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MASNA MASA TELA U NORMALNOJ UHRANJENOSTI

BODY FAT MASS IN NORMAL WEIGHT SUBJECTS

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Sažetak - Gojaznost je oboljenje koje karakteriše prekomerno nagomilavanje masne mase u meri koja dovodi do narušavanja zdravlja i razvoja komplikacija. Indeks telesne mase koristi se kao najpovoljniji parametar za ocenu stanja ishranjenosti i dijagnostikovanje gojaznosti. Međutim, primenom savremenih postupaka analize telesne kompozicije precizno se može ustanoviti da li je uvećanje telesne mase nastalo na račun masne ili mišićne mase ili, pak, telesne vode. Tako, ako prema indeksu telesne mase neke osobe klasifikujemo u kategoriju normalno uhranjenih, a imaju uvećanu masnu masu, govorimo o tzv. sarkopeničnoj gojaznosti. U cilju utvrđivanja zastupljenosti sarkopenične gojaznosti ispitivana je grupa od 140 normalno uhranjenih studenata Medicinskog fakulteta u Novom Sadu, u kojih je pored standardnih antropometrijskih parametara određivana i veličina masne mase tela postupkom bioelektrične impedancne analize. Sarkopenična gojaznost konstatovana je u 25,71% ispitanika. Primenom indeksa telesne mase nije moguće detektovati ovaj oblik gojaznosti, a imajući u vidu da je uvećana masna masa i u normalno uhranjenih osoba udružena sa rizikom razvoja komplikacija, pre svega metaboličkih, neophodno je u dijagnostičkom postupku precizno utvrditi veličinu masne mase.

Ključne reči: Indeks telesne mase; Gojaznost; Uvećanje težine; Telesna konstitucija; Telesna težina; Komorbiditet

Summary - Obesity is characterized by excessive body fat accumulation which may lead to serious health problems and complications. Body mass index is the most optimal parameter to evaluate the level of nutritional status and diagnose obesity. However, modern techniques studying body composition can more accurately determine whether the gain of body weight was on the account of body fat, lean body mass or total body water. If one's body mass index is in the range of normal values but the amount of body fat is above normal range, we talk about sarcopenic obesity. In order to evaluate presence of sarcopenic obesity, a group of 140 normal weight students of the Faculty of Medicine in Novi Sad were measured. Apart from standard anthropometrical parameters the amount of body fat was also determined by using the method of bioelectrical impedance analysis. Sarcopenic obesity was diagnosed in 25.71% of examined students. By using body mass index values this type of obesity cannot be diagnosed, and knowing that a higher amount of body fat in normal weight persons can lead to complications, especially metabolic, it is of great importance to evaluate the amount of body fat accurately.

Key words: Body Mass Index; Obesity; Weight Gain; Body Constitution; Body Weight; Comorbidity

Uvod

Gojaznost je oboljenje koje se karakteriše prekomernim nagomilavanjem masne mase tela u meri koja dovodi do narušavanja zdravlja i razvoja komplikacija. Nastaje kada energetska unos premašuje energetska potrošnju neophodnu za održavanje bazalnog metabolizma i fizičku aktivnost [1]. Tokom poslednjih godina Komitet eksperata Svetske zdravstvene organizacije kritički je ocenio ranije korišćene metode i preporučio izračunavanje indeksa telesne mase (ITM, BMI - "body mass index") kao najpovoljniji za ocenu stanja ishranjenosti i gojaznosti, ukazujući istovremeno i na rizike od razvoja komorbiditeta [2] (tabela 1).

Medjutim, merenje telesne mase, a potom izračunavanje indeksa telesne mase, ne determiniše istovremeno i veličinu masne mase tela. U većini

Introduction

Obesity is a disease characterized by excessive body fat accumulation consequently leading to health disorders and complications. It occurs when energy intake is higher than needed for basal metabolism and physical activities [1]. During the last few years, Expert Committee of World Health Organization criticized the methods used in evaluation of nutritional status and obesity and recommended body mass index (BMI), as the most optimal and at the same time pointed to the risks of comorbidities [2] (table 1).

