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Original article

The Relationship Between Diet Quality And Body Weight Management In Pre-Obese And Obese Women

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Summary. *Objectives:* The aim of this study was to investigate the relationships between "KIDMED, Mediterranean Diet Quality Index", "Diet Quality Index International (DQI-I)" scales and Body Mass Index (BMI), body fat percentage, biochemical parameters of preobese and obese women. *Methods:* This descriptive and cross-sectional study was conducted on 125 participants who applied to Fırat University Hospital Nutrition and Diet Policlinic between 11 April 2019 and 31 May 2019 in Elazıg/Turkey. Nutritional habits were evaluated with KIDMED and DQI-I. Food frequency questionare was used to collect data on dietary patterns. Chi-square test, T-test, ANOVA were used to analyze data. Scheffe or Tamhane tests were used in the binary comparisons of the groups. Pearson Correlation was used to evaluate the relation of quantitative variables with each other. *Results:* The mean age of the participants was 39,09±14,36 (min 19- max 69) years and %52 (n:65) were pre-obese and % 48 (n:60) were obese according to BMI. Mean scores of KIDMED and DQI-I of pre-obeses were significantly higher than obeses. BMI, body fat percentage, total cholesterol level were inversely associated with both DQI-I and KIDMED. The relationship between total cholesterol level and dietary total fat, saturated fat, cholesterol, empty calorie food, and fatty acid ratio scores was negatively significant for each component. *Conclusion:* The majority of pre-obese people were in the good and average categories of KIDMED, while the obese were mostly in the average and poor categories.The relationship between BMI and DQI-I total score was stronger than KIDMED.

Key words: Diet quality, Mediternean diet, Obesity, Body fat, Nutritional behaviours

Introduction

Obesity is one of the major global public health problems and it leads morbidity and mortality. It causes various physical disabilities and psychological problems and increases the risk of non communicable disease that are diabetes, cardiovascular disease, and cancer. The risk of developing co-morbidity also increases with obesity (1).

Also obesity is related to increased cell hypoxia and impaired insulin sensitivity (2). Adipose tissue stores energy in the form of fat, and that is accepted as an endocrine organ and it also secretes signaling molecules and hormones (3).

Adipose tissue is more concentrated in subcutaneous tissue in women and visceral fat tissue in men (4). Globally, women have a greater risk of obesity-related conditions, as the prevalence of obesity is higher in women than in men (5).

Disparity of gender in obesity increase its complications' risks. The most common co-morbidities related to obesity are cardiovascular disease, type 2 diabetes mellitus, metabolic syndrome, infertility, polycystic ovarian syndrome, obesity-related disorders in pregnancy and breastfeeding problems, ovarian cancer, breast cancer, eating disorders, depression (6). Data obtained from the Turkish Health Study shows that obesity affects both men and women across all ages,

particularly obesity is more common among women than men in Turkey. When the Body Mass Index (BMI) is examined; while the proportion of obese individuals aged 15 and over was 19.6% in 2016, it was 21.1% in 2019. According to gender; In 2019, 24.8% of women were obese and 30.4% were pre-obese, 17.3% of men were obese and 39.7% were pre-obese (7).

Obesity among women of reproductive age effects the intergenerational transmission of obesity from mother to child. In patients who gain weight due to age or medication use, lifestyle interventions and pharmacologic options might be useful for weight loss (8).

Genetic, physiological, neurological, biochemical, psychological, socio-cultural, environmental factors, sedentary lifestyle and over-eating are the contributers of obesity (9).

Diet is the most important modifiable contributor of obesity. Dietary quality means that the diet has an effect on reducing the risk for non comunicable diseases (NCD) (9,10). Personal lifestyle modification helps people strategies to control the external food environment (11). Diet, physical activity, stress, sleep and circadian rhythm are various components of the lifestyle and can adversely affect energy regulation (12). "Diet quality/dietary quality indices" are the tools to evaluate diet quality in a population and evaluates the level of adherence to recommendations or predicts the risk for diet related NCD. Thus, diet quality indices have been ameliorated for nutrition researches (13).

