’a kızlar 22.3 ± 8.1 kg, her iki cinsiyet için de p < 0.001), yaşşı vücut kütesi oranı (erkekler için 19.7 ± 9.2 ye kızlar 25.7 ± 6.3, kadınlar için sırasıyla 25.9 ± 7.0 a kızlar 33.9 ± 7.9 a, her iki cinsiyet için de p < 0.001), yaşşı vücut kütesi indeksi (erkekler için 16.8 ± 2.6 kg/cm² ye kızlar 18.4 ± 2.0 kg/cm², kadınlar için sırasıyla 15.4 ± 1.7 kg/cm² ye kızlar 17.6 ± 2.7 kg/cm², sırasıyla p < 0.001 ve p < 0.001) anlamlı olarak daha düşük ancak yaşşı vücut kütesi oranı anlamlı olarak daha yüksek (erkekler için sırasıyla 77.2 ± 7.0 a kızlar 70.0 ± 6.8, kadınlar için sırasıyla 671.6 ± 11.4 ye kızlar 653.2 ± 8.3, sırasıyla p < 0.001 ve p = 0.001) saptandı. Yetersiz beslenmiş hastalar, hem ölçülen hem de normalize edilmiş istirahatte harcanan enerji miktarı her iki cinsiyet arasında anlamlı olarak daha düşük saptandı [sirasıyla ölçülen istirahatte harcanan enerji miktarı (kcal/gün): Erkeklerde 1327 ± 241 e kızlar 1490 ± 192 (p < 0.001), kadınlarda 1046 ± 117 ye kızlar 1253 ± 192 (p < 0.001); normalize edilmiş istirahatte harcanan enerji miktarı (kcal/gün): Erkeklerde 1320 ± 29 e kızlar 1479 ± 20 (p < 0.001), kadınlarda 1074 ± 42 ye kızlar 1268 ± 27 (p < 0.001)].
INTRODUCTION

Elderly compose a special population with a high prevalence and risk for malnutrition. The data on body composition and resting energy expenditure (REE) in the malnourished elders is scarce (1). It is known that both age and malnutrition are risk factors for the decrease in fat free mass (FFM). Aging is associated with a decrease in REE due to the age-related decline in FFM, but the loss of FFM in elders does not fully account for the lower REE as REE adjusted for FFM is lower in normal weight elders than in young subjects (2,3). REE is affected by the gender, age, race, physical activity, health status, and the amount and metabolic rate of FFM as well (4). Since REE is the main portion of the daily energy consumption representing more than 60-75% of the total daily energy requirement of the elderly, the correct knowledge on REE and the factors influencing REE is essential for their proper nutrition (2,5,6). There is conflict of evidence about the metabolic activity of FFM in undernourished elders, some studies suggesting a decrease while the others suggesting an increase (1,4,7). In this study we aimed to examine body composition, REE and metabolic rate of FFM in a group of Turkish elders with different nutritional statuses. Since we aimed to compare the elders having undernutrition with well nourished ones, we performed the study in nursing home setting where the prevalence of malnutrition is very relevant.

PATIENTS and METHODS

Patients

The study was conducted in a nursing home in Istanbul. The ambulatory residents were included in the study for exact anthropometric measurement. The residents affected by acute illness, severe liver, heart, or renal failure; endocrinopathy; cancer; and inflammation states as well as patients treated with steroid hormones and other drugs interfering with resting metabolic rate were excluded (4).

Measurements

The heights and weights of all residents were measured and body mass indexes (BMIs) were calculated from weight (kg) divided by the square of height (m). Nutritional assessment was performed either by BMI evaluation or by mini-nutritional assessment test (MNA). Residents were divided into three groups according to BMI measurement (Underweight residents: BMI < 20 kg/m², normal residents: BMI: 20-30 kg/m², overweight residents: BMI > 30 kg/m²) or to two groups according to nutritional status [well-nourished or undernourished (either malnourished or under malnutrition risk)] (4). The body composition and REE were assessed in between elders having BMI<20 kg/m² and those with BMI: 20-30 kg/m², and between malnourished elders and undernourished elders (either overtly malnourished or under malnutrition risk) classified according to MNA (4). Residents with an MNA score < 17 were assessed as undernourished, with an MNA score of 17-23.5 as at risk of undernutrition and >24 as well nourished (8).