However, measurement of body weight and calculation of body mass index cannot determine the amount of body fat. In most cases body weight gain is on the account of body fat, but using modern techniques in the evaluation of body composition

Skraćenice

ITM	- indeks telesne mase
TM	- telesna masa
TV	- telesna visina

Tabela 1. Klasifikacija gojaznosti prema vrednostima indeksa telesne mase**Table 1.** Classification of obesity by using values of body mass index (BMI)

Klasifikacija <i>Classification</i>	BMI (kg/m ²)	Rizik od komorbiditeta <i>Risk of comorbidities</i>
Normalna uhranjenost <i>Normal weight</i>	18,5 - 24,9	Prosečan <i>Average</i>
Prekomerna telesna masa/ <i>Overweight</i> ≥ 25		
Predgojaznost <i>Pre-obesity</i>	25,0 - 30,0	Malo povišen <i>Mildly increased</i>
Gojaznost/ <i>Obesity</i>		
1. "gojaznosti/Class I	30,0 - 34,9	Umereno povišen <i>Moderate</i>
2. "gojaznosti Class II	35,0 - 39,9	Veoma povišen/ <i>Severe</i>
3. "gojaznosti (ekstremna gojaznost) <i>Class III (extreme obesity)</i>	≥ 40	Višestruko povišen <i>Very severe</i>

slučajeva, uvećanje telesne mase nastaje na račun masne mase tela, ali primenom savremenih postupaka za određivanje telesne kompozicije, uočena su izvesna odstupanja (tabela 2). Tako, u nekih sportista, poput bodibildera, rvača, vaterpolista i drugih,

Tabela 2. Odnos kategorija uhranjenosti prema veličini masne mase tela**Table 2.** Relationship between body weight categories and the amount of body fat

Indeks telesne mase <i>Body mass index</i>	Pothranjenost/ <i>Underweight</i>	Pothranjeni/ <i>Underweight</i>	Sarkopenična gojaznost <i>Sarcopenic obesity</i>
Normalna uhranjenost/ <i>Normal weight</i>	Zdrave osobe <i>Healthy people</i>		
Prekomerna telesna masa/ <i>Overweight</i>	Prekomerna telesna masa bez gojaznosti/ <i>Overweight without obesity</i>		Gojaznost/ <i>Obesity</i>
	Smanjena <i>Low</i>	Normalna <i>Normal</i>	Uvećana <i>High</i>
Masna masa tela/ <i>Body fat mass</i>			

uvećana telesna masa nije nastala na račun masne mase, već mišićne mase, te se oni ne mogu klasifikovati kao gojazni. Slična situacija je i u osoba sa uvećanom telesnom masom koje imaju ITM > 30 kg/m², u kojih postoji nakupljanje telesne tečnosti, kao što su generalizovani edemi, ascites i anasarka. U pogledu telesne kompozicije ovih osoba uočava se uvećanje totalne telesne vode, što uzrokuje

Abbreviations

BMI	- body mass index
BM	- body mass
BH	- body height

some exceptions were made. In some athletes, like bodybuilders, wrestlers, water-ball players and others, enlargement of body weight was not on the account of body fat, but on the account of muscle mass, and that is why they cannot be classified as obese. It is almost the same situation in people with enlargement of body weight and BMI above 30 kg/m², in whom accumulation of body water is present in the form of generalized edema, ascites and anasarca. Analyzing the body composition in these persons it can be shown that accumulation of body water is the reason for body weight gain, so they can't be classified as obese. Opposite to such cases, people with normal body weight can have higher values of body fat than normal. Heber D. and associates [3] identified this type of obesity, as the so called "normal weight obesity", as sarcopenic obesity since reduction of muscle mass is present. This type of obesity is accompanied by risk for developing complications, like in obese people, but not so severe. In the study done by this scientist a higher prevalence of sarcopenic obesity was identified in premenopausal women with breast cancer. Gallagher D. and associates [4] in their study on a large number of people from three ethnic groups, came to results that showed that sarcopenic obesity is very frequent, especially in women and children. Their study showed that 10% of young women have this type of obesity.

The aim of this study was to determine presence of sarcopenic obesity in a group of normal weight people.

Material and methods

A group of 140 normal-weight students (76 female and 64 male) of the IV and V year of the Faculty of Medicine in Novi Sad was examined, average age 23.44±1.26 years.

The students joined the study on voluntary bases, after they were given a detailed explanation about the design and the aim of the study. The examinations were made at the Department of Endocrinology, Diabetes and Metabolic Disorders, Institute of Internal Medicine, Clinical Center of Novi Sad.

Apart from sex and age distribution all students underwent measurements of body weight and body height and BMI was calculated (BMI= BM (kg)/BH² (m²)). The percentage of body fat was evaluated using the method of bioelectrical impedance analysis. At the beginning of the study all examinees with high level of physical activity (athletes, bodybuilders) and pregnant women were excluded.

