Progress in Nutrition 2019; Vol. 21, N. 2: 347-355 DOI: 10.23751/pn.v21i2.7689

Original article

Comparison of dietary quality (Healthy Eating Index-2010) according to metabolic health status in obesity: a cross-sectional study

Murat Açik[1], Funda Pınar Çakiroğlu[1]
[1]Ankara University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Ankara, Turkey
E-mail: acikm@ankara.edu.tr

Summary. *Objectives:* The aim of the study is to compare dietary quality between metabolically healthy obese (MHO) and unhealthy obese (MUO) individuals. *Methods:* This study was conducted with 67 MHO and 70 MUO participants who consulted the obesity clinic of Adıyaman's Community Health Centre. Data for the study were collected via questionnaire forms by face-to-face interview. The questionnaire form includes socio-demographic characteristics, anthropometric measurements, certain biochemical findings, and dietary intake record with the 24-hour recall method.*Results:* The mean age of the MHO and MUO participants are 39.2±8.7 and 46.5±10.1, respectively. The mean healthy eating index-2010 (HEI-2010) scores of the MHO and MUO participants are 49.0±10.4 and 47.3±8.4, respectively ($p>0.05$). In addition, the scores on "dairy", "empty calories" and "refined grains" were found to be higher in the MHO participants when compared to their counterparts and the difference between the scores is statistically significant ($p<0.05$). Although higher score of HEI-2010 was not associated with metabolic health among the obese subjects (OR 1.55, 95% CI 0.68-3.53, p=0.204), high dairy and low refined grains intake was associated with metabolic health (OR 2.98, 95% CI 0.57-3.06, p=0.035; OR 3.23, 95% CI 1.27-8.21, p=0.014, respectively).*Conclusions:* It is considered that increasing consumption of dairy products and reducing the intakes of refined grains may provide a protective effect in terms of cardiometabolic risk factors. However, there needs to conduct longitudinal follow-up cohort and clinical studies to investigate the efficacy of nutrients and food groups on cardiometabolic health despite increased fat mass.

Key words: cardiometabolic risk, healthy eating index-2010 (HEI-2010), metabolically healthy obese (MHO), obesity

Introduction

Obesity rates have been doubled worldwide since 1980 and it is estimated that more than 650 million people are obese according to WHO's (World Health Organization) 2016 data. It is also predicted that while the burden of diabetes is 44% higher in mildly obese and obese individuals, the burden of ischemic heart diseases is 23% higher in these people. Nevertheless, each obese individual experiences the development of any metabolic disorder in a different way (1). While most obese individuals have complications such as diabetes, hypertension, or dyslipidaemia, others do not have such complications despite similar fat mass and age. Metabolically healthy and unhealthy obese phenotypes have been defined since 1982 according to cardiometabolic status (2).

It is critical to consider cut-off values of each parameter used in the health status-oriented obesity classification to make it clear whether metabolically healthy obese (MHO) individuals are indeed healthy. However, these parameters and cut-off values may differ in studies (3). It can be stated that MHO individuals are less likely to have atherosclerotic lesion formation (4), cardiovascular diseases (5), and Type II DM incidence (6) when compared to MUO counterparts. Visceral adiposity, inflammation activity, liver steatosis, and macrophage-specific T-cells are lower in the healthy obese than the unhealthy obese (7). Moreover, adiponectin level, mitochondrial function, aerobic fitness, and the incretin response to nutrients are better in healthy obese subjects (8-10).

It is first necessary to lose weight by changing one's lifestyle in the treatment of obesity. This causes an increase in insulin sensitivity thanks to a decrease in adipose tissue and affects the metabolic healthy positively (11-13). A short-term intervention study with energy restriction revealed that the unhealthy obese could switch to the healthy phenotype. However, there is still no consensus on the long-term intervention (7). In recent years, obesity has been considered as a new concept or strategy that can prevent many metabolic disorders and related mortalities thanks to the dietary quality emerged from the principle of adequate and balanced nutrition (14, 15). Yet, studies on the efficacy of dietary composition on metabolic health status despite increased fat accumulation are both limited and inconsistent (8, 16, 17). The aim of this study is to compare the dietary quality of MHO and MUO individuals obtained with the calculation of the components of the healthy eating index-2010 (HEI-2010) and total score.

