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EVALUATION OF THE RELATIONSHİP BETWEEN QUALITY OF LIFE AND DIETARY ACID LOAD IN OBESE WOMEN

OBEZ KADINLARDA YAŞAM KALİTESİ VE DİYET ASİT YÜKÜ ARASINDAKİ İLİŞKİNİN DEĞERLENDİRİLMESİ

Nurefşan Konyalıgil[1*], Betül Çiçek[1], Tuba Tekin[2], Meltem Ünlüsavuran Sönmez[1]

[1]Department of Nutrition and Dietetics, Faculty of Health Sciences, Erciyes University, Kayseri, Turkey

[2]Department of Nutrition and Dietetics, Faculty of Health Sciences, Sivas Cumhuriyet University, Sivas, Turkey

ABSTRACT

Objective: This study was conducted to determine the dietary acid load of obese women and to examine the relationship between dietary acid load, anthropometric measurements, and quality-of-life.

Method: 140 volunteer adult individuals with body mass index 30-<40 kg/m² were included. To determine the food consumption status and the dietary acid load of the women, food consumption records were taken for three consecutive days (two days on weekdays, one day on the weekend). Potential renal acid load (PRAL) and net endogenous acid production (NEAP) were calculated by various algorithms based on food intake. The Obese-Specific Quality of Life Scale was used to determine the quality of life. The researcher measured body weight, height, waist, hip, and neck circumferences.

Results: PRAL and NEAP scores increased with the increment in the degree of obesity but not significant for statistical (p>0.05). PRAL score in obese smokers was higher than the PRAL score of obese non-smokers (p<0.05). A negative correlation was detected between body weight and quality of life (r=-0.234, p=0.005). There was no significant relationship between quality of life and socio-economic status and constipation status and PRAL and NEAP scores (p>0.05).

Conclusion: In this study, the dietary acid load increased with the increase in obesity. Smoking is another condition that increases dietary acid load. In addition, factors such as socioeconomic status and constipation also affect dietary acid load. Besides, as the obesity status of individuals increases, the quality-of-life decreases. Therefore, attention should be paid on assessing dietary acid load and weight control when planning nutritional therapy in obese individuals.

Key Words: Nutrition, Obesity, Quality of Life, PRAL, NEAP

ÖZ

Amaç: Bu çalışma; obez kadınların diyet asit yüklerinin belirlenmesi ve diyet asit yükü, antropometrik ölçümler ve yaşam kalitesi arasındaki ilişkinin incelenmesi amacıyla yürütülmüştür.

Yöntem: Çalışmaya beden kütle indeksi ≥30-<40 kg/m² arasında olan 140 gönüllü yetişkin birey dahil edildi. Bireylerin besin tüketim durumlarını ve diyet asit yükünü belirlemek amacıyla üç günlük (iki gün hafta içi, bir gün hafta sonu) besin tüketim kaydı alındı. Besin alımına dayanarak potansiyel renal asit yükü (PRAL) ve net endojen asit üretimi (NEAP) çeşitli algoritmalar kullanılarak hesaplandı. Yaşam kalitesinin belirlenebilmesi için Obezlere Özgü Yaşam Kalitesi Ölçeği kullanıldı. Vücut ağırlığı, boy uzunluğu, bel, kalça ve boyun çevresi araştırmacı tarafından ölçüldü.

Bulgular: Kadınların PRAL ve NEAP skorları obezite derecesi arttıkça artış gösterdi (p>0.05). Sigara kullanan obez kadınlarda PRAL skoru, sigara kullanmayanlardan yüksek bulundu (p<0.05). Kadınların vücut ağırlığı ile yaşam kalitesi arasında negatif yönlü bir ilişki bulundu (r=-0.234, p=0.005). Kadınların yaşam kalitesi, sosyo-ekonomik durumu ve konstipasyon durumları ile PRAL ve NEAP skorları arasında ilişki saptanmadı (p>0.05).

Sonuç: Bu çalışmada obezite derecesi arttıkça diyet asit yükü artış göstermiştir. Sigara kullanımı diyet asit yükünü artıran diğer bir neden olarak saptanmıştır. Ayrıca sosyo-ekonomik durum, kabızlık gibi faktörler de diyet asit yükünü etkilemektedir. Bireylerin obezite durumu arttıkça yaşam kalitesi düşmektedir. Bu nedenle obez bireylerde beslenme tedavisi planlanırken diyet asit yükünün değerlendirilmesine ve ağırlık kontrolüne dikkat edilmelidir.

