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Effect of Abdominal Obesity on Body Composition and Obesity Markers in Healthy Adults

Sağlıklı Yetişkinlerde Abdominal Obezitenin Vücut Kompozisyonu ve Obezite Belirteçlerine Etkisi

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Abstract

Aim: To reveal possible metabolic risks that may occur in the future by evaluating the effects of abdominal obesity on body composition and peptide hormones (adropin, ghrelin, obestatin), which are obesity markers, in healthy individuals.

Material and Method: 69 healthy participants between the ages of 25-52 were divided into two groups as abdominally obese and non-obese. Anthropometric measurements and body composition of the participants were analyzed and blood sample was taken from the antecubital vein to measure adropin, obestatin and ghrelin levels after 8-10 hours of fasting.

Results: In the abdominal obese group, body mass ındex (BMI), waist circumference, body fat ratio, visceral fat rating and obesity degree were statistically higher, while skeletal muscle ratio, serum adropin and ghrelin levels were statistically lower compared to the control group. BMI and body fat ratio were negatively correlated with adropin, obestatin and ghrelin levels, while waist circumference and visceral fat rating were only negatively correlated with ghrelin levels.

Conclusion: As a result of this study BMI, body weight, body fat ratio, visceral fat rating and obesity degree increased and muscle ratio, serum adropin and ghrelin levels decreased in healthy abdominal obese individuals. It is suggested that in the light of this and similar studies, the relationship between obesity related hormones and obesity also metabolic risks will be understood better in the future.

Keywords: Abdominal obesity, anthropometric measurement, body composition, adropin, obestatin, ghrelin

Öz

Amaç: Abdominal obezitenin sağlıklı bireylerde vücut kompozisyonu ve obezite belirteçleri olan peptit hormonlar (adropin, ghrelin, obestatin) üzerindeki etkilerini değerlendirerek ileride oluşabilecek metabolik riskleri ortaya çıkarmaktır.

Gereç ve Yöntem: 25-52 yaş aralığındaki 69 katılımcı abdominal obezitesi olan ve olmayan şeklinde iki gruba ayrılmıştır. Katılımcıların antropometrik ölçümleri ve vücut kompozisyon analizi yapılmış; serum adropin, ghrelin ve obestatin düzeyleri 8-10 saat açlık sonrası antekübital venden kan alınarak ölçülmüştür.

Bulgular: Abdominal obez grupta kontrol grubuna kıyasla vücut kitle endeksi (VKİ), bel çevresi, vücut yağ oranı, iç yağlanma, obezite derecesinin istatistiksel olarak daha yüksek olduğu görülürken; iskelet kas oranı, serum adropin ve ghrelin düzeylerinin istatistiksel olarak daha düşük olduğu bulunmuştur. VKİ ve vücut yağ oranı adropin, obestatin ve ghrelin düzeyleri ile negatif korelasyon gösterirken; bel çevresi ve iç yağlanma sadece ghrelin düzeyi ile negatif korelasyon göstermiştir.

Sonuç: Sağlıklı bireylerde abdominal obeziteyle birlikte VKI, vücut ağırlığı, vücut yağ oranı, iç yağlanma derecesi ve obezite derecesinin arttığı; kas oranı, serum adropin ve ghrelin düzeyinin ise azaldığı görülmüştür. Bu ve benzer çalışmalar sayesinde, obezite ile ilgili hormonların obezite ve metabolik risklerle olan ilişkisinin gelecekte daha iyi anlaşılacağı düşünülmektedir.

Anahtar Kelimeler: Abdominal obezite, antropometrik ölçüm, vücut kompozisyonu, adropin, obestatin, ghrelin

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INTRODUCTION

Obesity is defined by the World Health Organization (WHO) as excess fat in the body.[1] Abdominal obesity is better known as the increase in fat tissue around the internal organs.[2] Abdominal obesity is more closely associated with many chronic disease components compared to gluteal obesity.[3] Therefore, recently measuring waist circumference along with body mass index (BMI) has become an important indicator in anthropometric evaluation.[4] Although BMI is a widely used method in the diagnosis of obesity, waist circumference measurement gives better results in calculating abdominal obesity.[5] According to the Turkish Society of Endocrinology and Metabolism (TEMD) guidelines, the diagnostic criteria for abdominal obesity include a waist circumference of ≥100 cm in men and ≥90 cm in women.[6]