FFM, FM and REE were detected by bioimpedance analysis (BIA) early in the morning, after a 12-hour fasting via BC 532 model body analysis monitor convenient for personal use. FM and FM were expressed as absolute value and as a percentage of total body weight. FFM was also normalized for height as FFM index (FFMI) to evaluate FFM in relation to body size and nutritional status and calculated as FFM/height (2,9). Assessment of body composition by using BIA has been validated by underwater weighing and dual energy X-ray absorptiometry (DEXA) and assessment of REE by using BIA has been validated by indirect calorimetry (10-15). This study was conducted according to the guidelines laid down in the Declaration of Helsinki. Informed consent was obtained from all patients and/or their related conservators.
Statistical Analysis

The statistical analysis was carried out with Statistical Package for Social Sciences for Windows ver. 14.0 (SPSS Inc., Chicago, Ill., USA). Numerical variables were given as mean ± standard deviation.

Two groups were compared with paired Student’s t-test or Mann-Whitney U tests when necessary. Chi-square test with Yates correction and Fisher’s exact test were used for 2 x 2 contingency tables when appropriate for non-numerical data. Correlations between numerical parameters were analyzed with Spearman’s rho correlation test. Comparisons in the more than two groups were made by Kruskal Wallis-H analysis of variance when the distributions were abnormal and analysis of variance (ANOVA) when the distributions of the groups were normal. Tukey HSD was used for post-hoc comparisons. p values less than 0.05 were accepted as significant.

The normalization of REE for FFM variations was performed with two different methods: ratio method: REE/FFM (kg) and adjusted REE for FFM differences in the two groups by analysis of covariance (ANCOVA) (4).

RESULTS

Demographic Data

Two hundred and ten nursing home residents compos ed the study cohort. Their mean age was 75.1 ± 8.0 (60-98) years. One hundred and thirty eight were male (mean age: 73.3 ± 6.9) and 72 were female (78.4 ± 9.0).

There were 32 (21 male, 11 female) underweight (BMI < 20 kg/m²) residents and 137 (96 male, 41 female) normal weight (BMI: 20-30 kg/m²). The residents with BMI > 30 kg/m² were not included in the comparison of underweight vs normal weight residents. Therefore for this analysis 169 residents composed the study cohort.

There were 143 well-nourished residents (93 male and 50 female) and 67 undernourished residents (45 male, 22 female) according to MNA assessment.

The mean age was similar in underweight versus normal residents (73.7 ± 6.4 vs. 73.5 ± 7.1, p = 0.93 for males; 79.8 ± 8.7 vs. 78.4 ± 9.0, p = 0.65 for females; respectively) and in well-nourished versus undernourished residents (73.1 ± 6.8 vs. 73.8 ± 7.1, p = 0.58 for males; 77.7 ± 8.8 vs. 80.0 ± 9.5, p = 0.31 for females; respectively) for both genders.

Anthropometric Characteristics, Body Composition Values, Measured and Normalized Data of REE in Normal Weight and Underweight Residents

Anthropometric characteristics, body composition values, measured and normalized data of REE in normal weight and underweight residents by gender are given in Table 1.

The underweight elders had significantly lower weight, BMI, absolute FFM value (kg), absolute FM value (kg), FM percentage, FFMI (Table 1). FM percentage was significantly higher in the underweight elders in both genders.

The underweight elders had also significantly lower measured and normalized REE according to all two methods (ratio method and REE adjusted for FFM differences by ANCOVA) in both genders (Table 1). (Measured REE (kcal/day): 1192 ± 106 vs. 1438 ± 172 in males (p < 0.001), 977 ± 65 vs. 1145 ± 119 in females (p < 0.001); REE/FFM (kcal/kg/day): 30.0 ± 3.9 vs. 30.7 ± 2.6 in males (p = 0.002), 30.4 ± 2.5 vs. 31.3 ± 1.2 in females (p = 0.034); adjusted REE (kcal/day): 1185 ± 35 vs. 1430 ± 16 in males (p < 0.001), 1003 ± 49 vs. 1164 ± 25 in females (p = 0.002); for underweight and normal weight elders, respectively) (Table 1).