"Diet Quality Index International (DQI-I)" was ameliorated by Kim et al. (14) to compare dietary quality between populations that have different nutritional behaviours. DQI-I focuses on concerns about chronic diseases as well as undernutrition problems. It is an international tool to monitor the health of the diet and evaluates aspects of diet quality related to changes in nutrition. DQI-I was first applied to the United States and China and it is a high-quality, healthy diet covering the nutritional habits of both developed and developing countries in four categories; variety, adequacy, moderation and overall balance. The scores for each components are summarized for each of the four main categories, and DQI-I score is obtained by the sum of scores for four categories.

Rates of chronic disease morbidity is lower in mediterranean countries and also lifespan is higher. Adherence to the Traditional Mediterranean diet is related to lower risk for diabetes mellitus, myocardial infarct, breast and colorectal and prostate cancers, and pathologies that are associated with oxidative stress. The specific features of the traditional Mediterranean diet are high intake of vegetables, fruits, whole-grain cereals and breads, nuts, legumes. These foods are consumed in season and mostly fresh, little or no processed foods. Olive oil is the special dietary element of mediterranean diet. Meat intake is a few times per month also lamb, poultry, rabbit or fish consumptions are greater. Eggs are consumed a few times per week. Moderate wine consumption is the characteristic for Mediterranean diet model. Serra-Majem et al. developed "KIDMED, Mediterranean Diet Quality Index" to evaluate the adequacy of Mediterranean dietary patterns, and it consists total of 16 questions (15).

The aim of this study was to investigate the relationships between "KIDMED, Mediterranean Diet Quality Index", "Diet Quality Index International (DQI-I)" scales and Body Mass Index (BMI), body ve

Material and Methods

Subjects and Study design

The population of this descriptive, cross-sectional study is the pre-obese and obese women who applied to Fırat University Hospital Nutrition and Diet Policlinic between 11 April 2019 and 31 May 2019. The sample size, was calculated according to the study of Kontogianni et al. (16) and the effect size was obtained for pre-obese and obese classification as 0.453. This effect size is 80% with a minimum sample size of 124 and a minimum error of 0.050. The sample was determined by simple random sampling method. All of the sample selected from the population has been reached. The sample of the study consists of 65 (52.0 %) pre-obese and 60 (48.0 %) obese women with a mean age of 39,09±14,36 years (min 39- max 69 years). The exclusion criteria were; those with communication difficulties or diagnosed with cancer or pregnancy. The cohort consisted of from the master's thesis entitled "Evaluation of the relationship between body mass

index and mediterranean diet quality index and diet quality scale in pre-obese and obese women" (17).

Information about the socio-demographic characteristics of the participants and all other data of the research were obtained through face-to-face interview method.

This study was found appropriate by the Ethics Committee of Fırat University Faculty of Medicine Hospital (Date: 11.04.2019, Number: 25-06) and investigated under the guidance of the Declaration of Helsinki.

Anthropometric measurements

Measurements were performed by trained researcher. Height was measured to the nearest 0.5 cm using a stadiometer. Body weight was measured to the nearest 0.1 kg using an electronic scale and body fat percentage was obtained by the Bioelectrical Impedance Analysis (BIA) (Tanita SC 330). BMI (kg/m^2) was calculated as weight (kg) divided by squared height (m^2).

The participants were divided into pre-obese (BMI 25.0-29.9 kg/m^2) and obese (BMI≥30.0 kg/m^2) groups according to the World Health Organization (WHO) BMI classification.

Biochemical parameters

Serum glucose, aspartate aminotransferaze (AST), alanine aminotransferaze (ALT), total cholesterol, low density lipoprotein (LDL)-cholesterol, high density (HDL)- cholesterol, trigliserid were analyzed in the laboratuary of Fırat University Faculty of Medicine Hospital based in Elazıg, Turkey.

Dietary assessment

Groups of age divided into four groups (19-30, 31-50, 51-70 ve >70 year) according to Dietary Reference Intake (DRI) (18).