Anahtar Kelimeler: Beslenme, Obezite, Yaşam Kalitesi, PRAL, NEAP

INTRODUCTION

Non-communicable diseases; including cardiovascular diseases, cancer, and diabetes mellitus, account for >70% of premature deaths worldwide. An important risk factor for non-communicable diseases is obesity. Depending on the degree of comorbid conditions, the decrease in the estimated life span of 5-20 years is associated with obesity [1]. According to the World Health Organization (WHO), obesity is defined as the condition in which excessive or abnormal fat accumulation increases health risks [2]. The global prevalance of obesity has increased significantly in the last 40 years, affecting all age groups, populations, and countries regardless of income level [3]. The World Obesity Atlas 2022 predicts that one billion people globally, including 1 in 5 women and 1 in 7 men, will be living with obesity by 2030 [4]. Obesity increases the risk of metabolic disease (type 2 diabetes mellitus and fatty liver disease), cardiovascular disease (hypertension, myocardial infarction, and stroke), musculoskeletal disease (osteoarthritis), Alzheimer's disease, depression, and some

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***Sorumlu yazar/Corresponding author:** Erciyes University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Kayseri, Turkey
[1*]Email: efsankonyaligil@gmail.com, [2]Email: bcicek@erciyes.edu.tr, [3]Email: tuba.tekin38@gmail.com, [4]Email: meltemunlusavuran@gmail.com

types of cancer (breast, ovarian, prostate, liver, kidney, and colon). In addition, obesity can lead to increased health expenditures, decreased quality of life, unemployment, low productivity, and social disadvantages [1,5].

Acid-base homeostasis and pH regulation are vital for normal physiology, cell metabolism, and function. Systemic acid-base balance is maintained between 7.36-7.44 by regulating arterial pH. Intracellular pH should be approximately 7.2. Intracellular and extracellular buffers act as a defense mechanism against changes in systemic pH [6]. Dietary components are essential determinants of the acid load and the kidney must excrete to maintain acid-base balance [7]. Diets rich in animal protein create acid and increase the net acid load of the diet. Diets rich in fruits and vegetables generate bicarbonate and reduce the net acid load of the diet. Therefore, vegetarian diets are considered alkaline and Western diets increase the acid load [7,8]. The body's acid-base balance is normalized with the administration of dietary interventions (lowering protein intake, increasing fruit and vegetable consumption) and dietary supplements (with magnesium or potassium salts). The acid load of the diet can be calculated with validated algorithms based on the acid or base-forming capacity of foods [8].

In epidemiological studies, two algorithms are used to estimate the dietary acid load. Potential renal acid load (PRAL) considers food ionic balance, protein metabolism in sulfate production, and intestinal absorption rates of protein, phosphorus, potassium, magnesium, and calcium. While a positive PRAL score indicates the acid formation potential, a negative score suggests the alkali formation potential [9]. Net endogenous acid production (NEAP) is determined to assess the effects of diet on acid-base metabolism. Quantification of NEAP is based on dietary protein and potassium intakes as the main determinants of endogenous acid production [10]. A high NEAP score is an indicator of increased consumption of animal protein. While the NEAP score of a typical Western diet is approximately 48 mEq/day, the NEAP score of a strict-moderate vegan diet was 15 mEq/day [11]. The relationship between dietary acid load and metabolic diseases has been examined in studies. Increasing dietary acid load leads to acid-base imbalance and increases the risk of metabolic diseases [12]. Studies have shown that increased dietary acid load is associated with an increased risk of cardiovascular disease, chronic kidney disease, insulin resistance, hypertension, and kidney stones [12-16]. A study stated that there might be a relationship between dietary acid load and non-alcoholic fatty liver disease [17]. Severe metabolic acidosis causes bone loss, however a consistent relationship was not detected between dietary acid load and bone mineral density [18]. Obesity is also known to be a risk factor for metabolic diseases. However, the health risk and physical pain that increase obesity can lead to poor health and decreased daily activities. This situation significantly affects the quality of life in obese patients [19].