Methods

Ethical approval and samples size calculation

This study was carried out in the obesity clinic of between February 27 and April 21, 2017. This study was conducted on a voluntary basis in accordance with the regulations set out in the Declaration of Helsinki (as revised in Brazil 2013) and all the procedures were agreed by the participants. In addition, an approval was obtained from Human Ethics Committee for Non-Clinical Research for the present study (Approved no. 85434274-050.04.04/2152). The reporting of this work is compliant with STROBE guidelines. The power analysis for this study was performed using the results of the average HEI-2005 scores of each group in the study on MHO and MUO individuals (16). The minimum sample size for the statistical evaluation of the data obtained from the study; it was determined that 67 individuals for each group was necessary according to G*Power 3.1.9.2 package program with 0.80 power, α=0.05 error level and effect size d=0.43.

Study design

The study was conducted with the individuals who consulted the clinic during the morning hours, met the inclusion criteria, and signed the voluntary consent form. In the preliminary interview, it was regarded that the participants were present in the clinic for the first time and did not lose more than 5% of their body weight over the last 6 months. In addition, it was regarded that participants were between 20-64 years and had at least 30.0 kg/m^2 body mass index (BMI) (BMI=body weight (kg)/height x height (m^2)), It was also considered that the participants did not have any psychiatric disorders, neurological diseases, other diseases causing obesity such as diabetic diseases, hypothalamus diseases, adrenal gland diseases, and genetic diseases such as Prader Willi, Leprechanism, and Rabson-Mendenhall syndrome. Individuals who do not fulfil these criteria were excluded from the study.

Venous blood samples were taken from voluntary participants after an 8-12 hour fasting and their analysis was conducted at the same centre. Blood pressure measurement was performed three times by taking systolic (SBP) and diastolic (DBP) blood pressure. In addition, participants' socio-demographic data and dietary intake record were obtained with a questionnaire form and the face-to-face interview technique.

Body composition measurements

Body weights of the participants were measured with a portable Tanita BC 545 N sensitive to 0.05 kg. For the measurement, the participants had to avoid heavy physical activity 24-48 hours prior to the measurement and alcohol 24 hours before. Moreover, they had to eat at least two hours before and avoid drinking too much water and consumption of other beverages 4 hours before the test. They also had to avoid wearing metal jewellery and cardiac pacemaker. Their body weights were measured with light clothes and with-out shoes. The obtained data was recorded as a whole number (18).

Body height was measured using a stadiometer. This measurement was done in centimetres from the highest point of the head to the floor in a standing upright position with heels, back, shoulders and back of the head all touching the wall. The participants had to take off their shoes for this measurement (18).

Blood pressure measurement and biochemical analysis

Participants' blood pressure measurements were made by the researcher 3 times at 20-minute intervals with a Medisana MTC 51134 digital blood pressure monitor, and the final 2 values were averaged to determine the values of SBP and DBP (19).

Blood samples from participants were incubated for approximately 25-30 minutes at room temperature in biochemical tubes, then cooled and centrifuged at 4000 rpm at + 4°C for 10 minutes. Serum samples obtained after centrifugation were taken in microcentrifuge tubes for biochemical analyses, incubated at -20°C, and then stored at -20°C until the measurement. Fasting blood glucose (FBG), triglyceride (TG) and high-density lipoprotein (HDL) -cholesterol levels were measured from the blood samples.

Dietary intake assessment

Dietary intakes of the participants were recorded in a weekday on a 1-day retrospective basis with the 24-hour recall method. A catalogue of dishes and foods were utilized to determine measures and amounts. The participants were asked the amount of food they consume in a serving to make calculations. Non-domestic foods were calculated using their standard recipes (20). Average energy and macro- and micronutrient values of the foods were calculated by the Nutrition Information System (BEBIS 7.1).

Calculation of Healthy Eating Index-2010

The Healthy Eating Index is a tool that assesses diet quality in terms of adherence to the Dietary Guidelines for Americans which is a basis for the US nutrition policy. HEI-2010 consists of 12 components. These components are based on daily recommended intake amounts per 1000 calories. While those who consume total fruit (daily intake ≥0.8 cup, maximum score=5), whole fruit (daily intake ≥0.4 cup, maximum score=5), total vegetables (daily intake ≥1.1 cup, maximum score=5), greens and beans (daily intake ≥0.2 cup, maximum score=5), total protein foods (daily intake ≥2.5 oz, maximum score=5), seafood and plant proteins (daily intake ≥0.8 oz, maximum score= 5), dairy products (daily intake ≥1.3 cup, maximum score=10), whole grains (daily intake ≥1.5 oz, maximum score=10), and fatty acids (PUFAs + MUFAs)/SFAs>2.5, maximum score=10) in daily recommended amounts or above get the maximum score, those who remain under the recommended amounts are scored in a proportionally declining manner based on the maximum score. On the other hand, An inverse proportion scoring is made between the threshold values given for maximum and minimum scores to calculate the score on refined grains (daily intake ≤1.8 oz maximum score=10, daily intake >4.3 oz minimum score=0), sodium (daily intake ≤1.1 g maximum score=10, daily intake >2.0 g minimum score=0) and empty calories from solid fats, alcoholic beverages and added sugar (calories ≤19% of total calories, maximum score=20; calories ≥50% of total calories, minimum score=0) (21).