Analysis of body composition is an essential part of nutritional status assessment, especially in weight loss programs. Body weight and composition are the result of genetics, metabolism, environment, behavior and culture. Additionally, local fat accumulation has been shown to have a significant, negative impact on morbidity, disability, emotional well-being, and quality of life.[7] Bioelectrical impedance analysis (BIA) is a simple, noninvasive, fast, portable, repeatable and convenient method of measuring body composition (fat, muscle, soft tissue, etc.) and fluid distribution with less physical requirements.[8]

Adropin was first used by Kumar et al. (2008), it is a nutritionally regulated peptide hormone that is secreted mainly by the liver and modulates metabolic homeostasis in many tissues.[9,10] It has been proven by animal and human studies that adropin is associated with adiposity and weight management by interacting with receptors that play a role in the regulation of energy metabolism and glucose lipid homeostasis.[11] Adropin has also been shown to suppress lipogenic genes, lipid accumulation, and differentiation of preadipocytes into mature adipocytes.[12]

Ghrelin is an orexigenic hormone that was first detected in the mouse stomach in 1999.[13] While ghrelin level in the body reaches its peak during fasting, its level decreases immediately after a meal and satiety develops.[14] Circulating ghrelin increases abdominal fat by a mechanism independent of its central orexigenic activity. However, the effect of ghrelin on adipocytes is controversial. Ghrelin has been reported to inhibit and/or increase adipogenesis, increase fat storage enzyme activity, and reduce fat utilization/lipolysis.[15]

Obestatin is an anorexigenic peptide hormone produced in the same endocrine cell type as ghrelin and primarily in the stomach.[16] As the opposite of obestatin and ghrelin; It has adverse effects such as reducing food intake, body weight and delaying gastric emptying, and when both peptides are administered together, obestatin antagonizes the actions of ghrelin.[17] Existing studies have shown that plasma obestatin is significantly lower in obese subjects compared to controls.[18]

The aim of this study was to evaluate the effects of abdominal obesity, which poses a great risk for many chronic diseases, especially metabolic syndrome,[19] on body composition and peptide hormones, which are markers of obesity, in healthy individuals and to obtain information about future metabolic risks.

MATERIAL AND METHOD

Study Design and Population

Approval for this study was received from Amasya University Faculty of Medicine Clinical Studies Ethics Committee (Decision date and number: 28/02/2020-E-5735). The research was carried out in accordance with the Ethics Committee Directive. All participants included in the study signed the Informed Consent Form. This study was admitted to Amasya Gümüşhacıköy State Hospital. None of the participants had any chronic disease and had never smoked or consumed alcohol. 69 participants were divided into two groups: abdominally obese (n=35) (waist circumference >90 cm for women, >100 cm for men) and non-obese (control group) (n=34)) (waist circumference <90 cm for women, <100 cm for men). Anthropometric measurements and body composition tests of the participants were analyzed at Amasya Gümüşhacıköy State Hospital. TANITA MC 580 type BIA device was used for body composition analysis. A 5 ml blood sample was taken from the antecubital vein to examine adropin, obestatin and ghrelin levels in the morning after 8-10 hours of fasting during routine admission in the study groups.The blood taken into the biochemistry tube was kept for 45 minutes and then centrifuged at 3500-4000 rpm for 5 minutes and the serum was separated. The separated serums were stored in 2 mm Eppendorf tubes in a deep freezer at -80ºC in Amasya University Faculty of Science and Letters Laboratory to measure adropin, obestatin and ghrelin levels. ELISA kits (SUNRED ELISA kit, kit no. 201-12-3107, and 201-12-0091; Shanghai Sunred Biological Technology Co., Ltd., Shanghai, China) were used. These parameters were studied in Amasya University Faculty of Science and Letters Laboratory in accordance with the working method.

Statistical Analysis of Data

For continuous data, mean (μ), standard deviation (SD) and confidence interval values were determined. Categorical data are expressed as percentages. Student's t test was used for pairwise comparisons of data conforming to normal distribution, and Mann Whitney U test was used for pairwise comparisons of data not conforming to normal distribution. Pearson and Spearman tests were chosen appropriately for significance testing of categorical variables. The obtained results were subjected to statistical evaluation at a %95 confidence interval with a significance level of $p<0.05$.

RESULTS

Comparisons and correlation statistics of study findings with study groups are shown below with tables and explanations. This research was conducted with 40 healthy women and 29

healthy men, aged between 25 and 52 years. The mean age of the participants was 36.39±6.72 years.