Anthropometric Characteristics, Body Composition Values, Measured and Normalized Data of REE in Well-Nourished and Undernourished Residents

Anthropometric characteristics, body composition values, measured and normalized data of REE in well-nourished and undernourished residents by gender are given in Table 2.

The undernourished elders had significantly lower weight, BMI, absolute FFM value (kg), absolute FM value (kg), FM percentage, FFMI (Table 2). FM percentage was significantly higher in the undernourished elders in both genders.

The undernourished elders had significantly lower measured and normalized REE according to REE adjusted for FFM differences by ANCOVA in both genders (Measured REE (kcal/day): 1327 ± 241 vs. 1490 ± 192 in males (p < 0.001), 1046 ± 117 vs. 1253 ± 192 in females (p < 0.001); adjusted REE (kcal/day): 1320 ± 29 vs. 1479 ± 20 in males (p < 0.001), 1074 ± 42 vs. 1268 ± 27 in females (p < 0.001); for undernourished and well-
nourished elders, respectively] (Table 2). However, normalized REE according to ratio method was not significantly different between undernourished and well-nourished residents in both genders [REE/FFM (kcal/kg/day): 30.0 ± 3.9 vs. 30.7 ± 2.6 in males (p = 0.065), 30.1 ± 1.9 vs. 31.4 ± 1.2 in females (p = 0.22) for undernourished and well-nourished elders, respectively] (Table 2).

**DISCUSSION**

In our cohort there were 32 underweight and 67 undernourished individuals composing the 18.9% and 31.9% of the studied individuals, respectively. The mean age was similar in underweight versus normal residents and in well-nourished versus undernourished residents for both genders so that the differences in the body composition parameters and REE were not due to the age in between the groups.

When the residents were grouped according to either BMI or to MNA scores, the underweight/undernourished elders had significantly lower weight, BMI, absolute FFM value (kg), absolute FM value (kg), FM percentage, FFMI. FFM percentage was significantly higher in the underweight/undernourished elders in both genders. This means, in our study cohort, both fat free mass and fat mass were decreased in underweight/undernourished individuals but the decrease in fat mass was more prominent than the decrease in fat free mass yielding a higher fat free mass percentage but lower fat mass percentage in the underweight/undernourished group. In healthy young individuals, it was shown that after a six-month semi-starvation period, an average 22.7% loss of body weight resulted in 71.1% loss of FM in contrast to only 14.8% loss of FFM (16). FFM tends to decline from

---

**Table 1.** Anthropometric characteristics, body composition values, measured and normalized data of REE in normal weight and underweight residents by gender