Determination of metabolic health status

MUO was defined as 2 or more cardiometabolic risk factors: triglycerides ≥150 mg/dL or on cholesterol medication, HDL-C <40 mg/dL for men, <50 mg/dL for women or on cholesterol medication, blood pressure ≥130/85mmHg or on blood pressure medication, and fasting glucose ≥100mg/dL or glucose/insulin medication. MHO was defined as having 0 or 1 abnormal cardiometabolic risk factors (9).

Statistical analysis

Statistical analysis was conducted using SPSS 21.0 version (SPSS, Chicago, II, USA). The Kolmogrov-Smirnov test was performed to determine whether continuous variables displayed a normal distribution. If the values did not display a normal distribution: the results were shown as mean±sd, median and 25-75th. Mann-Whitney U test was used to assess the mean between MHO and MUO groups which did not display a normal distribution. If continuous variables were normally distributed, values were expressed as mean±sd and median and independent-t test was used to assess statistically significance between MHO and MUO groups. Categorical variables were expressed as percentages and differences in categorical variables between MHO and MUO groups were compared using chi-square analyses. Multivariate logistic regression analysis was performed including age, gender, BMI and physical activity level as confounding factors. While total HEI-2010 score and the scores on "dairy" were taken into 3rd quartile, the scores on "refined grains" were taken into 2nd quartile since approximately half of the participants received zero in this component. Most participants got the maximum score on "empty calories" and the minimum score on the component of "seafood and plant protein". Therefore, the multivariate logistic regression analysis was not able to be performed. The results were evaluated at a 95% confidence interval and the values with p <0.05 were accepted as significant (22).

Results

There were 107 (78.1%) female and 30 (21.9%) male participants in the study. It was found out that 5 of the MHO participants (7.5%) and 14 of the MUO participants (20.0%) are illiterate. It was determined that MHO participants have better educational status than their MUO counterparts, and the difference is statistically significant (p=0.004). While 43 (64.2%) of the MHO participants do not have any disorders, 47 (67.1%) of the MUO participants have one or more disorders. 10 (14.9%) MHO and 12 (17.1%) MUO participants were found to smoke (p>0.05). Mean BMI values of the MHO participants were found be statistically lower than that of the MUO participants (p<0.001). While 43 (64.2%) of the MHO individuals had minimal level of physical activity, 41 (58.6%) of the MUO individuals were found to be sedentary and MHO group had better physical activity than the MUO group (p=0.008). Biochemical parameters and blood pressure values of MHO group were found to be better than MUO group and the difference was statistically significant (p<0.05). Daily average energy intakes of the MHO and MUO participants were 1847.5±522.8 and 2084.3±727.6 kcal, respectively, but the difference was not statistically significant (p> 0.05). The percentage of energy intake from protein was statistically higher in the MHO participants (14.8±3.1) than in the MUO participants (13.4±2.5) (p=0.009) (Table 1).

Participants' mean scores on "total fruit", "whole fruit", "total vegetables", "greens and beans", "whole grains", "total protein foods", and "fatty acids" are similar between MHO and MUO groups (p>0.05). It was found that the MHO participants got higher scores (5.0±3.1) on "dairy products" than the MUO ones (4.3±2.7) (p<0.05). The mean scores on "empty calories" were statistically lower in the MUO participants (p<0.05). In terms of the scores on "refined grains", it was found that the MHO and MUO participants got 2.6±3.6 and 1.1±2.6, respectively, and this difference is significant (p=0.004) (Table 2).

Crude and adjusted odds ratio of having a metabolically healthy profile based on total HEI-2010 score and the scores on "dairy" and "refined grains" were given in Table 3. Among the obese subjects, a higher score of a HEI-2010 was not associated with metabolic health (OR 1.55, 95% CI 0.68-3.53, *p*=0.204). In the crude analyses dairy intake was positively associated with metabolic health (OR 2.98, 95% CI 0.57-3.06, p=0.035), but not adjusted model (OR 3.07, 95% CI 1.09-8.58, *p*=0.055). Low refined grains consumption was associated with metabolic health in the adjusted analyses (OR 3.23, 95% CI 1.27-8.21, *p*=0.014).