The present study was conducted to determine the dietary acid load of obese women and to examine the relationship between dietary acid load, anthropometric measurements, and quality of life.

METHOD

Study Sample

This study was carried out in Erciyes University Health Application and Research Center Diet Polyclinic between June and September, 2019. One hundred and forty voluntary adult women with a body mass index (BMI) 30-<40 kg/m² were included. Patients with type 1 diabetes mellitus, gestational diabetes mellitus, cancer, systemic diseases (heart failure, liver or kidney disease or lung disease), including patients with hormone replacement therapy, major depressive disorder, severe acute or chronic infectious disease, and pregnant women, were excluded.

Ethical Approval

The study was reviewed by the Erciyes University Clinical Research Ethics Committee and was approved on 22/05/2019 with report number 96681246. Participants signed a written consent form indicating that they voluntarily participated in the study.

Determination of Food Consumption

A questionnaire form was prepared to determine the study participants' sociodemographic characteristics and nutritional habits. Food consumption records were taken in order to determine the food consumption status of the individuals for three consecutive days (two days on weekdays, one day on the weekend) by the researcher. With a three-day food consumption record, the amount of energy, macro, and micronutrients taken by individuals through diet was calculated by using the Nutrition Information Systems Package Program (BEBIS) [20].

Calculation of Dietary Acid Load

Dietary acid load is calculated with PRAL and NEAP scores. The PRAL [9] and NEAP [10] score were calculated using the following algorithms based on food intake records:

PRAL (mEq/d)=0.4888×dietary protein (g/d)+0.0366×dietary P (mg /d)−0.0205×dietary K (mg/d)−0.0125×Ca (mg/d)−0.0263×Mg (mg/d)

NEAP (mEq/d)={(54.5×protein intake (g/d)}/K intake (mEq/d)−10.2m

Anthropometric Measurements

The body weight was measured on an empty stomach in the morning, with light clothing and without shoes, with a TANITA BC 730 (TANITA Corporation, Japan) brand scale with a sensitivity of ± 0.10 kg. The height was measured in an upright position, with the head in the Frankfort plane, the feet adjacent to the heels, and the back, hips, and heels touching the wall. [21].

The BMI value in weight (kg) / height (m²) was calculated from the obtained body weights and height values. BMI values are divided into three categories in accordance with the classification criteria. These; were classified as normal weight (<25), overweight (25-30), obese (>30) [22]. The individuals' waist, hip, and neck circumferences were measured using a non-stretch measure. Waist circumference was found between the lowest rib bone and the crystalline and measured from the midpoint. Abdominal obesity was defined as waist circumference ≥88 cm and ≥102 cm for women and men, respectively [23].

The other hand, hip circumference was measured from the broadest point by standing on the side of the individual. The waist-to-hip ratio was calculated from the obtained waist and hip circumference values. A ratio of higher than 0.9 for males and 0.85 for females suggests abdominal obesity. Neck circumference was measured in an upright position, with head in the Frankfort plane, below the cricothyroid cartilage [21].

Determination of Quality of Life

The Obese-Specific Quality-of-Life Scale was used to determine the quality of life. The scale was developed by Patrick et al. [24]. The scale is a six-point Likert-type scale consisting of 17 questions. The scale is one-dimensional and has no sub-dimensions. The quality-of-life score is obtained by adding the scores of all questions. Using the formula, the obtained raw scores are converted into standardized scores between 0-100. As the total score from the scale approaches 0, the quality of life decreases, and the closer to 100, the higher the quality of life. The validity and reliability study of the scale was conducted by Gündüzoğlu et al. [25].

Statistical Analysis

The data obtained from the study were analyzed in a computer environment using SPSS (IBM SPSS Statistics 22.0) package program. Descriptive statistics of frequency distribution, minimum, maximum values, mean and standard deviation (SD) were used to define the sample. Before all data were analyzed, normality and homogeneity tests were carried out. Whether the data is normally distributed or not was determined by the Kolmogorov Smirnov test and its homogeneity by the One Way Anova test. The t-test was applied as a parametric test in normally distributed and homogeneous two-group data, depending on whether the group is independent or dependent. The Mann Whitney U test or Wilcoxon Paired Two-Sample Test, which are nonparametric tests, used two-group data that were not normally distributed. ANOVA was used for more than two groups in the categorized data, and Kruskal Wallis tests were used for non-normally distributed data. A value of p <0.05 was considered statistically significant.

