Bioelectric impedance measurement body mass of the patients who applied to the dietary clinics and the effect to daytime sleepiness

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Abstract

Aim: We aimed to investigate body mass parameters using bioelectric impedance measurement in patients who encountered our dietary clinic and, in addition, we aimed to investigate the relationship between these parameters and Epworth Scale.
Methods: 156 patients were enrolled in this study which was conducted in Akyazi State Hospital, Sakarya, Turkey, during October 2013 – October 2014. Age, gender, height, weight, neck circumference, body mass index, waist circumference, and body mass analysis using Bioelectric Impedance measurement device were examined. Patients were asked to fill Epworth sleep index.
Results: 18 of the cases were males and 138 were females. Mean anthropometric indices of the patients were as follows: height: 159.6±7.3 cm; weight: 91.7±63.6 kg; body mass index: 34.2±5.2 kg/m^2; neck circumference: 37.3±3.1 cm; waist circumference: 111.3±13.3 cm, and; Epworth Scale: 6.5±5.1. Body mass index and body fat mass exhibited approximately the same magnitude of the correlation with Epworth scale (R=0.628 and R=0.626, respectively). Waist circumference, visceral fat ratio, body fat percentage, correlation values was assessed at the level of medium significance (0.588, 0.573 and 0.526, respectively).
Conclusion: Obesity is one of the predisposing factors of Sleep Apnea syndrome. Biolectrical Impedance measurement provides practical, inexpensive method analysis of the body distribution. This can be thought of as a pre-screening test. Patients with excess weight who attend dietary clinics should be referred to the ENT services if body parameters are above certain values in order to prevent their potential morbidity.

Keywords: bioelectric impedance, body mass index, diet, Epworth Scale.

Introduction

Sleep disorders is a problem that can cause disruption of quality of life and daytime sleepiness disorders. Obstructive Sleep Apnea Syndrome (OSAS) may cause sleep disorders and daytime sleepiness. Prevalence of OSAS is 2-4% in literature (1). Polysomnography is the gold standard test in diagnosis of OSAS. However, equipment is required for polysomnography test, thus the test is not available everywhere. Parameters can provide valuable information in the body in patients with sleep apnea syndrome patients. Examination of these parameters at least can provide preliminary information before selection of patients for polysomnography test. Daytime sleepiness is one of the most important symptoms of OSAS. Epworth sleep scale is a verbal test which provides information for daytime sleepiness.

Obesity is one of the predisposing factors for OSAS. In addition to an increase in body weight, increased adipose tissue distribution is important in this regard. The thickness of the neck, waist circumference and the increase of fat in the skin have been reported to be associated with the OSAS in the scientific literature (2). There are also magnetic resonance studies in the scientific literature which have linked neck and waist with the percentage of fat (3).

Bioelectric impedance measurement (BIM) is a device that works on the basis of total body fat analysis (Tanita, SC330) (4). The test examines the distribution of body fat, muscle, water ratios.

We aimed to analyze total body distribution in patients referred to our dietary clinic with overweight problems and compare the means with Epworth sleep scale.

Methods

A study was conducted in Akyazi State Hospital, Sakarya, Turkey, during October 2013 – October 2014 including 156 patients referred to dietary clinics with the complaint of overweight. Drug uses due to a sleep disorder, or sedative drug use cases were excluded from the study.

Patients age, gender, weight, size, waist circumference, neck circumference were measured. Neck circumference was measured from cricotyroid membrane as the patients were awake and standing. Waist circumference was measured from umblicus as patients were awake and standing. Body mass index (BMI) is calculated. BMI is assesed (18.5–24.9) as normal (25.0–29.9) overweight, (>30.0) as obesity and (>40) as morbid obesity. Total body measures were investigated using BIM. Body fat percent, Body fat mass, body muscle percent, visceral fat mass percent, BMI and fat free body mass were examined using BIM.

All patients were passed a total Ear Nose Throat examination. Patients with severe septum deviation and grade 4 tonsil hypertrophy were excluded from study.

Patients were asked to mark Epworth sleep scale. Epworth sleep scale is a verbal test which provides information for daytime sleepiness.