<table>
<thead>
<tr>
<th></th>
<th><strong>Men</strong></th>
<th></th>
<th><strong>Women</strong></th>
<th></th>
<th><strong>p</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Underweight (n= 21)</td>
<td>Normal (n= 96)</td>
<td>Underweight (n= 11)</td>
<td>Normal (n= 41)</td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>48.2 ± 1.9</td>
<td>65.1 ± 0.9</td>
<td>42.0 ± 2.6</td>
<td>57.7 ± 1.4</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>162 ± 1.6</td>
<td>161 ± 0.8</td>
<td>150 ± 2.0</td>
<td>150 ± 1.2</td>
<td>0.67**</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>18.2 ± 0.5</td>
<td>24.9 ± 0.3</td>
<td>18.3 ± 0.7</td>
<td>25.3 ± 0.4</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>FFM (kg)</td>
<td>39.7 ± 3.8</td>
<td>47.0 ± 6.2</td>
<td>32.4 ± 3.8</td>
<td>36.6 ± 3.8</td>
<td>&lt; 0.001**</td>
</tr>
<tr>
<td>FFM (%)</td>
<td>81.9 ± 3.0</td>
<td>72.3 ± 6.3</td>
<td>79.2 ± 8.0</td>
<td>65.3 ± 7.5</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>FM (kg)</td>
<td>6.7 ± 2.0</td>
<td>15.6 ± 4.8</td>
<td>8.2 ± 2.6</td>
<td>18.5 ± 2.6</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>FM (%)</td>
<td>13.7 ± 3.4</td>
<td>23.5 ± 5.2</td>
<td>19.9 ± 5.6</td>
<td>31.6 ± 7.3</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>FFMI (kg/m²)</td>
<td>14.9 ± 0.7</td>
<td>17.9 ± 1.6</td>
<td>14.6 ± 1.7</td>
<td>16.4 ± 1.4</td>
<td>&lt; 0.001**</td>
</tr>
<tr>
<td>Measured REE (kcal/day)</td>
<td>1192 ± 106</td>
<td>1438 ± 172</td>
<td>977 ± 65</td>
<td>1145 ± 119</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>REE/FFM (kcal/kg/day)</td>
<td>30.0 ± 3.9</td>
<td>30.7 ± 2.6</td>
<td>30.4 ± 2.5</td>
<td>31.3 ± 1.2</td>
<td>&lt; 0.002**</td>
</tr>
<tr>
<td>Adjusted REE (kcal/day)</td>
<td>1185 ± 35</td>
<td>1430 ± 16</td>
<td>1003 ± 49</td>
<td>1164 ± 25</td>
<td>&lt; 0.001**</td>
</tr>
</tbody>
</table>

* p values are same for both genders.
** p value for men.
*** p value for women.
the sixth decade with an increase in FM continuing to increase until around age 75 (17). Our findings are in accordance with the Forbes’ theory saying that “for a given weight loss the higher body fat is at baseline, the more important FM loss and consequently the less important FFM loss will be (18). Therefore, in case of weight loss, elderly, with a high percentage of FM are expected to lose more FM than FFM. Our findings are also compatible with those of Sergi et al.’s (4). In their report of 48 elderly with BMI < 20 kg/m², they also reported lower absolute FFM (kg), absolute FM (kg), FM percentage and FFMI but higher FFMI percentage compared to normal weight (BMI: 20-30 kg/m²) 54 elderly subjects. However, in their article on the body composition changes in the underweight elderly, Schneider et al. reported elder individuals > 70 years of age to lose FFM but maintain their absolute values of FM (1). In fact, they reported that elder individuals had higher FM percentage and lower FFMI percentages while losing weight and suggested that the adaptation mechanism to starvation: “more fat loss than fat free mass loss” may disappear with aging. However, their study was performed in a cohort with more severe malnutrition-all individuals had BMI < 20 kg/m² with only 20.6% having BMI > 18.5 kg/m². We suggest that their findings were due to more severe level of malnutrition of their cohort. Their cohort had a more severe level of malnutrition so that those individuals had already diminished FM percentages. Hence, they could not lose more fat than fat free mass but started to lose fat free mass.

Table 2. Anthropometric characteristics, body composition values, measured and normalized data of REE in well-nourished and undernourished residents by gender

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Well-nourished (n= 93)</td>
<td>Undernourished (n= 45)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>69.9 ± 11.6</td>
<td>58.2 ± 14.4</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>162 ± 7.7</td>
<td>162 ± 7.5</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.6 ± 3.8</td>
<td>22.1 ± 4.9</td>
</tr>
<tr>
<td>FFM (kg)</td>
<td>48.5 ± 6.7</td>
<td>44.2 ± 8.0</td>
</tr>
<tr>
<td>FFM (%)</td>
<td>70.0 ± 6.8</td>
<td>77.2 ± 7.0</td>
</tr>
<tr>
<td>FM (kg)</td>
<td>18.3 ± 7.0</td>
<td>12.6 ± 9.9</td>
</tr>
<tr>
<td>FM (%)</td>
<td>25.7 ± 6.3</td>
<td>19.7 ± 9.2</td>
</tr>
<tr>
<td>FFMI (kg/cm²)</td>
<td>18.4 ± 2.0</td>
<td>16.8 ± 2.6</td>
</tr>
<tr>
<td>Measured REE (kcal/day)</td>
<td>1490 ± 192</td>
<td>1327 ± 241</td>
</tr>
<tr>
<td>REE/FFM (kcal/kg/day)</td>
<td>30.8 ± 2.6</td>
<td>30.0 ± 1.3</td>
</tr>
<tr>
<td>Adjusted REE (kcal/day)</td>
<td>1479 ± 20</td>
<td>1320 ± 29</td>
</tr>
</tbody>
</table>