RESULTS

General Characteristics and Nutritional Habits of Obese Women

Voluntary women (n=140) with BMI≥ 30-<40 kg/m² were included. The average age of the participants was 43.40±11.24 years. 81.4% of the women were married and 82.1% were housewives. When the educational status is examined, 54.3% of the women are primary school graduates, 10.0% are middle school graduates, and 18.6% are high school graduates. 52.1% of the participants had an additional systemic disease. The most common diseases among the participants are; endocrine and cardiovascular system diseases. 15.7% of the participants stated that they are smokers.

While the proportion of women with obese family members is 69.3%, the rate of women who are obese in childhood is 23.6%. 55.7% of the women are on a diet for weight loss. The rate of those who used a diet in line with the dietician's recommendation was 37.9%. 14.3% of the women determine the diet program by themselves. 55.7% of the participants skipped meals. Of those who skip meals, 45.7% skip lunch and 13.6% skip breakfast.

Anthropometric Measurements

While the mean weight of women was 88.25±11.99 kg; mean height is 158.47±6.57 cm. The mean BMI of the participants is 35.16±4.41 kg/m² (Table 1). When the obesity degrees of women are examined; 57.1% were 1st degree obese, 30.0% were 2nd degree obese, 12.9% were 3rd degree obese. The mean waist circumference is 107.47±10.89 cm, while the mean hip circumference is 121.19±11.03 cm (Table 1). The mean neck circumference is 37.74±2.14 cm. 77.1% of the women have a risky waist-to-hip ratio and 95% have a risky neck circumference. In addition, the neck circumference risk also carries a risk in terms of sleep apnea in 1.4% of obese women.

Table 1. Distribution of anthropometric measurements

Anthropometric Measurements	x̄±SD (n=140)
Body Weight (kg)	88.25 ± 11.99
Height (cm)	158.47 ± 6.57
BMI (kg/m²)	35.16 ± 4.41
Waist Circumference (cm)	107.47 ± 10.89
Hip Circumference (cm)	121.19 ± 11.03
Waist/hip ratio	0.88 ± 0.66
Neck Circumference (cm)	37.74 ± 2.14

Quality of Life Scores of Obese Women, PRAL and NEAP scores

PRAL and NEAP scores of obese women increased as the degree of obesity increased in 1st and 2nd degree obese individuals (p>0.05). As the degree of obesity increased, the quality of life decreased (p<0.05). The average quality-of-life scores of obese women was 48.61±19.92. The average PRAL and NEAP scores of obese women were determined as 6.11±17.04 and 52.90±22.77, respectively. The quality-of-life scores of obese women were evaluated according to their social life impact. The quality-of-life score of obese women whose social life was not affected was 58.20±17.01, the score of those who did not want to participate in any social activity was 36.22±26.77 (p <0.05). When the PRAL scores of obese smokers were examined, the PRAL score was 14.84±16.24, and the PRAL score of obese non-smokers was 4.49±16.75 (p<0.05). When the PRAL and NEAP scores were examined according to the condition of constipation, the PRAL (9.48±15.22) and NEAP (58.24±19.57) scores of the obese women with constipation were higher; the PRAL (6.34±15.45) and NEAP (52.45±22.42) scores of the non-constipated women were lower (p>0.05). The socioeconomic status of obese women was classified as poor, moderate, and good, and their quality-of-life scores, PRAL, and NEAP scores were compared. As the socioeconomic situation improved, the quality of life increased, and the PRAL and NEAP scores decreased. However, the relationship between socioeconomic status and quality-of-life scores, PRAL and NEAP scores was insignificant (p> 0.05).