Body fat was determined using Tanita TBF- 310, electrodes were not applied on the skin but the examined person stood on them ("Foot Pad

uvećanje telesne mase, tako da se ne mogu svrstati u gojazne. Suprotno tome, osobe sa normalnom telesnom masom, tj. normalno uhranjene, mogu imati veću masnu masu od referentne. Heber D. i saradnici [3] ovaj oblik gojaznosti - tzv. gojaznost u normalnoj telesnoj masi, nazvali su, s obzirom na redukciju mišićne mase, sarkopeničnom gojaznošću. Ovaj oblik gojaznosti udružen je sa rizikom pojave niza komplikacija, poput onih u gojaznosti, ali blažeg stepena. U svojoj studiji, ovi istraživači konstatovali su postojanje visoke prevalencije sarkopenične gojaznosti u premenopauzalnih žena sa karcinomom dojke. Gallagher D. i saradnici [4] u ispitivanju sprovedenom na velikoj grupi osoba tri etničke grupe, ustanovili su da je sarkopenična gojaznost česta pojava, naročito u populaciji žena i dece. Njihova studija je pokazala da 10% mladih žena ima ovaj oblik gojaznosti.

Cilj ispitivanja bio je da se u grupi normalno uhranjenih osoba ustanovi zastupljenost sarkopenične gojaznosti.

Materijal i metode

Ispitivana je grupa od 140 normalno uhranjenih studenata (76 ženskog i 64 muškog pola) IV i V godine Medicinskog fakulteta u Novom Sadu, prosečne životne dobi $23,44 \pm 1,26$ godina. U studiju studenti su se uključivali dobrovoljno, nakon detaljno datog objašnjenja dizajna i ciljeva studije. Ispitivanja su sprovedena na Klinici za endokrinologiju, dijabetes i bolesti metabolizma Instituta za interne bolesti Kliničkog centra u Novom Sadu.

U svih studenata vršeno je, pored evidentiranja pola i uzrasta, merenje telesne mase, telesne visine i izračunavanje indeksa telesne mase [ITM- BMI (*body mass index*) = $TM (kg)/TV(m^2)$]. Procenat masne mase tela utvrđivan je postupkom bioelektrične impedancne analize. Na samom početku ispitivanja isključene su osobe sa izraženom fizičkom aktivnošću (sportisti, bodibilderi i dr.) i trudnice.

Merenje masne mase tela vršeno je aparatom Tanita TBF - 310, primenom elektroda koje se ne aplikuju na kožu, već ispitanik na njih staje (*Foot Pad Electrodes*). Nekoliko sekundi nakon što ispitanik stane na postolje sa elektrodama, na ekranu aparata prikazuju se podaci o telesnoj masi, ukupnoj masnoj i bezmasnoj masi, te totalnoj telesnoj vodi. Referentne vrednosti za veličinu masne mase tela uzete su prema preporukama od strane proizvođača (*Tanita Body Fat Scale*) [5] (tabela 3).

U statističkoj obradi podataka korišćeni su srednja vrednost, standardna devijacija i procenat.

Rezultati

U ispitivanoj grupi normalno uhranjenih studenata prosečan ITM iznosio je $20,57 \pm 1,86 \text{ kg/m}^2$ u osoba ženskog i $22,52 \pm 1,88 \text{ kg/m}^2$ muškog pola (tabela 4). Procenat masne mase u studentkinja iznosio je $21,55 \pm 6,8\%$, a u studenata $15,33 \pm 3,59\%$. Masna

Tabela 3. Preporučene vrednosti masne mase tela prema polu i uzrastu

Table 3. Recommended values of body fat mass according to gender and age

Uzrast/Age	Žene/Female	Muškarci/Male
14 - 29 god./14-29 years	17-24%	14-20%
Preko 30 god./Over 30 years	20-27%	17-23%

Electrodes"). Several seconds after the examined person stood on electrodes, data about body weight, body fat, lean body mass and body water appeared on the display. Recommended values for the body fat mass were given by the manufacturer (*Tanita Body Fat Scale*) [5] (table 3).

Statistical analysis included average values, standard deviation and percentage.