It was observed that BMI, waist circumference, body weight, body fat ratio, visceral fat rating and obesity degree were statistically significantly higher in the abdominal obese group compared to the control group (p=0.0001). Skeletal muscle ratio and ghrelin level were highly significant (p=0.0001); serum adropin level was significantly (p<0.05) lower in obese group compared to non-obese group (p=0.0001). Although obestatin level was lower in the obese group, there was no statistical difference between the groups (p>0.05) (**Table 1**).

The waist circumference showed a positive, moderately significant correlation with body fat ratio (r=0.643) and a positive, highly significant correlation with visceral fat rating and obesity degree (r=0.921; 0.896, respectively) in all participants. Waist circumference showed negative and moderately significant correlations with skeletal muscle ratio and ghrelin level (r =-0.644; -0.461, respectively). There was a high positive (r=0.928; 0.904, respectively) and significant correlation between body weight and visceral fat rating and obesity degree of all participants, and a moderate positive correlation (r=0.644) with body fat ratio. Statistically significant negative correlation was found between body weight and skeletal muscle ratio and ghrelin levels (r=-0.644; -0.416, respectively). There was a statistically significant positive correlation between BMI and body fat ratio, visceral fat rating and obesity degree (r=0.844; 0.900; 0.995, respectively). Similarly, significant negative correlation was found between BMI and skeletal muscle ratio (r=-0.844) and moderate negative correlation was found with adropin, obestatin and ghrelin levels (r=-0.414; -0.353; -0.379, respectively) (**Table 2**).

A statistically significant negative correlation was observed between the body fat ratio and adropin, obestatin and ghrelin levels of all participants (r=-0.494; -0.434; -0.309 respectively). A moderately significant negative correlation was found between obesity degree and adropin, obestatin and ghrelin (r=-0.401; -0.348; -0.356 respectively). Likewise, skeletal muscle ratio showed a statistically significant negative correlation with these three obesity markers (r =-0.492; -0.433; -0.309, respectively). Visceral fat rating showed only a moderate negative correlation (r=-0.342) with ghrelin level (**Table 3**).

Table 1. Comparison of groups in terms of anthropometric, body composition and biochemical markers

	Mean±SD				
	Abdominal Obese Group (n=35)	Non-obese Group (n=34)	p	95% Confidence Interval	
BMI (kg/m²)	35.96±7.32	22.35±2.04	0.0001[b]	11.01	16.21
Body Weight (kg)	98.31±16.74	16.74±8.78	0.0001[b]	29.37	42.28
Waist Circumference (cm)	109.80±10.46	75.94±8.26	0.0001[b]	29.31	38.39
Body Fat (%)	37.15±8.81	23.82±5.91	0.0001[a]	9.70	16.94
Visceral Fat Rating	12.06±4.43	3.65±1.84	0.0001[b]	6.77	10.05
Obesity Degree*	53.44±31.16	-2.60±8.47	0.0001[b]	45.00	67.09
Skeletal Muscle (%)	35.59±4.96	43.14±3.33	0.0001[a]	-9.58	-5.51
Adropin (pg/ml)	319.35±321.99	432.10±247.82	0.0180[b]	-251.10	-25.60
Obestatin (ng/ml)	8.13±6.87	10.59±5.45	0.1050[b]	-0.45	-0.52
Ghrelin (ng/ml)	1.80±0.53	2.40±0.67	0.0001[a]	-0.89	-0.30

a: Student's t test (data follow a normal distribution), b: Mann Whitney U (data follow a non-normal distribution), *Obesity Degree expresses distance from the most ideally calculated weight as %

Table 2. Correlation of anthropometric measurements with body composition and obesity markers

	Waist Circumference		Body Weight		BMI	
	Correlation Coefficient	p	Correlation Coefficient	p	Correlation Coefficient	p
Body fat ratio	0.643	<0.001	0.644	<0.001	0.844	<0.001
Visceral fat rating	0.921	<0.001	0.928	<0.001	0.900	<0.001
Obesity degree	0.896	<0.001	0.904	<0.001	0.995	<0.001
Skeletal muscle	-0.644	<0.001	-0.644	<0.001	-0.844	<0.001
Adropin	-0.215	0.077	-0.189	0.121	-0.414	<0.001
Obestatin	-0.183	0.132	-0.157	0.199	-0.353	0.003
Ghrelin	-0.461	0.012	-0.416	<0.001	-0.379	<0.001