Discussion

Similar strategies are implemented in the prevention of the metabolic syndrome (MetS) and obesity, and in the medical nutrition treatment. It is thought that an increase in energy intake escalates the risk of obesity. In addition, the macro- and micronutrient content may have an impact on the risk factors of MetS.

137 adult individuals satisfying the criteria were included in the study after signing the informed consent form. It was found that the MHO participants have better educational status than their MUO counterparts. The proportion of smokers was found to be similar in both groups and was consistent with similar studies (8, 17, 23). However, smoking is one of the major risk factors for MetS and CVD. Smoking can reduce insulin sensitivity by increasing the circulation

Table 1. Comparison of socio-demographic and anthropometric data of the MHO and MUO participants (Numbers and percentages; mean and standard deviation)

	MHO (n=67)		MUO (n=70)		Total (n=137)		p[(a)]
	n	%	n	%	n	%	
Gender (F)	52	48.6	55	51.4	107	78.1	0.892
Age (years)	39.2±8.7		46.5±10.1		42.9±10.1		**<0.001*****
Marital status (Married)	56	83.5	60	85.7	116	84.6	0.729
Level of education							
Illiterate	5	7.5	14	20.0	19	13.9	
Literate	1	1.5	6	8.6	7	5.1	
Primary School	25	37.3	32	45.7	57	41.6	**0.004****
High School	15	22.4	12	17.1	27	19.7	
Undergraduate and above	21	31.3	6	8.6	27	19.7	
Disorder (None)	43	64.2	23	22.9	66	48.2	**<0.001*****
Smoking (Yes)	10	14.9	12	17.1	22	16.1	0.724
Physical activity							
Sedentary	24	35.8	41	58.6	65	47.4	**0.008****
Minimal active	43	64.2	29	41.4	72	52.6	
Anthropometric measurements (Mean±SD)							
BMI (kg/m²)	33.2±3.5		36.1±4.2		34.7±4.1		**<0.001*****
WC (cm)	104.8±8.8		113.6±11.6		109.3±11.2		**<0.001*****
Waist/height	0.64±0.06		0.71±0.07		0.67±0.07		**<0.001*****
Body fat percentage	38.0±6.8		41.7±5.7		39.9±6.5		**0.001*****
Biochemical parameters and blood pressure (Mean±SD)							
FPG (mg/dL)	90.5±8.5		116.1±33.5		103.6±27.8		**<0.001**
HDL-cholesterol (mg/dL)	62.8±11.0		50.1±14.1		56.3±14.1		**<0.001**
Triglycerides (mg/dL)	117.9±45.2		183.0±77.6		151.2±71.5		**<0.001**
SBP (mmHg)	123.3±12.7		139.2±16.1		131.4±16.5		**<0.001**
DBP (mmHg)	80.5±9.1		86.6±10.3		83.6±10.2		**<0.001**
Dietary intake							
Energy (kcal/d)	1847.5±522.8		2084.3±727.6		1968.7±644.5		0.065
Carbohydrate (%)	49.2±9.9		52.5±10.2		50.9±10.1		0.056
Protein (%)	14.8±3.1		13.4±2.5		14.1±2.9		**0.009*****
Fat (%)	35.9±8.5		33.9±9.6		34.9±9.1		0.214

BMI, body mass index F, Female WC, waist circumference
[(a)] Student's t-test was used to determine the statistical value of continuous variables of the MHO and MUO participants, and χ^2 test was used to determine the statistical value of categorical data.
$^{**}p<0.01$, $^{***}p<0.001$

of insulin-antagonist hormones such as cortisol and catecholamine (24). In addition, nicotine and carbon monoxide play a role in the development of insulin resistance and dyslipidemia (25). MHO participants were found to have better physical activity levels than MUO ones. Besides components of metabolic syndrome and insulin resistance, physical fitness is an alternative means to define metabolically healthy obesity. Physical activity is the main nongenetic determinant of fitness, and also has beneficial effects on body fat distribution, insulin sensitivity, and other characteristics of the metabolic syndrome (7). Moreover, a more favourable fat distribution, with less visceral fat, was associated with a long-term metabolically healthy profile in obese adults over a period of 10 year, and no excess risk of Type II DM and CVD (26). In recent

Table 2. MHO and MUO participants' mean scores on HEI-2010 components
(Mean and standard deviation; median and 25th and 75th quartiles)