Results

A group of 140 normal-weight medical students (76 female and 64 male) of the IV and V year of Faculty of Medicine in Novi Sad was examined, average age 23.44 ± 1.26 years. In the examined group of normal weight students the average BMI was $20.57 \pm 1.86 \text{ kg/m}^2$ in females and $22.52 \pm 1.88 \text{ kg/m}^2$ in males (table 4). The percentage of body fat in the group of female students was $21.55 \pm 6.8\%$ and in male students $15.33 \pm 3.59\%$. Body fat mass in the range of normal values was present in 51 (67.10%) female students and in 53 (82.81%) male students. Using the BMI values for evaluation of the nutritional status all students had normal weight. However, in 25 (32.89) female students and 11 (17.18%) male students higher amounts of body fat or sarcopenic obesity was identified (table 5). In regard to the whole group, sarcopenic obesity was present in 25.71% of examined students.

Tabela 4. Karakteristike ispitivane grupe

Table 4. Characteristics of the examined group

	ženskog pola female	muškog pola male
Telesna masa (kg)/Body mass (kg)	$57,57 \pm 6,01$	$74,71 \pm 8,18$
Telesna visina (cm)/Body height (cm)	$167,55 \pm 5,28$	$181,92 \pm 4,83$
Indeks telesne mase (kg/m^2)		
Body mass index (kg/m^2)	$20,57 \pm 1,86$	$22,52 \pm 1,88$
Masna masa (%)/Fat mass (%)	$21,55 \pm 6,8$	$15,33 \pm 3,59$

Tabela 5. Klasifikacija ispitivane grupe prema veličini masne mase tela

Table 5. Classification of the amount of body fat mass in examined group

	BMI= $18.5-25 \text{ kg/m}^2$ ↑ % masne mase ↑ % body fat (sarkopenična gojaznost) (sarcopenic obesity)	N% masne mase N % fat mass
žene (n=76)/female	25 (32,89%)	51 (67,10%)
muškarci (n=64)/male	11 (17,18%)	53 (82,81%)
Sarkopenična gojaznost/Sarcopenic obesity: 36 (25,71%)		

↑ - povišeni/increased; N-u opsegu referentnih vrednosti/normal ranges

masa u granicama referentnih vrednosti verifikovana je u 51 (67,10%) studentkinje i 53 (82,81%) studenta.

Korišćenjem samo ITM kao parametra stepena uhranjenosti svi ispitivani studenti bili su normalno uhranjeni. Međutim, u 25 (32,89%) studentkinja i 11 (17,18%) studenata konstatovana je uvećana masna masa, tj. sarkopenična gojaznost (tabela 5). Posmatrajući grupu u celini, sarkopenična gojaznost bila je zastupljena u 25,71% ispitanika.

Diskusija

U ispitivanoj grupi normalno uhranjenih studenata Medicinskog fakulteta u Novom Sadu sarkopenična gojaznost verifikovana je u oko četvrtine ispitanika (25,71%). Ukoliko bi se primenio ITM kao parametar stepena uhranjenosti, ovaj oblik gojaznosti se ne bi mogao konstatovati. Primenom postupka bioelektrične impedancne analize, uz određivanje procenta masne mase tela, uočeno je njeno uvećanje u oko četvrtine ispitanika, što se ne može zanemariti, imajući u vidu postojanje rizika razvoja komplikacija poput onih u gojaznosti, ali blažeg stepena. Gallagher i saradnici [6] u grupi zdravih osoba pratili su zastupljenost nepodudarnosti nalaza ITM, kao pokazatelja stepena uhranjenosti, i veličine masne mase tela, u postupku determinisanja gojaznosti. Konstatovali su odstupanja, posmatrajući za sve kategorije ITM, u 20,8% osoba ženskog i 33,7% muškog pola. Najveća odstupanja, tj. nepodudarnost stepena uhranjenosti i masne mase tela bila su prisutna u grupi normalno uhranjenih osoba. Sarkopenična gojaznost verifikovana je u 13,79% ispitanika. Zastupljenost ovog oblika gojaznosti u ovom ispitivanju manja je nego u našem ispitivanju, što je verovatno rezultat nehomogenosti grupe ovih istraživača. Naime, u studiji Gallaghiera i saradnika [6] ispitivane su osobe bez obzira na životnu dob i fizičku aktivnost, dok je naše ispitivanje sprovedeno u grupi normalno uhranjenih osoba mlađe životne dobi, bez intenzivne fizičke aktivnosti. Verovatno i etničke karakteristike ispitivanih grupa doprinose različitom stepenu zastupljenosti sarkopenične gojaznosti. Ispitivanja u cilju utvrđivanja stvarne zastupljenosti sarkopenične gojaznosti u našoj populaciji neophodno je sprovesti na daleko većem broju ispitanika različitih starosnih grupa. Interesantno je napomenuti da isti autori konstatuju greške u klasifikaciji i u grupi gojaznih. Naime, određivanjem masne mase tela ustanovljene su njene normalne vrednosti u 5,94% ispitanika i 16,56% ispitanika koji su bili klasifikovani kao gojazni ($ITM > 30 \text{ kg/m}^2$).