The study was planned prospectively. Written informed consent was obtained from each subject following a detailed explanation of the objectives and protocol of the study, which was conducted in accordance with the ethical principles stated in the Declaration of Helsinki and approved by the institutional ethics committee.

The obtained data were compared statistically. Patients' total body distribution and Epworth Scale distribution were assessed using Kolmogorov Smirnov test. Waist circumference, body mass index and body fat mass were normally distributed, whereas other parameters did not follow a normal distribution. The values were compared using SPSS v.13 program with Independent-T test ($p<0.05$ was accepted as statistically significant). Correlations between values were assessed using Pearson's coefficients for normal distribution and Spearman's test for non-normal distribution values.

Results

From a total of 156 patients, 138 were female and 18 were male; age ranged from 18 to 70 years (mean 38.6±11.3). Size of the patients ranged from 140 cm to 179 cm (159.6±7.3 cm). Weight of the patients ranged from 58 kg to 124 kg (91.7±63.6 kg). Neck circumference of the patients ranged from 31 cm to 49 cm (37.3± 3.1 cm). Waist circumference of the patients ranged from 83 cm to 154 cm (111.3±13.3 cm). BMI of the patients ranged from 24.9 to 53 kg/m^2 (34.2±5.2 kg/m^2). 35 of the patients were overweight, 95 of them were obese and 26 were morbid obese. Epworth scale of the patients ranged from 0 to 20 (6.5±5.1). BIM of the patients are shown in Table 1.

Table 1. Bioelectric impedance measurement of the patients

	Minimum-Maximum	Mean ± Standard Deviation
Fat percent	217-54.6%	40.4±5.7 %
Fat mass	16.1-65.2 kg	35.9±10.2 kg
Fat free body mass	38.30-83.2 kg	51.5±7.1 kg
Muscle mass	28.70-79.1 kg	48.8±7 kg
Visceral fat mass	3-31 kg	9.8±4.6%
Body Mass Index	24.90-53.1 kg/m^2	34.2±5.6 kg/m^2

Examination was carried out between male and female subgroups (Table 2). There was a statistically significant difference of muscle mass and fat free body mass between genders ($p<0.001$).

Table 2. Total body analysis by gender

	Gender	Value	Mean ± Standard Deviation
Waist Circumference (cm)	Male	18	113.1±14.4
	Female	138	111.1±13.2
Age (years)	Male	18	39.1±11
	Female	138	38.5±11.3
Weight (kg)	Male	18	95.1±18.4
	Female	138	86.7±14.6
Neck circumference (cm)	Male	18	39.8±4.9
	Female	138	37±2.6
Epworth Scale	Male	18	4.7±4.5
	Female	138	6.8±5.2
Fat Percent (%)	Male	18	35.7±7.9
	Female	138	41±5.1
Fat mass (kg)	Male	18	34.4±5.1
	Female	138	36.1±11.3
Fat free mass (kg)	Male	18	60.9±10.1
	Female	138	50.3±5
Muscle mass (kg)	Male	18	57.9±12
	Female	138	47.6±5
Visceral fat mass (kg)	Male	18	12.6±6.8
	Female	138	9.5±4.1
Body mass index (kg/m^2)	Male	18	33.8±5
	Female	138	34.3±5.7

Waist circumference, Body mass index and body fat mass and Epworth scale correlation was examined using Pearson analysis (Table 3). There was a statistically significant difference between the measures and the correlation coefficient was moderate.

Table 3. Pearson's correlation of the measurements with Epworth scale

	Correlation coefficient	P-value
Epworth - Body mass index	0.628	<0.001
Epworth - Fat mass	0.626	<0.001
Epworth - Waist circumference	0.588	<0.001

Visceral fat mass, fat mass, fat free mass, muscle mass and neck circumference and Epworth scale correlation was examined using Spearman analysis (Table 4). The correlation was moderate between Epworth scale and Visceral fat mass. Conversely, the correlation was mild between Epworth scale and fat free mass, muscle mass and neck circumference.