HEI-2010 Components	MHO (n=67)			MUO (n=70)			P(a)
	Mean ± SD	Median	25th and 75th quartiles	Mean ± SD	Median	25th and 75th quartiles	
Total fruit	2.4±2.1	2.5	0.04-5.0	2.9±1.9	2.8	0.96-5.0	0.118
Whole fruit	2.8±2.3	4.9	0.09-5.0	3.2±2.1	4.8	0.33-5.0	0.267
Total vegetables	2.7±1.4	2.7	1.6-4.0	2.2±1.1	2.0	1.4-2.0	0.068
Green and beans	2.0±2.0	1.2	0.15-5.0	2.0±1.7	1.6	0.3-3.3	0.726
Whole grains	3.1±3.6	1.6	0.00-5.2	2.9±3.2	1.7	0.00-5.0	0.823
Dairy	5.0±3.1	4.9	2.4-7.7	4.3±2.7	3.9	2.1-6.3	**0.01***
Total protein foods	2.8±2.0	2.9	0.39-5.0	3.3±1.6	3.7	1.9-5.0	0.423
Seafood and plant proteins	0.11±0.69	0.00	0.00-0.00	0.51±2.0	0.00	0.00-0.00	**0.034***
Fatty acids	3.8±3.1	3.1	1.1-6.0	3.5±3.1	2.5	1.0-5.2	0.668
Refined grains	2.6±3.6	0.00	0.00-5.3	1.1±2.6	0.00	0.00-0.00	**0.004****
Sodium	0.98±2.0	0.00	0.00-0.63	2.2±3.3	0.00	0.00-4.1	0.068
Empty calories	19.7±0.97	20.0	20.0-20.0	18.8±7.1	20.0	19.5-20.0	**0.006****
Total HEI-2010 score	49.0±10.4	49.0	41.0-54.0	47.3±8.4	46.2	40.8-53.1	0.278

(a)*Mann Whitney U test*
**P<0.05, **P<0.01*

Table 3. Crude and multivariable-adjusted ratios of the metabolically healthy phenotype according to quartile of total HEI-2010, dairy and refined grains

	Crude OR (%95 CI)	p(a)	Adjusted OR (%95 Cl)(b)	p(a)
Total HEI				
Quartile 1(Minimum)	1 (Reference)		1 (Reference)	
Quartile 2	0.72 (0.31-1.66)	0.204	0.64 (0.24-1.71)	0.195
Quartile 3 (Maximum)	1.55 (0.68-3.53)		1.60 (0.59-4.32)	
Dairy				
Quartile 1 (Minimum)	1 (Reference)		1 (Reference)	
Quartile 2	1.33 (0.57-3.06)	**0.035***	1.06 (0.39-2.88)	0.055
Quartile 3 (Maximum)	2.98 (1.26-7.03)		3.07 (1.09-8.58)	
Refined Grains				
Quartile 1 (Minimum)	1 (Reference)	**0.004****	1 (Reference)	**0.014***
Quartile 2 (Maximum)	2.97 (1.40-6.27)		3.23 (1.27-8.21)	

(a) *Multivariate logistic regression analysis. Figures are expressed as OR (95% CI)*
(b) *Adjusted according to age, gender, educational status, body mass index (BMI), and physical activity*
**p<0.05, **p<0.01*

other studies, it was found that moderate physical activity was higher in MHO participants than in MUO (17, 27).

It was discovered that the MHO participants had a higher percentage of energy from protein but a lower percentage of carbohydrate when compared to the MUO ones. In some cross-sectional studies, the percentage of macronutrients from energy was found to be similar between the MHO and MUO groups (8, 28). However, in a short-term study on rats, it was observed that high carbohydrate and fat intake and low protein intake escalated the level of FBG by 22 mg/dL and such a result caused dyslipidaemia in the rats. There was also an increase in abdominal fat although there was no significant difference in the weight gain. Therefore, it can be said that high carbohydrate and low protein intakes have a critical role in the MetS since affecting the metabolic health adversely (29).

In the study, there is no significant difference between the MHO (49.0±10.4) and MUO (47.3±8.4) participants in terms of the HEI-2010 scores. Although similar results were found between the groups in dietary composition and total dietary score, it was determined that the MHO participants have a higher consumption of dairy and lower consumption of grains, alcoholic beverages, solid fats, and added sugar. There are also studies revealing that the MHO and MUO individuals have a similar dietary quality (8, 28). In prospective cohort studies rather than cross-sectional ones, it was observed that those who have better dietary quality have low SBP, fasting plasma insulin, FBG, total cholesterol and high insulin sensitivity (30), reduced inflammatory cytokines (31) and low abdominal adiposity (32).