The Harokopio Food Frequency Questionnaire was used to collect data on dietary patterns. It is a semi-quantitative Food Frequency Questionnaire (FFQ) that contains 69 questions about the frequency of consumption of all main food groups and beverages consumed and 7 questions about eating behavior (19).

Data determining nutritional habits were evaluated with KIDMED (15) and DQI-I (14) by the Harokopio Food Frequency Questionaire (FFQ). Data were analyzed using the BeBiS (Nutritional Information System) 7.1 package program. Calculated nutritional values were evaluated according to the proposed DRI by gender and age (18).

KIDMED, Mediterranean Diet Quality Index

Serra-Majem et al. (2004) (15) developed KIDMED, Mediterranean Diet Quality Index. Index consists 16 questions and total score of the index ranges from 0 to 12 . Questions reporting a negative adherence to the Mediterranean diet were assigned a value of -1, and those with a positive assigned a value of +1. The sums of the values were classified into three levels: (1) good ≥8, optimal Mediterranean diet; (2) average 4–7, improvement needed to adjust intake to Mediterranean patterns; (3) poor ≤3, very low diet quality.

The Diet Quality Index-International (DQI-I)

The Diet Quality Index-International (DQI-I) was developed by Kim et al. (2003) (14). Total DQI-I score ranges from 0 to 100 points. The DQI-I evaluates categories: variety: variety of all food group (0–15 points); withingroup variety of protein source (0–5 points); adequacy: protein, cereals, fruits, vegetables, iron, vitamin C, calcium, fibre, (0–5 points each); moderation: empty-energy foods, cholesterol, total fat, saturated fatty acid, sodium, (0–6 points each); overall balance: ratio of macronutrients (carbohydrate: protein: fat, 0–6 points); ratio of fatty acid (Poliunsaturated fatty acid (PUFA): Monounsaturated fatty acid (MUFA): Saturated fatty acid (SFA), 0–4 points).

Statistical analysis

Data analysis was evaluated with the IBM SPSS (Statistical Package for Social Sciences) Statistics Version 22.0 package program. Descriptive statistics of qualitative variables are expressed in frequency and percentage, while descriptive statistics of quantitative variables are expressed as mean and standard deviation.

Chi-square test was used to compare qualitative variables between groups. In comparing the means of quantitative variables between the two groups, t-test was used in independent groups. One-way analysis of variance (ANOVA) was used to compare the quantitative variable averages of more than two groups. If there was a difference in the general comparison of the quantitative variable averages of more than two groups, Scheffe or Tamhane tests were used in the binary comparisons of the groups according to whether the variances in the group were homogeneous or not. In evaluating the relation of quantitative variables with each other, Pearson Correlation coefficient and related p value were obtained. Statistical significance level was as 0.05 in all tests.

Results

Table 1 shows that the comparison of age, BMI, body fat percentage (%), biochemical findings, daily intakes of energy and macronutrients, saturated and polyunsaturated and monounsaturated fatty acids, cholesterol and fiber according to BMI. Mean age, BMI, body fat percentage, serum cholesterol of obese group were significantly higher than pre-obese group ($p<0,001$). Energy, carbonhydrate %, fat %, saturated fatty acid, diet cholesterol contents of diet in obese group were significantly higher than pre-obese group ($p<0,001$). PUFA and fiber consumption of pre-obese group were significantly higher than obese group ($p<0,001$).

The mean KIDMED score of the pre-obese women (6.29 ± 1.94) is significantly higher than obese (3.83 ± 1.76) ($p<0.001$). The mean KIDMED score of the participants was significantly different with respect to age groups ($p = 0.036$); 19-30 years old group had the highest (5.76 ± 2.08), 31-50 years had the lowest score (4.58 ± 2.16), 51-70 years old groups' KIDMED mean score was 5.17 ± 2.36. There was no statistically significant difference in mean KIDMED scores by educational status or presence of disease.