Table 3. Correlation of body composition with obesity markers

	Body Fat Ratio		Visceral Fat Rating		Obesity Degree		Skeletal Muscle Ratio	
	Correlation Coefficient	p	Correlation Coefficient	p	Correlation Coefficient	p	Correlation Coefficient	p
Adropin	-0.494	<0.001	-0.182	0.135	-0.401	0.001	0.492	<0.001
Obestatin	-0.434	<0.001	-0.124	0.310	-0.348	0.003	0.433	<0.001
Ghrelin	-0.309	0.010	-0.342	0.004	-0.356	0.003	0.309	0.010

DISCUSSION

Acoording to results of this study, in the abdominal obese group, body mass ındex (BMI), waist circumference, body fat ratio, visceral fat rating and obesity degree were statistically higher, while skeletal muscle ratio, serum adropin and ghrelin levels were statistically lower compared to the control group. BMI and body fat ratio were negatively correlated with adropin, obestatin and ghrelin levels, while waist circumference and visceral fat rating were only negatively correlated with ghrelin levels.

In support of this research, in a study investigating the relationship between muscle mass to visceral fat (MVF) ratio and metabolic syndrome in 1464 young adult university students in Colombia; the study population was divided into four groups according to MVF ratio. Participants' muscle and visceral fat measurements were determined by BIA and cardiometabolic risk factors including anthropometry and biochemical parameters were evaluated. As a result of the study, it was stated that a low MVF ratio was associated with a high cardiometabolic risk and that clinicians could use this ratio to determine the cardiometabolic risk in adult individuals.[20] Similarly, Kim et al. (2014) investigated whether low cardiorespiratory condition (CRF) is associated with low muscle mass, visceral obesity, and low muscle mass with visceral obesity in 298 healthy adults aged 20-70 years and classified the participants into four groups according to the muscle mass/visceral fat ratio. It has been reported that individuals with low CRF have low muscle mass and an increased risk of visceral obesity with combined low muscle mass. These results emphasize that low CRF may be a potential indicator for low muscle mass and visceral obesity.[21]

In a randomized controlled study, it was aimed to determine whether serum adropin level is related to cardiorespiratory condition, carotid β stiffness, plasma nitrite/nitrate (NOx) level and abdominal visceral fat in 27 normal weight, 20 overweight and 25 obese adult individuals (age 41-70 ages) and it was reported that serum adropin level is negatively correlated with carotid β-stifness and abdominal visceral fat in all adults.[22] Likewise, Zaki et al. (2022) researched the relationship between serum adropin level, DNA damage and body composition in 40 women with NAFLD and 40 healthy obese women in a similar age it was observed that NAFLD patients had significantly lower serum adropin and higher visceral fat and waist-hip ratio compared to controls. Additionally, serum adropin level was negatively correlated with obesity-related parameters in all subjects similar to this study.[23] Similarly, in Shanghai Hospital in China 16 abdominally obese and 14 normal weight adults were included in a study that hypothesized that obesity might present with imbalance in circulating ghrelin and obestatin levels. It was found that preprandial plasma ghrelin and obestatin levels and obestatin levels were lower in the obese individuals compared with normal-weight controls and also reported that the ghrelin/obestatin ratio may affect the etiology and pathophysiology of obesity.[24] In a case-control study involving nine healthy controls, nine morbidly obese subjects, and eight post-gastrectomy individuals investigated the obestatin response in the body after a fixed meal it has been shown that plasma obestatin does not change substantially following a fixed-energy meal, but is significantly lower in obese subjects than in controls. This suggests that obestatin may have an important role in long-term body weight regulation.[18]

CONCLUSION

Anthropometric measurements, body composition and obesity markers levels of healthy adult individuals with abdominal obesity showed significant differences (higher BMI, body weight, waist circumference, body fat ratio, visceral fat rating, obesity degree; lower skeletal muscle ratio, adropin and ghrelin levels) compared to the control group. As the body fat ratio increases with obesity, obesity-related hormones have been found to decrease. There are very few studies on obesity related hormones in healty individuals. Since this research was conducted in healthy adults, it is believed that it will contribute to the literature to reveal the relationship of these newly identified hormones with obesity and metabolic risks.

ETHICAL DECLARATIONS

Ethics Committee Approval: Approval for this study was received from Amasya University Faculty of Medicine Clinical Studies Ethics Committee (Decision date and number: 28/02/2020-E-5735).

Informed Consent: All participants included in the study signed the Informed Consent Form.

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