The score on "milk and dairy products" was found to be higher in the MHO participants (5.0±3.1) than in the MUO ones (4.3±2.7) ($p<0.05$). In the study conducted by Camhi et al.(2015), the score on "milk and dairy products" was higher in the male MHO participants (3.9±0.6) than in the MUO counterparts (2.3±0.7) ($p<0.05$). Such a finding is consistent with the present study. It is known that lipogenesis is reduced, and lipolysis is increased in adipose tissue thanks to regular consumption of milk and dairy products. Milk and dairy products with rich calcium and vitamin D content contribute to the reduction of plasma fasting insulin in the obese by increasing lean tissue mass and decreasing total body fat. It was also found that consumption of 3-4 servings of milk and dairy products per day reduces low-grade inflammatory cytokine levels (33) and visceral adiposity (34) within the aetiology of cardiometabolic risk factors. In a cross-sectional study, those who consume yoghurt were found to receive 47% less vitamin B_2, 55% less vitamin B_{12}, 48% less calcium, 38% less magnesium, and 34% less zinc when compared to those who consume milk and dairy products. Moreover, those who consume yoghurt have less likely FBG, blood pressure, TG levels and insulin when compared to the those who do not consume yoghurt. Yoghurt consumption is a good source of certain micronutrients and is proven to play an important role in improving dietary quality (35). As a result, it was shown that consumption of milk and dairy products despite increased fat tissue may have positive effects on metabolic health.

In this study, it was found that the mean score of MHO participants from refined grains was higher than that of MUO ones. In some studies, it was found that the consumption of processed grains was similar between the MHO and MUO groups (8, 16, 28). Processed grains with high glycaemic index and load are critical risk factors for obesity, MetS, CVD, and diabetes (36). The consumption of processed grains is known to escalate the levels of FBG and TG as well as the risk of MetS but decrease HDL-cholesterol (37). Moreover, in a study, it was determined that the high consumption of processed grains has a greater effect on visceral adiposity than on subcutaneous adiposity (38).

The MHO and MUO participants' scores on "sources of empty calories" are 19.7±0.97 and 18.8±7.1, respectively ($p<0.01$). However, such a result is not clinically significant because the mean scores of both groups are close to the maximum score. Simple sugar plays a dramatic role in blood glucose and the increase in insulin secretion and this plays a role in metabolically unhealthy phenotype formation in obesity by leading to the development of abdominal obesity and insulin resistance (39). In addition, simple sugars are rapidly absorbed in the body and converted to lipids in the liver, thus they lead to an escalation in triglyceride levels. The escalation in triglyceride levels is also associated with obesity, dyslipidaemia and insulin resistance (40). In clinical studies, it was found that saturated fat intake is associated with the insulin resistance and coronary artery disease. Especially, saturated fat intake, having an adverse effect on insulin sensitivity, is known to be an important cardiometabolic risk factor.

Even though the MUO participants got higher scores on "seafood and plant proteins" than the MHO counterparts, the intake of seafood and herbal protein is quite low in both groups. The main reason for this is thought to be the fact that the cuisine culture of the city is mostly based on red meat and milk and dairy products (41).

Strengths and Limitation

This study has some strengths and weaknesses. The strengths of this study include the use of power analysis in determining the sample, the inclusion of those who have never taken a weight-loss diet before and consulted the obesity clinic for the first time, and the use of the most updated version of HEI. The 24-hour recall method was used to obtain dietary composition and quality. For the weaknesses of the study, it can be said that the use of a dietary intake record covering three or more days can yield more effective results. The present study allowed to assess the overall situation as a cross-sectional study. However, it lacks cause and effect relationships.

Conclusion

In conclusion, although both groups have similar a dietary composition and quality, it can be asserted that the high consumption of milk and dairy products and the low consumption of processed grains, saturated fat, added sugar, and alcoholic beverages can result in a protective effect on cardiometabolic risk factors in the obese. Nevertheless, there needs to conduct longitudinal follow-up cohort and clinical studies to investigate the efficacy of micro and macro nutrients and food groups on cardiometabolic health despite increased fat mass. Such studies will contribute significantly to the question of whether healthy obesity is a temporary phenotype depending on the age factor.

Authorship: MA analysed the data and wrote the manuscript. FPA made general checks of the work and adapted it to the format of the journal.