The KIDMED quality classification was not similar in pre-obese and obese groups. According to the KIDMED quality classification, it was determined that the majority of pre-obese women were catogorized in the good and avereage categories, while obese women were mostly in the average and poor categories. According to other demographic characteristics (age, educational background, comorbidities), the ratio distribution of KIDMED quality classification is similar (Table 2).

Table 3 shows the relationship between the mean values of biochemical findings (glucose, cholesterol, triglyceride, HDL, LDL, ALT and AST) and KIDMED score. The relationship between other cholesterol and KIDMED score was statistically significant ($p=0.001$). There was a negative relationship between serum total cholesterol level and KIDMED score.

Mean total score of the DQI-I and the mean score of its' components (variety, adequacy, moderation, overall balance) were statistically significant in pre-obese and obese women. The mean score of the variety, adequacy, moderation, overall balance components of pre-obese women was higher than obese women ($p<0.05$).

There was no statistically significant difference in the total score of DQI-I and the mean scores of variety, adequacy, overall balance according to the educational status ($p>0.05$). The mean score of moderation was statistically significant according to the educational level. As the education level increased, moderation score increased. Those with the highest moderation score were university / postgraduate graduate women (Table 4).

Table 5 shows the relationship between total fat, saturated fat, cholesterol, empty energy foods, fatty acid ratio and fiber score of the DQI-I and biochemical findings. The relationship between serum cholesterol level and dietary total fat ($r=-0,533$, $p<0,001$), saturated fat ($r=-0,255$, $p=0,004$), cholesterol ($r=-0,346$, $p<0,001$), empty calorie food ($r=-0,329$, $p<0,001$), and fatty acid ratio scores ($r=-0,264$, $p=0,003$) was negatively significant for each component. There was no relationship between other biochemical analyzes (Triglyceride, HDL, LDL, ALT and AST) and DQI-I components ($p>0.05$).

Body fat percentage was inversely associated with both DQI-I total and KIDMED score. There was inversely significant relationship between BMI and both of KIDMED and DQI-I scores. The relationship between BMI and DQI-I total score was stronger than KIDMED. In addition, the relationship between

KIDMED and DQI-I scores was positively significant and moderately strong (Table 6).

Discussion

One of the most important variables that can be modified in the prevention of obesity is diet, and diet quality can also reduce the risk of non-communicable diseases (13). Mediterranean Diet is the most convenient diet style for the prevention of diseases, a lifestyle plan of healthcare sustainability (20) that is rich in olive oil, legumes, vegetables, fruits and cereals, low consumption of red meat, moderate red wine consumption, and it has been shown to be beneficial influences to longevity and cardiovascular diseases, blood pressure, lipid metabolism, and overweight (21,22).

Consuming high mounts of vegetables and fruits, which characterizes mediternean diet, diet provides much more antioxidants that inhibit oxidation of LDL-C, increase HDL-C, and reduce total cholesterol concentrations (23,24). A study conducted by Rogerson et al. (25) showed that after following a four-week of Vegeterian diet and Mediternean diet, Vegeterian diet provided to decrease in Total-C and weight loss, and that the Mediternean Diet related to improvements in microvascular function and Nitric Oxide (NO) bioavailability in a healthy sedentary population. In the current study, there was a negative relationship between total cholesterol level and KIDMED score, higher KIDMED score was associated with lower total cholesterol level. The relationship between glucose, cholesterol, triglyceride, HDL, LDL, ALT, AST and KIDMED score was not statistically significant. In addition, there was a negative significant relationship between each components' of DQI-I (dietary total fat, saturated fat, cholesterol, empty calorie food, and fatty acid ratio) and total cholesterol levels. There was no relationship between other biochemical analyzes (Triglyceride, HDL, LDL, ALT and AST) and DQI-I components. The Dietary Approaches to Stop Hypertension (DASH) dietary pattern, that accentuates vegetables, fruit, fat-free or low-fat dairy products, legumes, whole grains, nuts, and limits red and processed meats, cholesterol, saturated fat, sweets and added sugars, sugar-sweetened beverages, salt. International diabetes and heart association guidelines suggests DASH dietary model (26). Similarly Chiavaroli et al. (2019) informed that the DASH dietary pattern was found to lower Total-C and LDL-C with no significant effects on HDL-C or triglycerides (27).