Food Consumption of Obese Women

When the three-day food consumption records were evaluated, the daily energy was 1498.6 kcal (1122.2-1885.2 kcal). Daily carbohydrate intake was 162.7 g (119.8-222.5 g), protein intake was 51.5 g (38.3-69.1 g), fat intake was 62.4 g (45.9-82.8 g). The fiber intake was 19.6 g (12.9-26.9 g), and the dietary cholesterol intake was 275.2 mg (112.6-376.4 mg). When the dietary fatty acid pattern was examined; the polyunsaturated fatty acid intake was 13.3 g (7.1-20.3 g), the monounsaturated fatty acid intake was 20.7 g (14.6-26.7 g), the n-3 and n-6 fatty acid intakes were 1.1 g (0.8-1.7 g) and 12.0 g (6.1-17.3 g), respectively. When the daily mineral intakes were calculated; mean sodium intake was 3078.0 mg (2206.8-3920.3 mg), mean iron intake was 9.0 mg (6.2-12.1 mg), mean potassium intake was 1884.5 mg (1366.0-2491.9 mg), mean calcium intake was 606.1 mg (388.0-813.2 mg), mean magnesium intake was 217.5 mg (150.9-320.7 mg), mean phosphorus intake was 901.4 mg (651.4-1189.3 mg), respectively.

The Relationship Between the Quality of Life Scores, PRAL and NEAP Scores and Anthropometric Measurements

A statistically significant negative correlation was found between the quality-of-life score of obese women and body weight, hip circumference, and BMI values (p<0.05). There was no significant relationship between PRAL and NEAP scores and anthropometric measurements (p>0.05) (Table 2).

The Relationship Between the Body Weight, BMI and Waist Circumference and Nutrient Intakes

A significant negative correlation was found between the body weight of obese women and polyunsaturated fatty acid and n-6 fatty acid intakes (p<0.05). A significant negative correlation was found between BMI values of obese women and polyunsaturated fatty acid intakes (p<0.05). A significant positive correlation was found between waist circumference and carbohydrate (%) intakes (p<0.05). There was no significant relationship between the other nutrient intakes of obese women and anthropometric measurements (p>0.05) (Table 3).

DISCUSSION

The prevalence of obesity worldwide increases in both developed and developing countries. Large-scale, long-term epidemiological studies revealed that obesity increases the risk of dyslipidemia, type 2 diabetes mellitus, hypertension, coronary heart disease, stroke, gall-bladder disease, respiratory problems, sleep apnea, osteoarthritis, and some types of cancer [26]. Many non-communicable diseases such as obesity, diabetes, cardiovascular disease, and some cancers can be attributed mainly to modifiable lifestyle factors, including diet.

Changing dietary behavior can significantly reduce disease and mortality and prolong life expectancy [27]. Diet and dietary content can dramatically affect the body's acid-base balance [14]. Increased dietary acid load leads to increased sulfate, phosphorus, chloride, and calcium excretion in urine, intrarenal vasodilation, and glomerular filtration rate [28].

The high dietary acid load has been linked to cardiometabolic risk factor profiles such as insulin resistance, hypertension, large waist circumference, increased triglyceride, LDL- cholesterol levels, and type 2 diabetes.

Table 2. Quality of Life scores, PRAL and NEAP scores by degree of obesity

Variables	BMI Classification 1st Degree Obese (x̄±SD) (n=80)	2nd Degree Obese (x̄±SD) (n=43)	3rd Degree Obese (x̄±SD) (n=17)	p
QoL Score	51.76±18.70	48.25±19.66	34.74±21.27	0.005*
PRAL Score	5.97±18.00	6.77±18.56	5.15±10.56	0.941
NEAP Score	51.80±21.64	55.33±26.91	51.87±16.28	0.704

**p<0.05*

Table 3. The relationship between the Quality of Life scores, PRAL and NEAP scores and anthropometric measurements

Variables	Quality of Life Score r	p	Correlation PRAL Score r	p	NEAP Score r	p
Body Weight (kg)	-0.234	0.005*	-0.049	0.566	-0.006	0.947
Height (cm)	-0.015	0.860	-0.063	0.457	-0.049	0.567
Waist Circumference (cm)	-0.097	0.253	-0.071	0.404	0.027	0.755
Hip Circumference (cm)	-0.267	0.001*	-0.149	0.079	-0.057	0.503
Waist / Hip Ratio	0.190	0.025*	0.079	0.352	0.104	0.221
Neck Circumference (cm)	-0.099	0.245	-0.150	0.076	-0.150	0.076
BMI (kg/m^2)	-0.263	0.002*	-0.020	0.818	0.019	0.827

**p<0.05*

Based on current evidence, the high dietary acid load may impact other chronic diseases such as cardiovascular disease and cancer, leading causes of death [27]. This study investigated the relationship between dietary acid load and anthropometric measurements and quality of life in obese women.