Place of Study: Obesity Clinic of Adıyaman's (Turkey's Province) Community Health Centre

Ethics Approval: Ankara University, Human Ethics Committee for Non-Clinical Research for the present study

References

1. WHO I. Obesity and overweight. Fact sheet WHO http://www mclveganway org uk/publications/who_obesity_and_overweight pdf Zugegriffen. 2014; 26.
2. Samocha-Bonet D, Dixit V, Kahn C, Leibel R, Lin X, Nieuwdorp M, et al. Metabolically healthy and unhealthy obese–the 2013 Stock Conference report. Obesity reviews 2014; 15(9): 697-708.
3. Blüher M. Mechanisms in endocrinology: Are metabolically healthy obese individuals really healthy? European journal of endocrinology 2014; 171(6): R209-R19.
4. Khan UI, Wang D, Thurston RC, Sowers M, Sutton-Tyrrell K, Matthews KA, et al. Burden of subclinical cardiovascular disease in "metabolically benign" and "at-risk" overweight and obese women: the Study of Women's Health Across the Nation (SWAN). Atherosclerosis 2011; 217(1): 179-86.
5. Mørkedal B, Vatten LJ, Romundstad PR, Laugsand LE, Janszky I. Risk of myocardial infarction and heart failure among metabolically healthy but obese individuals: HUNT (Nord-Trøndelag Health Study), Norway. Journal of the American College of Cardiology 2014; 63(11): 1071-8.
6. Hamer M, Stamatakis E. Metabolically healthy obesity and risk of all-cause and cardiovascular disease mortality. The Journal of Clinical Endocrinology & Metabolism 2012; 97(7): 2482-8.
7. Stefan N, Häring H-U, Hu FB, Schulze MB. Metabolically healthy obesity: epidemiology, mechanisms, and clinical implications. The lancet Diabetes & endocrinology 2013; 1(2): 152-62.
8. Phillips CM, Dillon C, Harrington JM, McCarthy VJ, Kearney PM, Fitzgerald AP, et al. Defining metabolically healthy obesity: role of dietary and lifestyle factors. PloS one 2013; 8(10): e76188.
9. Camhi SM, Waring ME, Sisson SB, Hayman LL, Must A. Physical activity and screen time in metabolically healthy obese phenotypes in adolescents and adults. Journal of obesity 2013; 2013.
10. Schwenk RW, Vogel H, Schürmann A. Genetic and epigenetic control of metabolic health. Molecular metabolism 2013; 2(4): 337-47.
11. Kantartzis K, Machann J, Schick F, Rittig K, Machicao F, Fritsche A, et al. Effects of a lifestyle intervention in metabolically benign and malign obesity. Diabetologia 2011; 54(4): 864-8.
12. Karelis A, Messier V, Brochu M, Rabasa-Lhoret R. Metabolically healthy but obese women: effect of an energy-restricted diet. Diabetologia 2008; 51(9): 1752-4.
13. Miller CT, Fraser SF, Levinger I, Straznicky NE, Dixon JB, Reynolds J, et al. The effects of exercise training in addition to energy restriction on functional capacities and body composition in obese adults during weight loss: a systematic review 2013; 8(11): e81692.
14. Chiuve SE, Sampson L, Willett WC. The association between a nutritional quality index and risk of chronic disease. American journal of preventive medicine 2011; 40(5): 505-13.