Mean total score of the DQI-I and the mean score of its 'components (variety, adequacy, moderation, overall balance) were statistically significant in pre-obese and obese women. The mean score of the variety, adequacy, moderation, overall balance components of pre-obese women was higher than obese women. In the cross-sectional study that was conducted by Gregory et al. (28), dietary, anthropometric, demographic and cardio-metabolic risk factor data obtained from adults. DQI-I was positively associated with BMI in both women and men. Similarly, in the Nurses' Health Study, Fung et al. (29) reported that higher dependence to the DQI-R was inversely associated with BMI. Quatromoni et al. (30) investigated that dietary quality through DQI, they showed that DQI was related to weight change in adults and reported an inverse, linear association between better dependence to DQI and lower weight gain and higher scores was associated with lower BMI among female group. Lassale et al. (31) assessed the associations of dietary scores through DQI-I for 13 years and associations were not statistically significant among women, the associations of the dietary scores with weight change were not strong.

Asghari et al. (32) investigated the associations between the Healthy Eating Index-2005, (HEI-2005), Mediterranean Diet Scale (MDS) and DQI-I with BMI and none of the indices had significant associations with BMI.

In the current study, the relationship between BMI and DQI-I total score was stronger than KIDMED. The mean KIDMED score of the pre-obese women is significantly higher than obese. The KIDMED quality classification was not similar in pre-obese and obese groups. According to the KIDMED quality classification, it was determined that the majority of pre-obese women were conglomerated in the good and avereage categories, while obese women were mostly in the average and poor categories. The relationship between BMI and DQI-I total score was stronger than KIDMED.

In studies conducted with adults, compliance with the Mediterranean diet has been associated with a lower risk of obesity (33,34). Romaguera et al. (35) searched that the compliance to the Mediterranean diet is associated with prospective weight change, and the incidence of obesity or overweight. They reported that Mediternean diet had beneficial effect to avoid weight gain and obesity.

While classification is made according to BMI in adults, those with BMI 25–29.9 kg/m^2 are defined as pre-obese and those with BMI ≥30 kg/m^2 are defined as obese (36). There is no consensus for the definition of obesity based on body fat percentage (37). Ortega et al. (38) reported that high body fat percentage was associated with higher risk of cardiovascular disease mortality and all-cause mortality.

In the current study, body fat percentage was inversely associated with both DQI-I total and KIDMED score There was inversely significant relationship between BMI and both of KIDMED and DQI-I scores. The relationship between BMI and DQI-I total score was stronger than KIDMED. In addition, the relationship between KIDMED and DQI-I scores was positively significant and moderately strong.

Conclusions

In conclusion, some components of diet quality are associated with BMI classification. There is no enough evidence that any single life style behaviour is enough to provide weight loss or weight maintenance. Self-monitoring by recording food intake or exercise can help patients to understand their own behaviours and provides a to sustainable behavior or /and lifestyle change. Obese people need to know that they need to eat healthier and exercise more to maintain their body weight. The success is to catch healty behavioral and nutritional strategies.

Authorship: Irem Dagoglu: Constructing an idea or hypothesis for research and/or manuscript, providing personnel, tools and place that are vital for the project, Taking responsibility in the construction of the whole or body of the manuscript, Taking responsibility in logical interpretation and presentation of the results, making statistical analyze, writing– original draft preparation. **Ozlem Persil-Ozkan:** Taking responsibility in logical interpretation and presentation of the results, constructing an idea or hypothesis for research and/or manuscript, Organizing and supervising the course of the project or the article and taking the responsibility. Planning methodology to reach the conclusion**,** taking responsibility in this necessary function, Organizing, and supervising the course of the project or the article and taking the responsibility, writing – review and editing.

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