Table 4. Spearman's correlation of the measurements with Epworth scale

	Correlation coefficient	P-value
Epworth - Visceral fat mass	0.573	<0.001
Epworth - Fat mass	0.526	<0.001
Epworth - Fat free Mass	0.487	<0.001
Epworth - Muscle Mass	0.485	<0.001
Epworth - Neck Circumference	0.444	<0.001

Discussion

OSAS is a disease that can lead to the attacks of de-saturation during sleep, sleep disturbances, daytime sleepiness attacks because of total/partial obstruction of upper airway. Prevalence of the disease is 2-4%. Epworth sleep scale is a verbal test which provides information for daytime sleepiness (5). Male gender, anatomical anomalies, central sleep disorders, obesity are risk factors increasing the risk of the disease (6). Clinical studies showed the relationship between obesity and OSAS. The majority of OSAS patients are obese patients (7). Slimming may improve the clinical symptoms of OSAS. The prevalence of OSAS in obese people is 50-75% in the literature (7).

Clinical body parameters are important in assessing the severity of OSAS. There are clinical studies investigating the relation between OSAS and Body Mass Index (BMI) / waist circumference. Patients' apneas/hipopnea index may worsen with increasing BMI (8). BMI is commonly used in daytime practice. Schafer revealed BMI and body total fat percent are most valuable anthropometric factors for OSAS clinics (9).

Obesity is associated with serious diseases such as sudden death syndrome, hypertension, coronary artery disease, sleep apnea, type 2 diabetes mellitus, cerebrovascular disease (10). Also there may be daytime sleepiness and attention deficits. Because of this severe mortality and morbidity factors the patients referring to dietary clinics should be revealed for OSAS.

BIM is a method developed to measure the percentage of body fat. The method was first used in 1960 (11). The device can provide valuable, practical information that can be applied quickly. Operating system is based on the principle of the difference in the impedance of the body tissue. Bioelectric measurements of the fat, water, and muscle tissues are performed according to the differences (12).

Gender and age are important risk factors for OSAS. Prevalence of OSAS is higher among the elderly and male gender (13).

Fat accumulation in the area of neck and waist is more often in men due to androgenic obesity. Fat in the area of hips is more often in female gender. OSAS prevalence is 3/1 in male/female in the literature (14). The prevalence of the disease decreases to 1.5/1 in postmenopausal period (15). The vast majority of our patients were females. Female patients were referred to dietary clinics because of aesthetic anxiety. There is a weakness because of this issue in our study. We cannot compare gender objectively in our study because of this reason.

Obesity has an important place in the pathogenesis of OSAS. In the literature, 60%-70% of OSAS patient are obese (16). Distribution of fat tissue in the body is important. As fat tissue increases around the neck region, airway narrows and a collapse around airway may occur. In general, a short and thick neck is present in OSAS patients.

Neck circumference above 43 cm in male gender and 38 cm female gender are risk factors for OSAS (2). A study revealed that neck circumference is a more statistically significant predictor than general obesity (17). Palatofarengeal, glossofarengeal and laringo-faringeal fat accumulation is investigated using magnetic resonance in the literature (18). Neck circumferences were 39.8±4.9 cm in male gender and 37±2.6 cm in female gender in our study. We found a correlation between neck circumference and daytime sleepiness in our study.

Fat accumulation in waist region may occur during obesity. Waist circumferences above 94 cm in males and above 88 cm in females are considered as upper limits in the literature (19). Studies revealed that waist circumference is more important risk factor for OSAS than BMI (19). Especially, waist circumference more than 102 cm increases the risk for OSAS. Visceral fat obesity can be investigated using BIM. Literature reveals that if waist circumference is above 220 cm, all of the patients are OSAS rather than simple snoring cases (20). Abdominal obesity is correlated with OSAS. This fat tissue may be investigated using magnetic resonance or computed tomography. We can investigate the distribution using BIM. The method is practical, cheap and involves a harmless procedure for the patients.

Conclusion

BIM is a cheap and practical device which can be used for screening purposes in patients, and body fat and its distribution can provide valuable practical information. This can be used for screening before performing the polysomnography test.

In our study, obesity, total body fat, waist circumference and body mass index displayed all correlations with Epworth daytime sleepiness scale.

In conclusion, patients who are admitted to dietary clinics with certain values of these parameters should be referred to ENT clinics in order to prevent potential morbidity and improve their quality of life.

Conflicts of interest: None declared.

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