15. Tande DL, Magel R, Strand BN. Healthy Eating Index and abdominal obesity. Public health nutrition 2010; 13(2): 208-14.
16. Camhi SM, Evans EW, Hayman LL, Lichtenstein AH, Must A. Healthy eating index and metabolically healthy obesity in US adolescents and adults. Preventive medicine 2015; 77: 23-7.
17. Slagter SN, Corpeleijn E, Van Der Klauw MM, Sijtsma A, Swart-Busscher LG, Perenboom CW, et al. Dietary patterns and physical activity in the metabolically (un) healthy obese: the Dutch Lifelines cohort study 2018; 17(1): 18.
18. Pekcan G. Beslenme durumunun saptanmasi. Diyet El Kitabi Hatipoglu Yayinevi Ankara 2008: 67-141.
19. Casiglia E, Tikhonoff V, Albertini F, Palatini P. Blood Pressure Measurement 2016.
20. Merdol T. Standart Yemek Tarifeleri (3. bs.). Ankara: Hatipoğlu Yayınevi. 2003.
21. Guenther PM, Casavale KO, Reedy J, Kirkpatrick SI, Hiza HA, Kuczynski KJ, et al. Update of the healthy eating index: HEI-2010. Journal of the Academy of Nutrition and Dietetics 2013; 113(4): 569-80.
22. Sümbüloğlu K, Sümbüloğlu V. Biyoistatistik: Hatiboğlu; 2010.
23. Pajunen P, Kotronen A, Korpi-Hyövälti E, Keinänen-Kiukaanniemi S, Oksa H, Niskanen L, et al. Metabolically healthy and unhealthy obesity phenotypes in the general population: the FIN-D2D Survey 2011; 11(1): 754.
24. Artese A, Stamford BA, Moffatt RJJAJoLM. Cigarette Smoking: An Accessory to the Development of Insulin Resistance 2017: 1559827617726516.
25. Calo WA, Ortiz AP, Suárez E, Guzmán M, Pérez CMJIjopm. Association of cigarette smoking and metabolic syndrome in a Puerto Rican adult population 2014; 5(7): 849.
26. Appleton SL, Seaborn CJ, Visvanathan R, Hill CL, Gill TK, Taylor AW, et al. Diabetes and cardiovascular disease outcomes in the metabolically healthy obese phenotype: a cohort study. 2013:DC_121971.
27. Ortega FB, Cadenas-Sanchez C, Migueles JH, Labayen I, Ruiz JR, Sui X, et al. Role of physical activity and fitness in the characterization and prognosis of the metabolically healthy obesity phenotype: a systematic review and meta-analysis. 2018.
28. Hankinson AL, Daviglus ML, Horn LV, Chan Q, Brown I, Holmes E, et al. Diet composition and activity level of at risk and metabolically healthy obese American adults. Obesity 2013; 21(3): 637-43.
29. Wong SK, Chin K-Y, Suhaimi FH, Ahmad F, Ima-Nirwana S. The effects of a modified high-carbohydrate high-fat diet on metabolic syndrome parameters in male rats. Experimental and Clinical Endocrinology & Diabetes 2017.
30. McNaughton SA, Dunstan DW, Ball K, Shaw J, Crawford D. Dietary quality is associated with diabetes and cardio-metabolic risk factors. The Journal of nutrition 2009; 139(4): 734-42.
31. Kastorini C-M, Milionis HJ, Esposito K, Giugliano D, Goudevenos JA, Panagiotakos DB. The effect of Mediterranean diet on metabolic syndrome and its components: a meta-analysis of 50 studies and 534,906 individuals. Journal of the American College of Cardiology 2011; 57(11): 1299-313.
32. Azadbakht L, Esmaillzadeh A. Dietary diversity score is related to obesity and abdominal adiposity among Iranian female youth. Public health nutrition 2011; 14(1): 62-9.
33. Qureshi MM, Singer MR, Moore LL. A cross-sectional study of food group intake and C-reactive protein among children. Nutrition & metabolism 2009; 6(1): 40.
34. Bradlee ML, Singer MR, Qureshi MM, Moore LL. Food group intake and central obesity among children and adolescents in the Third National Health and Nutrition Examination Survey (NHANES III). Public health nutrition 2010; 13(6): 797-805.
35. Wang H, Livingston KA, Fox CS, Meigs JB, Jacques PF. Yogurt consumption is associated with better diet quality and metabolic profile in American men and women. Nutrition Research 2013; 33(1): 18-26.
36. Barclay AW, Petocz P, McMillan-Price J, Flood VM, Prvan T, Mitchell P, et al. Glycemic index, glycemic load, and chronic disease risk—a meta-analysis of observational studies. The American journal of clinical nutrition 2008; 87(3): 627-37.
37. Song S, Lee JE, Song WO, Paik H-Y, Song Y. Carbohydrate intake and refined-grain consumption are associated with metabolic syndrome in the Korean adult population. Journal of the Academy of Nutrition and Dietetics 2014; 114(1): 54-62.
38. McKeown NM, Troy LM, Jacques PF, Hoffmann U, O'Donnell CJ, Fox CS. Whole-and refined-grain intakes are differentially associated with abdominal visceral and subcutaneous adiposity in healthy adults: the Framingham Heart Study. The American journal of clinical nutrition 2010; 92(5): 1165-71.
39. Dhingra R, Sullivan L, Jacques PF, Wang TJ, Fox CS, Meigs JB, et al. Soft drink consumption and risk of developing cardiometabolic risk factors and the metabolic syndrome in middle-aged adults in the community. Circulation 2007; 116(5): 480-8.
40. Havel PJ. Dietary fructose: implications for dysregulation of energy homeostasis and lipid/carbohydrate metabolism. Nutrition reviews 2005; 63(5): 133-57.
41. Aksoy M, Sezgi G. Gastronomi turizmi ve Güneydoğu Anadolu bölgesi gastronomik unsurları. Journal of Tourism and Gastronomy Studies 2015; 3(3): 79-89.

Correspondence:
Murat Açik
Ankara University, Faculty of Health Sciences,
Department of Nutrition and Dietetics
Aktaş Neighborhood Plevne Street No: 5
Altindağ/Ankara/Turkey.
Fax: +90 3123197016
E-mail: acikm@ankara.edu.tr