Obesity is linked to the quality of life. As obesity increased according to the BMI classification, pain, limitation in social life, decreased life expectancy, and mental health deterioration were observed in the USA and Western European countries. A study found that as the degree of obesity increases, the quality-of-life decreases [19]. In a study conducted with adult individuals, statistical significance between waist circumference and health-related quality of life was detected higher than BMI [29]. In the current study, which was conducted in parallel with the literature, it was observed that the quality of life decreased as the body weight and BMI values of women increased.

In the current study, the PRAL and NEAP scores of women increased as the degree of obesity increased (in 1st and 2nd-degree obese individuals), however this result was not significant. The PRAL score in obese smokers was significantly higher than the obese non-smokers. In a study examining the relationship between dietary acid load and cardiometabolic risk, while a significant relationship was found between PRAL quartile values and BMI values and waist circumference measurements in women, no relationship was found between smoking [30]. In another study, NEAP scores were positively correlated with obesity status and smoking in individuals of both sexes [31]. In the study examining dietary acid load in Japanese women; while there was a significant relationship between dietary acid load and waist circumference measurements, no association was found between BMI and smoking status [32]. In the study examining net acid excretion from kidneys in healthy children, no significant difference was found in BMI in children with low and high net acid excretion from the kidneys [33]. In a study conducted in the United States, women with high NEAP scores have higher BMI values, lower physical activities, and lower alcohol, folate, and magnesium intakes [34].

Regarding BMI, the lowest values were observed in the highest PRAL value in a study involving adult individuals, but the results were insignificant. While there was a significant relationship between the quarter values of PRAL and smoking and economic status, there was no important relationship between physical activity level. When their dietary intake was examined, participants with the lowest PRAL values consumed the highest potassium and dairy products, and it was observed that participants with the highest PRAL value consumed more meat and meat products [35]. When analyzed according to PRAL quartiles in the Tehran Lipid and Glucose Study, a significant relationship was found between BMI, waist circumference, and abdominal obesity. When dietary intake is examined, as the PRAL score increases, the carbohydrate intake decreases, and the percentage of fat and protein intake increases. In addition, as the PRAL score increased, calcium, potassium, and magnesium intake decreased [36]. In the studies conducted, no significant relationship was found between the quartiles of the BMI and PRAL [14,15,37] and NEAP [15,38,39] scores. In some studies, the highest BMI was found in the lowest PRAL quartile [40-42]. Some studies found the lowest BMI in the highest PRAL quartile [30,36,43].

Different results have been obtained in the literature regarding the relationship between PRAL and NEAP scores and anthropometric measurements. In this study, PRAL and NEAP scores of obese women increased as the degree of obesity increased. The PRAL score in obese smoking women was significantly higher than non-smoking obese women. In addition, the quality of life, socioeconomic status, and constipation of obese women were evaluated and compared with PRAL and NEAP scores. However, meaningful results were not obtained. Including obese individuals as the sample group is vitalin showing the relationship between obesity and dietary acid load.

The present study has some limitations. First, the sample size is not large enough to represent all obese individuals. Second, individuals of two-day food consumption record were filled out through telephone interviews.

CONCLUSION

The increasing global prevalence of obesity affects all countries, regardless of age groups, populations, and income levels. Obesity increases the risk of metabolic, cardiovascular, musculoskeletal diseases. Western diet contributes to the increase of obesity prevalence. In addition, Western diets are accepted as diets that increase the acid load. Increasing dietary acid load leads to acid-base imbalance and increases the risk of metabolic diseases. As the degree of obesity increased in this study, the dietary acid load increased. Smoking is another reason that increases dietary acid load. In addition, as the obesity condition increased, a decrease in the quality of life was observed in the study. Therefore, it will be beneficial to evaluate dietary acid load and weight control when planning nutritional therapy in obese individuals. Lifestyle, socioeconomic status, cigarette, and alcohol consumption should also be considered in assessing dietary acid load

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