Heber D. i saradnici [3] ističu da se sarkopenična gojaznost može dijagnostikovati samo primenom neke od metoda za analizu telesne kompozicije, pre svega određivanjem veličine masne mase tela. Kao veoma precizan, jednostavan i neinvanzivan postupak analize telesne kompozicije pokazao se metod bioelektrične impedancne analize, te ga ovaj autor

Discussion

In the examined group of normal-weight students from the Faculty of Medical in Novi Sad 25.71% of them presented with sarcopenic obesity. If values of BMI are taken as a parameter to determine the nutritional status, this type of obesity cannot be identified. Using the method of bioelectrical impedance analysis and evaluating the percentage of body fat, in quarter of examines it was higher than recommended, this cannot be overlooked because of the risk developing complications such as in obesity, but moderate. Gallagher and associates [6] followed up a group of healthy people in regard to different findings of BMI, used as a parameter for evaluation of the nutritional status and the amount of body fat, in order to determine obesity. They established deviations, in all categories of BMI, in 20.8% of women and 33.7% of men. The biggest deviations regarding findings of BMI values and the amount of body fat were present in the normal weight group. Sarcopenic obesity was identified in 13.79% of examines. Presence of this type of obesity is much lower than in our study, which is due to the fact that their examined group wasn't homogenous. Gallagher and associates [6] examined persons regardless to age and the level of physical activity, while our study on the other hand, included a group of normal weight, younger people without intensive physical activity. It is possible that ethnic characteristics of the examined groups also contribute to different findings regarding sarcopenic obesity. In order to get a better estimation of how frequent sarcopenic obesity is in our population, it is necessary to study a larger number of people of different ages. It is interesting to mention that the same authors identified mistakes also in classification of obese subjects. By measuring the percentage of body fat, 5.94% of women and 16.6% of men had normal values, yet they were classified as obese using the values of BMI ($BMI > 30 \text{ kg/m}^2$).

Heber D. and associates [3] underline that sarcopenic obesity can be diagnosed only by using some methods which analyze body composition, whereas the most important is to evaluate the percentage of body fat. The bioelectrical impedance analysis is a precise, easy and non-invasive method for determination of body composition and it is recommended by this author as an important part in the diagnosis of obesity. Furthermore, this type of obesity has certain kinds of clinical and metabolic implications, and that is why it cannot be ignored. It has also been established that in premenopausal women with breast cancer sarcopenic obesity has higher prevalence [3].

predlaže kao neizostavnog u dijagnostičkom postupku. Štaviše, ovaj oblik gojaznosti ima odgovarajuće kliničke i metaboličke implikacije, te se ne može zanemariti. Takođe je ustanovljeno da u premenopauzalnih žena sa karcinomom dojke postoji visoka prevalenca sarkopenične gojaznosti [3].

Procenat masne mase tela, nezavisno od telesne mase i stepena uhranjenosti, bolje reflektuje aterogeni lipidski i lipoproteinski profil nego do sada korišćen indeks telesne mase, te je neophodno da postane važan parametar u dijagnostičkom postupku u gojaznosti [7].

Zaključak

U grupi normalno uhranjenih osoba verifikovana je, u oko četvrtine ispitanika, sarkopenična gojaznost. Ovo dobija na značaju ako se zna da je naveden oblik gojaznosti udružen sa rizikom pojave komorbiditeta kao kod izražene gojaznosti, ali blažeg stepena. Korišćenjem samo ITM nije moguće detektovati sarkopeničnu gojaznost, te je neophodno, u dijagnostičkom postupku utvrditi i veličinu masne mase nekim od postupaka analize telesne kompozicije.

The percentage of body fat, regardless to body weight and nutritional status, reflects better the atherogenic lipid and lipoprotein profile than often used body mass index, and that is why it is necessary to include it as an important parameter in the process of diagnosing obesity [7].

Conclusion

Sarcopenic obesity was verified in 25% of normal-weight examinees. This is of great importance if we know the fact that this type of obesity is accompanied with risks of developing comorbidities like those in severe obesity, but of moderate level. Sarcopenic obesity cannot be detected using values of BMI and that is why it is important to evaluate the amount of body fat using some methods for assessment of body composition.

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