* p values are same for both genders.
** p value for men.
*** p value for women.
When the residents were grouped according to either BMI or MNA scores, the underweight/undernourished elders had significantly lower measured and normalized REE according to REE adjusted for FFM differences by ANCOVA in both genders. However, while REE normalized according to ratio method was lower in the underweight subjects, it was not significantly different between undernourished and well-nourished subjects. Since MNA is a better tool to assess nutritional status in the elderly, the finding in the group classified according to MNA is significant. In their report about metabolic activity of FFM in underweight elderly subjects, Sergi et al. also reported decreased measured REE and normalized REE according to REE adjusted for FFM differences by ANCOVA in the underweight group (4). However, they reported higher REE in men and no significant difference in women in underweight group when REE was normalized according to ratio method. On the other hand, Schneider et al. and Campillo et al. also reported increased normalized REE in underweight group according to the ratio method (1,7). To investigate the metabolic activity of FFM, it is necessary to normalize REE for quantitative differences in FFM (4). In the reports of Schneider et al. and Campillo et al., ratio method was used for REE normalization (1,7). However, the ratio method is shown to provide misleading conclusions when compared to analysis of covariance method and use of normalized REE according to REE adjusted for FFM differences by ANCOVA method was suggested better in estimation of metabolic activity of FFM (3,4). When the ANCOVA method was used, in both our study and in Sergi et al.’s study, the low metabolic activity of FFM in undernourished elderly was demonstrated. Since, in our study, REE normalized according to ratio method lead to different results than the ANCOVA method among subjects classified according to MNA; our findings also confirm the ratio method for REE normalization to provide misleading conclusions on REE. The finding of decrease in metabolic activity of FFM in undernourished elders is important because this may not simply be an adaptive process but may also reflect a decreased energy intake worsening sarcopenia while thereby increasing the morbidity (19).

The strengths of the current study are those, it is performed in nursing home setting where the prevalence of malnutrition is relevant, estimation of REE adjusted for FFM difference by ANCOVA, and also assessment of nutritional statuses not only by BMI but also via a much better marker: MNA. MNA represents a more precise tool than BMI to measure nutritional status in elderly persons. From its validation in 1994, the MNA has been used in hundreds of studies and translated into more than 20 languages. It is a well-validated tool, with high sensitivity, specificity, and reliability (20). In the studies on the relation of nutritional status with body composition and REE, nutritional status was evaluated only with BMI classification. However, there are also some limitations as this is a cross sectional study and body composition and REE were both assessed by BIA instead of gold standard procedures as DE-XA and indirect calorimetry, respectively.

In conclusion, we have found significantly lower weight, BMI, absolute FFM value (kg), absolute FM value (kg), FM percentage, FM percentage, FFM but higher FFM percentage in the underweight/undernourished elders. Both FFM and FM were decreased in underweight/undernourished individuals but the decrease in FM was more prominent than the decrease in FFM yielding a higher fat free mass percentage but lower fat mass percentage in the underweight/undernourished group. The underweight/undernourished elders had significantly lower measured and normalized REE according to REE adjusted for FFM differences by ANCOVA suggesting that the elders with poor nutritional status show hypometabolism due to a reduction on both FFM quantity and its metabolic activity.

Conflict of Interest
The authors have no conflict of interest.

REFERENCES


